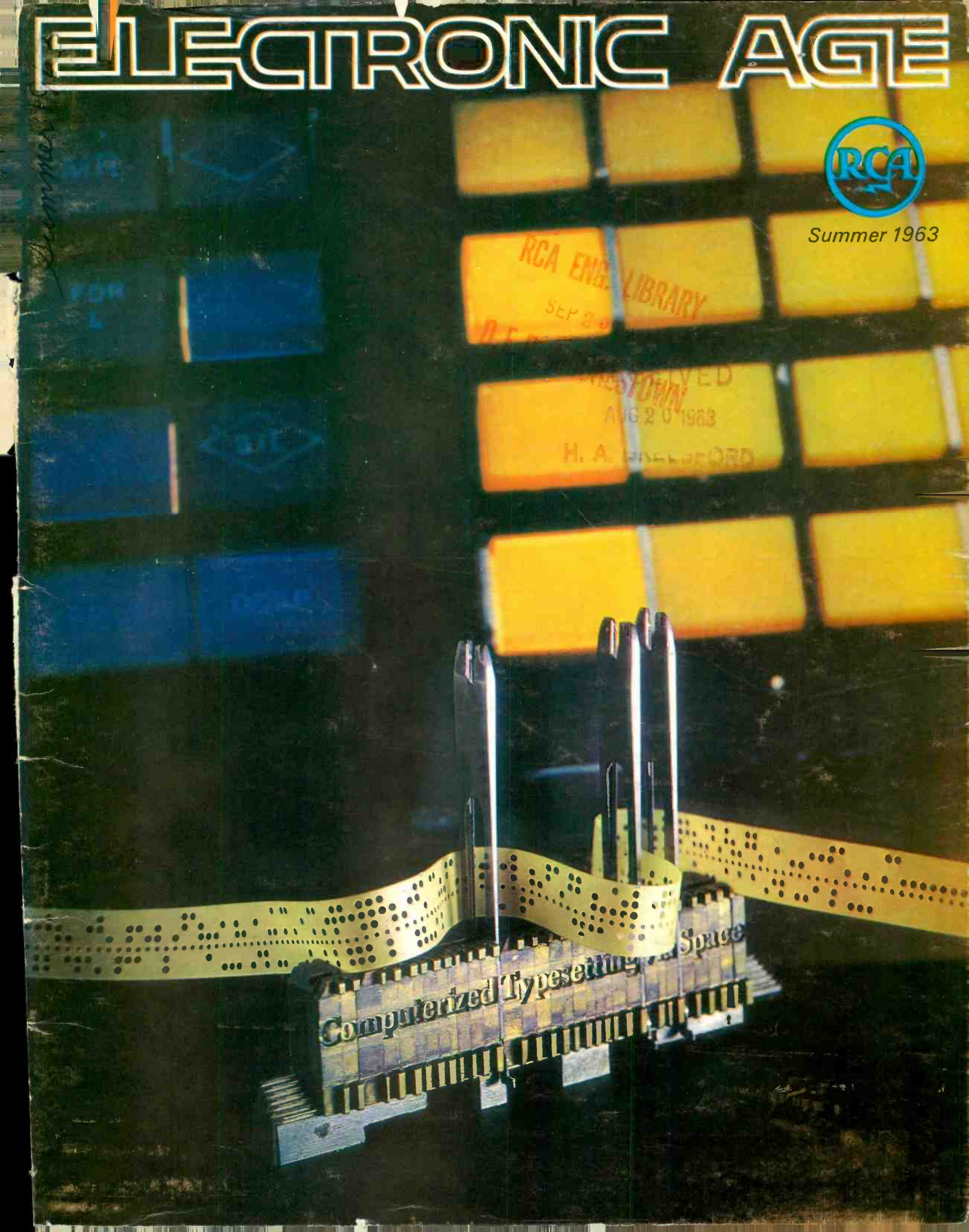
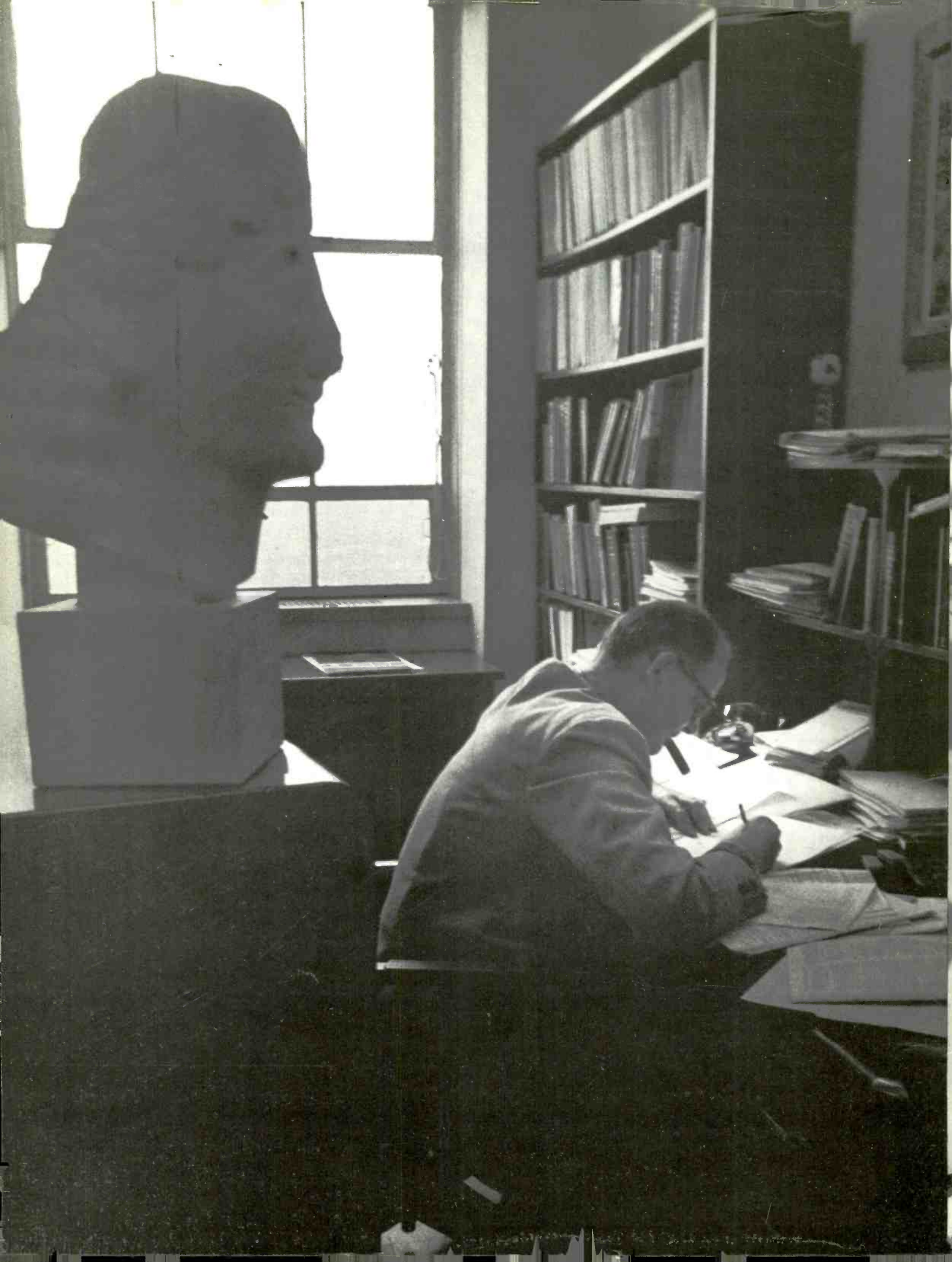
ELECTRONIC AGE

RCA

Summer 1963





ELECTRONIC AGE

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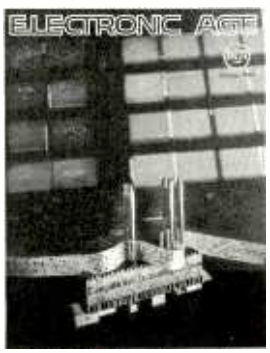
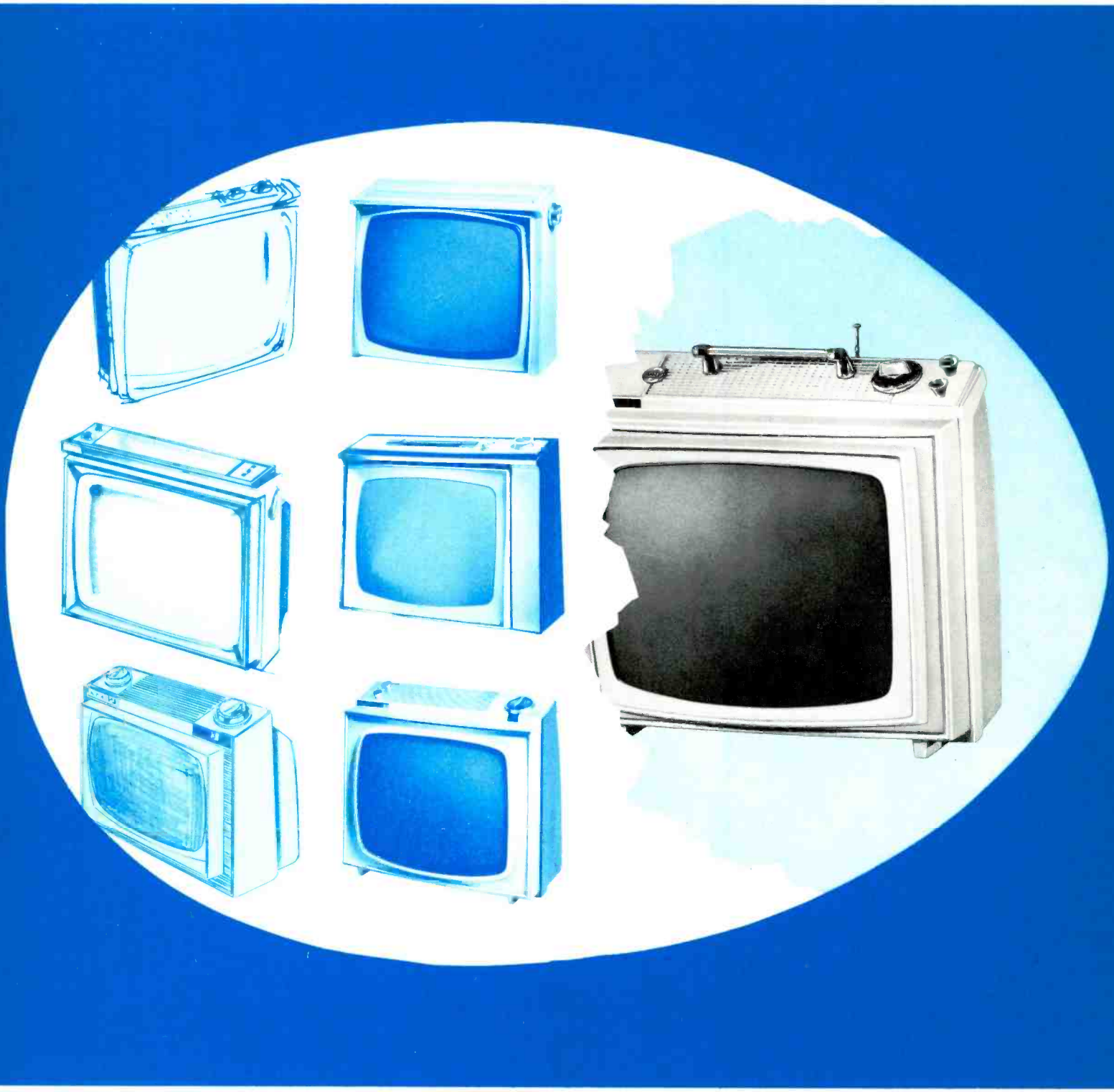
◄ Dr. Murray A. Lampert, at the David Sarnoff Research Center, Princeton, N. J., reflects on a theoretical problem concerning the electronic properties of insulators. The story of the vital role of the scientist theoretician in American business starts on page 12.



COVER: Typesetting by computer. Shown are three of the main elements—the control panel of the RCA 301 computer console, the punched paper tape utilized by the computer, and assembled linotype matrices and spacebands. The story of this important forward step in printing, as well as in transmitting copy intercontinentally via satellite, begins on page 9.

The Birth of a New Line

by David Lachenbruch



Design cycle of "Sweet 16" portable TV set: sketches, prototypes, and finished product.

A marriage of clairvoyance and practical judgment is necessary in the planning and design of home instruments to meet the requirements of new electronic developments and changing consumer tastes.

Tubes and transistors . . . resistors and circuit boards . . . style and taste . . . advance planning . . . and a little clairvoyance. These are some of the basic components of a modern line of television, radios, phonographs, and tape recorders.

Consumer electronic instruments must be many things to many people. In addition to a high level of reliable performance and a wide selection of models, the public must be offered cabinets every bit as attractive as the decorator pieces designed and built by America's leading furniture artisans.

Consider the new 1964 RCA Victor lines. There are 21 basic color TV models, 27 black-and-white sets, 28 Victrola phonographs, 26 radios, four cartridge tape recorders — carefully designed and coordinated to have something to appeal to everyone. These lines didn't just happen. They're the end result of a planning cycle that began as long ago as 1959 in one of the most intensive product planing operations in American industry.

"We already have quite a good idea of what our lines will be like five years from now," says Bryce S. (Buz) Durant, Vice President, Product Planning and Development, RCA Sales Corporation. "In television, this includes probable set sizes, type of product, and performance level, based on both electronic advances and anticipated market requirements. In the case of highly tooled items such as portables, we even know what they'll probably look like."

In a rapidly changing technology such as electronics, planning of this type is all the more difficult, and the planning cycle must be flexible enough to allow for late changes based on recent advances in the art.

As far as next year's lines are concerned — those which will be introduced in May, 1964 — they have been completely laid out, and prototype production of some models is under way. Lines for 1965, 1966, 1967, and 1968 are in various planning stages, each proceeding under its own five-year plan. Under the direction of David E. Daly, Manager of Advance Product Planning for RCA Sales Corporation in Indianapolis, each year's anticipated product line is sketched out in broad strokes as early as five years ahead of time.

Basic research for the product begins even before the five-year cycle, much of it at the Advanced Development Center of RCA's David Sarnoff Research Center in Princeton. Occasionally, however, the Research Center is asked to work on specific applied research products by the planning operation in Indianapolis. One of the most recent of these to be translated into a consumer product was the new FM stereo circuit used for the first time in FM-AM tuners of RCA Victor's 1964 lines.

In planning any product, there comes a time to say "this is it." Events leading directly to this point occur during the final 18 months before introduction date, as individual models within the line shape up in an intensive final planning cycle. At this time, a "Product Planning Committee" takes over, working under a master plan, with deadlines for each step in the process of transforming a gleam in the advance-planners' eye into actual production-model hardware.

When this 18-month cycle begins, "we're not working from a standing start," says Durant. "We have at least a walking start. We have had a complete engineering study. Our Product Planning Committee knows it has something that the engineering department can design, the factory can build, the materials people can support, and that marketing thinks is salable. We now have a firm plan in detail. And we can change the plan as we go along."

The Product Planning Committee isn't a society of high-dome dreamers. Just about every department of RCA Sales Corporation cooperates to accomplish the intricate job of making the pieces

fit together at the proper time. Working together are Product Administration, Engineering, Manufacturing, Materials, Sales Planning, Styling, Market Research, Advertising, Product Performance, Budgets and Pricing, Quality Control, Field Service, Technical Information, and even Personnel.

Actually, there are two Product Planning Committees working along parallel lines — one for television and the other for radio, Victrola, and tape products. Important leadership is exercised by the two product planning managers — Clyde K. Huxtable for television and Richard W. Hanselman for radio and Victrola products — and by industrial design manager Tucker P. Madawick.

The Product Planning Committee meets monthly, handing out assignments to members concerned with different aspects of planning. Groups meet informally between sessions, keeping other members up to date on their activities.

When the 18-month cycle begins, each model in the line becomes a colored peg on a display panel known at Indianapolis as the "Ouija board." The title is apropos, because the exact state of evolution of every model can be followed at any time by consulting this silent oracle.

Now let's follow an actual product — the brand-new 16-inch "Sweet 16" portable — through the master-plan cycle. This set was introduced to RCA Victor distributors in May, 1963. So we travel backward in our time machine to November, 1961. Here is the countdown to Introduction Day.

It is I-Day minus 18 months. The Product Planning Committee approves the "commercial concept" of the entire line. It now has before it rough sketches and descriptions of each proposed model, covering cabinet design, performance capability, components, target costs, selling price, anticipated quantities.

By I-Day minus 17 months, the portable has been given "engineering clearance." Style sketches have been refined, showing clearly the proposed appearance. The "Sweet 16" is still "in embryo," but the engineering department has signaled that "this product can be built within these concepts."

A three-dimensional mock-up is built and receives "styling approval" from management by I-Day minus 15 months. Many changes have been made, but its similarity to the original drawings may still be clearly seen. The mock-up is sent to engineering for approval and cost estimates.

I-Day minus 12 months is an important landmark — "engineering sign-off." From the mock-up, blueprints have been made, component layout selected, and a prototype built. Tooling contracts are then let, parts vendors and sources are selected, and the process engineers are beginning to plan factory production lines for the 16-inch set.

Pilot production starts about two months later, using "soft" tools which still can be changed. In another seven months, I-Day minus 3 months, after final changes based on the results of pilot output, pre-production runs start, from finished tools. Pre-production sets are given life tests and other performance checks.

A month or two before I-Day, production begins, to build up inventory in advance of the May introduction. For a brand-new model, such as the "Sweet 16," production is started as far in advance as possible, to anticipate any possible "bugs," and to prove out producibility and performance.

I-Day, May 16, 1963: "The RCA Sales Corporation today introduced its largest RCA Victor color television line and a companion black-and-white TV line that includes a low-priced 16-inch portable receiver."

That's that! Now the planners can relax and go fishing. Or can they?

They're constantly in the middle of other planning cycles. While the May, 1963, line was in one stage of countdown, other lines were in different phases, and the planners are required to divide their time between new lines and products being developed concurrently. In addition to the major introductions in May, there are other debut dates, such as the portable TV lines in the first quarter, the interim line in December, and special promotions (such as the "Bargain Bonanza") in between.

After I-Day, planners aren't even finished with the new line which has now gone to market. To assist them in designing future lines, they must listen attentively to feedback on the current models. Like the product itself, much of the feedback is electronic. By September, the public's vote on the new line is being tallied by an RCA 501 computer at Indianapolis, keeping track of the weekly flow of goods by cabinet, color, and model number.

This display panel—known at RCA Home Instrument headquarters as the "Ouija board"—indicates exact developmental stage of every model.

This plebiscite is an important cue to future set design. Competitive products, too, play their part. RCA Sales Corporation field salesmen are constantly surveying the reception given products of other manufacturers by dealers and the public. This information, also computerized, is fed to designers, too.

The most mystical ingredient in planning a consumer product line, however, is not rooted in past models, but in the future. This is where the creativity of the industrial designer comes in — intuition, sensitivity, awareness, sixth sense — call it what you will. He must anticipate future design trends, or mold them himself, to be blended with electronic developments as they come from the labs.

Here are some of the considerations in product styling, as seen by designer Madawick:

The designer must think regionally as well as nationally. What is big in Anaheim may flop in Albany. The rage of Fort Worth could bomb in Fort Wayne. American Colonial currently is the nation's most popular style in TV-stereo furniture — and a full 20 per cent of it goes to modern-conscious southern California. Contemporary styles are the national number two choice. Provincial is increasing in popularity, but its acceptance varies widely from area to area. Its major impact is in the cities which consider themselves sophisticated — "nonprovincial," in fact — such as Washington, New York, Boston, Atlanta.

Along with the growing influence of Provincial furniture, Madawick predicts the fruitwoods will grow in popularity. "People like textures," he says. "We don't live in a flat world. We see three dimensions all around us, and depth of texture is being emphasized increasingly in such manufactured items as automobiles, carpets, and building exteriors. Fruitwoods have this association of depth and texture."

The automobile still has a strong grip on the American taste. "Detroit is perhaps the single most important catalyst in American styling," according to Madawick, a onetime auto industry designer himself. Detroit often dictates what is "in" — the sheer look; the soft look; concave, convex, or sculptured surfaces; colors and fabrics. Its influence is felt most strongly in the design of portable television, which now accounts for nearly 70 per cent of the black-and-white market.

But the consumer electronics industry also sets styles itself. A good example is the transformation wrought by RCA designers in the speaker grille cloth — which too often in the past has been an embarrassingly large swatch of eyesore.

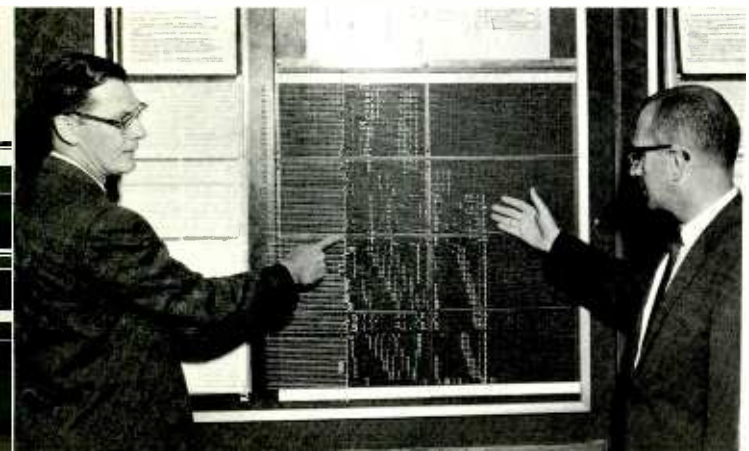
Some of the 1964 RCA Victor TV and stereo models display an entirely new concept — a needlepoint decorative medallion which appears to be custom embroidered and centered on the grille cloth, in place of previous repetitive patterns. This idea originated in RCA's styling department last September to enhance further the styling of French Provincial furniture pieces.

Upon approval of the idea, the designers were faced with a major problem: How to translate a European handwork concept into a mill operation. The stylists sought and received the cooperation of a grille-cloth supplier, who changed his mode of operation to solve the problem, and an innovation in electronics furniture design was born.

The advances of home electronics obviously have not been confined to science and technology. In style, too, the industry has come a long way in a few years. "Television and stereo used to be three years behind the furniture industry," says designer Madawick. "This gap has been closing rapidly. Now we're about even with them. The application of furniture used to be secondary; we're now in fine woods. We have our own furniture designers who have proved capable of anticipating furniture styles and preferences."

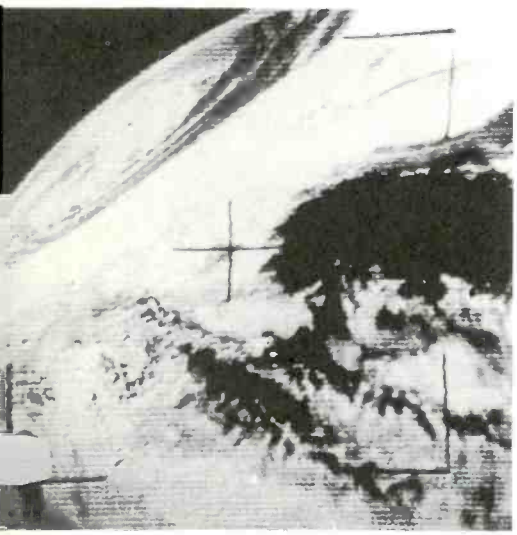
Styling thus has become an important aspect of product planning at RCA Sales Corporation. Although the initials RCA may conjure up an image of electronic wonders, they also stand for an important taste-making organization. Style, performance, and value must be planned and developed side by side.

What about 1968? We can say only that they're making some very educated guesses in Indianapolis right now. ■

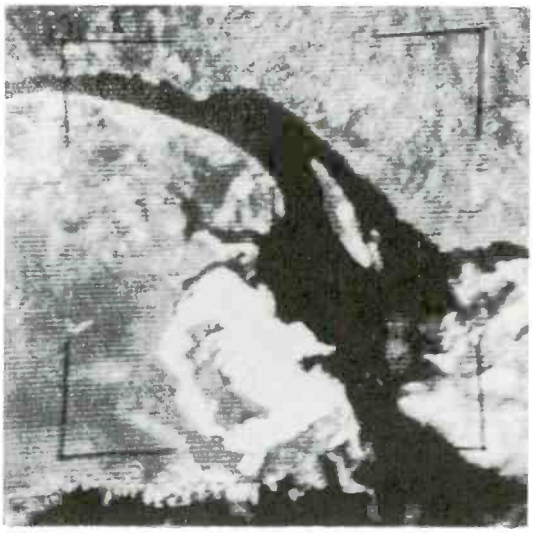


David Lachenbruch is editorial director of *Television Digest*.

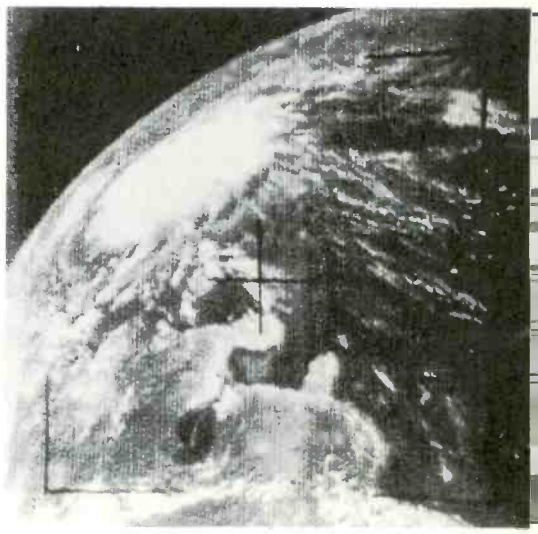
TIROS "WHEEL" IN POLAR ORBIT—An artist's conception of how TIROS would operate in a rotating configuration, with two cameras on opposite sides alternating in sending pictures to earth.



TIROS IV—Large vortex of a typhoon near New Zealand.



TIROS VI—Ice reconnaissance, showing the Gaspé Peninsula of Quebec and the St. Lawrence River. Prince Edward Island is completely surrounded by sea ice.



TIROS III—The vortex of Hurricane Anna, heading for Central America July 22, 1961, northwest of Venezuela. Lake Maracaibo is visible at bottom of picture, center.

Weather Watchers

Reliable TIROS "Eyes in the Sky" add new dimension to scientific weather forecasting.

Each year, from mid-June to early October, there is a period of watchful waiting along the Atlantic and Gulf coasts. It is the hurricane season, when great tropical storms from the South Atlantic or Caribbean spawning grounds lash the seas and inflict enormous damage on inhabited coastal areas.

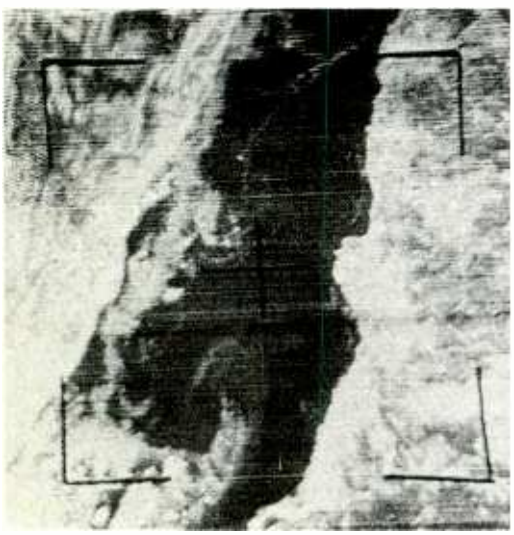
For the past three years, however, there has been unprecedented advance warning of these storms from an extraordinary series of "TV Weather Eyes" in space. They are the TIROS satellites, so-called because they combine television and infrared observation from space. Whirling around the earth at altitudes of approximately 400 miles, their TV cameras sight the telltale pinwheel cloud formations of new tropical storms and then track them day-by-day as they move across the earth.

Since April 1, 1960, seven TIROS satellites have been launched by the National Aeronautics and Space Administration. All seven have operated successfully — a record unparalleled in unmanned spacecraft. The latest launching, TIROS VII, took place from Cape Canaveral June 19, adding its weather eyes to TIROS VI, which has been operating since September 18, 1962.

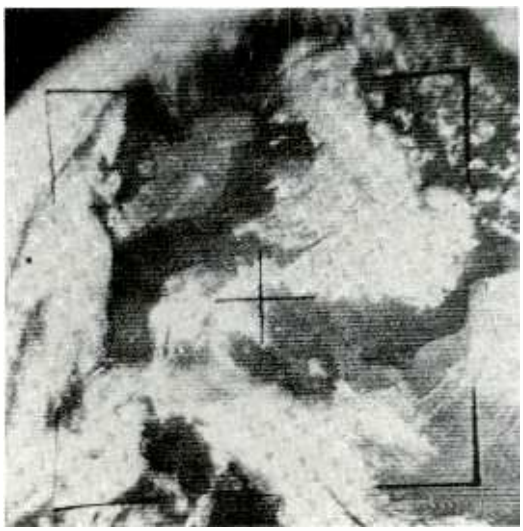
All the TIROS satellites are designed and built by the Astro-Electronics Division of the Radio Corporation of America, under contract to NASA. They are under operational control of the Goddard Space Flight Center.

In 1962, every major hurricane or typhoon throughout the world was sighted and tracked by one or more TIROS satellites. However, hurricane watching is only a small part of TIROS weather observation. TIROS satellites have played a major role in the U.S. space program, keeping a watchful eye for Project Mercury launches and recoveries as well as for support of Ranger, Mariner, and other space probes.

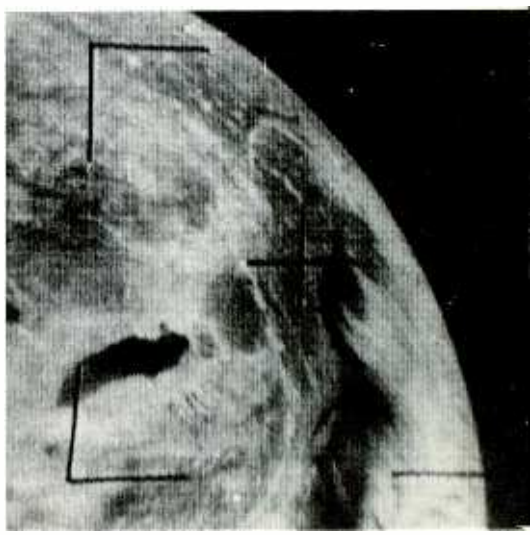
Many special missions have been carried out by TIROS, such as ice surveys in the Gulf of St.



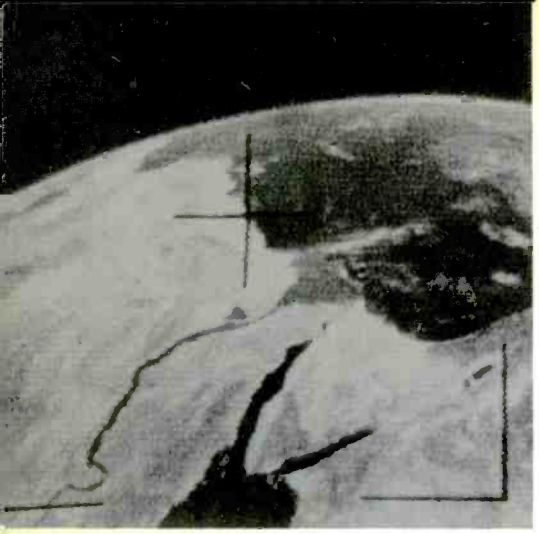
TIROS II—Ice swirling in the St. Lawrence River. This TIROS operated 376 days and transmitted 37,000 TV pictures.



TIROS IV—A foggy day in London town. Clouds completely outline England, Wales, and Scotland, while Ireland basks in the sun. Northern France is partially cloudy.

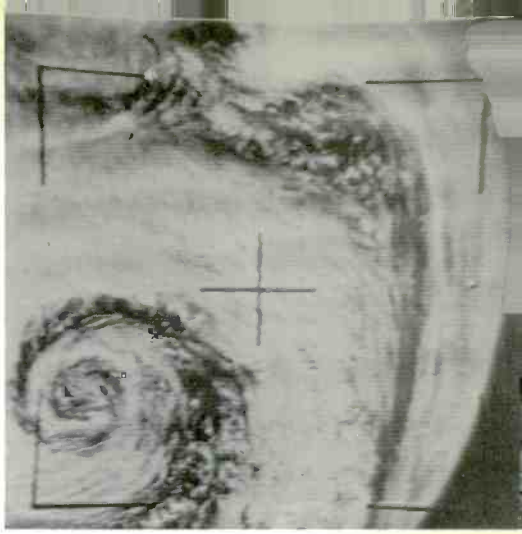


TIROS VI—Northeast coast of the United States and Quebec Province. Snow rims Lake Ontario. Visible are two Finger Lakes and Long Island.



TIROS III—A sunny day in the Near East. Visible are Libya, the Nile River and its delta, Suez, the Red Sea, Israel, Arabia, and the Mediterranean.

TIROS III—A clear day over Italy, Sicily, and Greece. This satellite operated 230 days, and transmitted 36,000 TV pictures.



TIROS V—A classic picture of a large vortex off Greenland, taken Feb. 16, 1963. The photo covers some 500,000 square miles.

Lawrence, photographing of ice packs, and analysis of cloud coverings and jet streams. Based on TIROS data, for example, a forecast was made of the break of a 45-day heat wave in Australia in 1961.

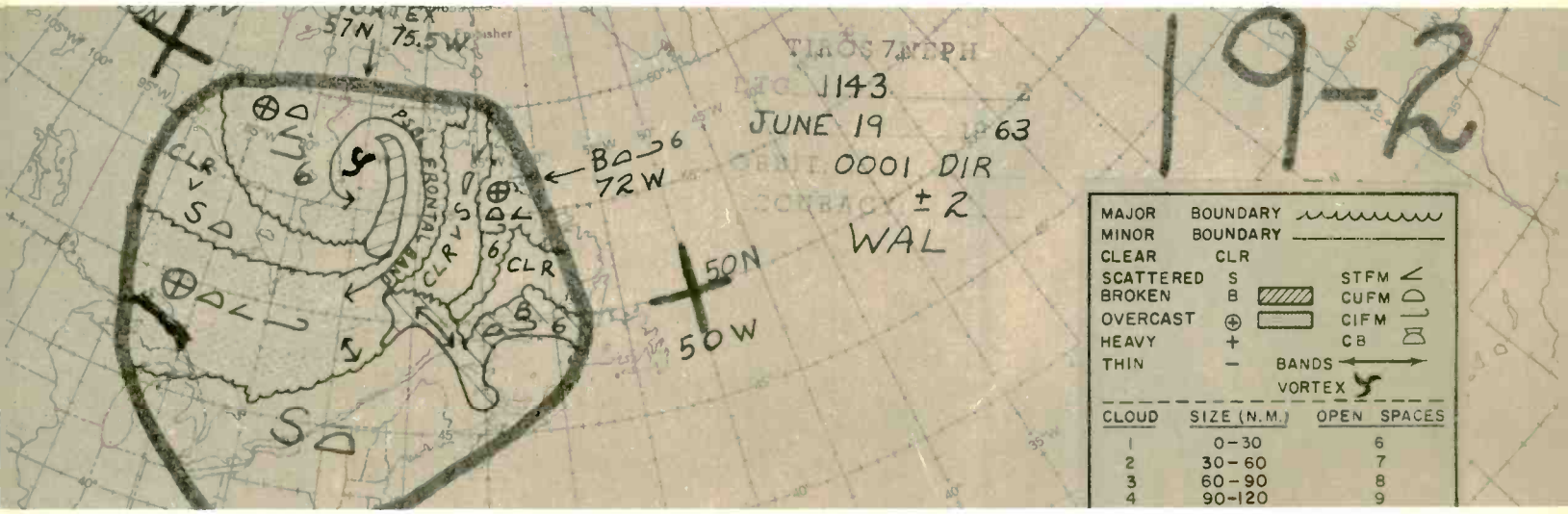
The Weather Bureau uses TIROS data in preparing nephanalyses (analyses of cloud cover), which are distributed daily to 45 countries via an international facsimile network. All international flights out of New York's Idlewild Airport routinely are given the latest nephanalysis based on TIROS photographs before takeoff, indicating wind, cloud, and possible storm conditions the pilots may expect to encounter.

TIROS VI detected a sandstorm in Saudi Arabia. Meteorologists of the Weather Bureau believe it may be possible to identify locust swarms moving across Africa and to warn countries in their path. Measurement of snow conditions in mountain areas and forecast of eventual runoff of melting snow to the lowlands also may become possible as a result of TIROS infrared and television reports.

Seven additional TIROS satellites have been ordered by NASA, of which two are to be used operationally by the Weather Bureau, three for research and development of new and advanced equipment, and two for backup.

A study contract was awarded to RCA in May, 1963, for development of a wheel-configured TIROS. This, in effect, would turn the satellite on its side and have it roll endlessly around its orbit in the sky, snapping pictures every three minutes in the sunlit portion of the orbit. Cameras would be positioned opposite one another in the edge of the hatbox-shaped satellite, instead of looking downward through the base, as at present. Existing TIROS satellites can take pictures only about 25 per cent of the orbital time, since the cameras do not always face the earth.

Pictures accompanying this article illustrate the wide range of information sent back by TIROS. ■



WEATHER MAPS like this are prepared daily from cloud cover pictures received from TIROS satellites. Each international flight leaving New York's Idlewild Airport receives a TIROS map for route guidance.

Intercontinental Typesetting Via Space

by Thomas I. Bradshaw

A high-speed computer and a communications satellite make possible the transmission intercontinentally of justified news copy.

For more than 500 years, since movable type first was invented by Johann Gutenberg in the middle of the 15th century, typesetting has required human brains and human hands to transform bits of metal or wood into printed words.

Even the development of mechanical linecasting machines, in 1878, did not eliminate this fundamental ingredient. The machine could produce a line of cast-metal type only after the letters, punctuation marks, and spaces had been assembled by a human operator, and "justified" to fit a predetermined column width.

Not even the refinement of long-distance teletypesetting could dispense with the human element. An operator still had to "punch" paper tape, giving instructions for word-spacing, hyphenation, and column width, before the signals could be sent by leased wires to subscribing newspapers.

On June 10, 1963, however, the Radio Corporation of America made printing history by demonstrating for the first time that an electronic computer located in one continent could give instructions to automatic linecasting machines in another continent, and thus cause type to be set without any human activity except preparing the original news copy.

The demonstration was carried out from Chicago, Ill., in connection with the 35th annual Production Management Conference of the American Newspaper Publishers Association.

News copy originating at the ANPA convention was transmitted by conventional teleprinter circuits to Camden, N.J., where it was delivered to an RCA 301 computer. The computer instantly counted the words and spaced them, hyphenating where necessary to achieve exact column width. The RCA 301 then flashed instructions via a submarine cable used by RCA Communications to keyboardless Intertype linecasters at the Manchester *Guardian,* the Glasgow *Herald,* and the Edinburgh *Scotsman.* Arrangements had been made to send the signals also by Relay I satellite, but last-minute failure of the tracking antenna of the British ground station in Cornwall made this impossible.

However, Relay I was used with complete success to transmit news copy from the Rio de Janeiro bureau of United Press International to Camden, where the RCA 301 processed the copy and sent it onward to Chicago. There, it was fed into UPI's national teletypesetter circuits, serving hundreds of American newspapers. In a parallel experiment, the Associated Press sent news copy by cable from London to New York and Chicago, via the RCA 301 at Camden.

On June 14, RCA and the National Aeronautics and Space Administration carried out a supplementary experiment, sending computerized news copy to the newspapers in Great Britain via the Relay I satellite.

The demonstrations marked the debut of RCA's Transmission and Information Exchange System (TIES), a multipurpose method of linking

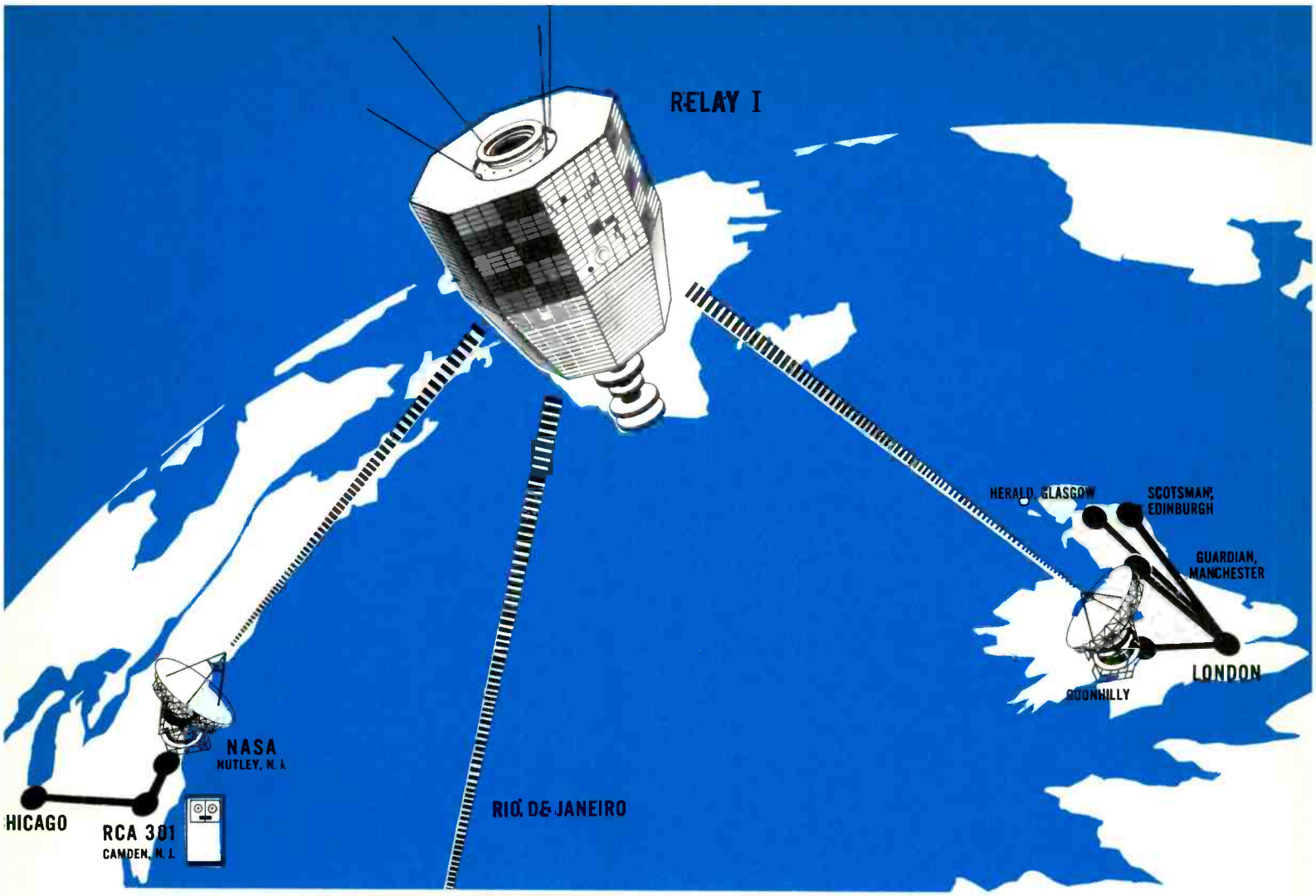
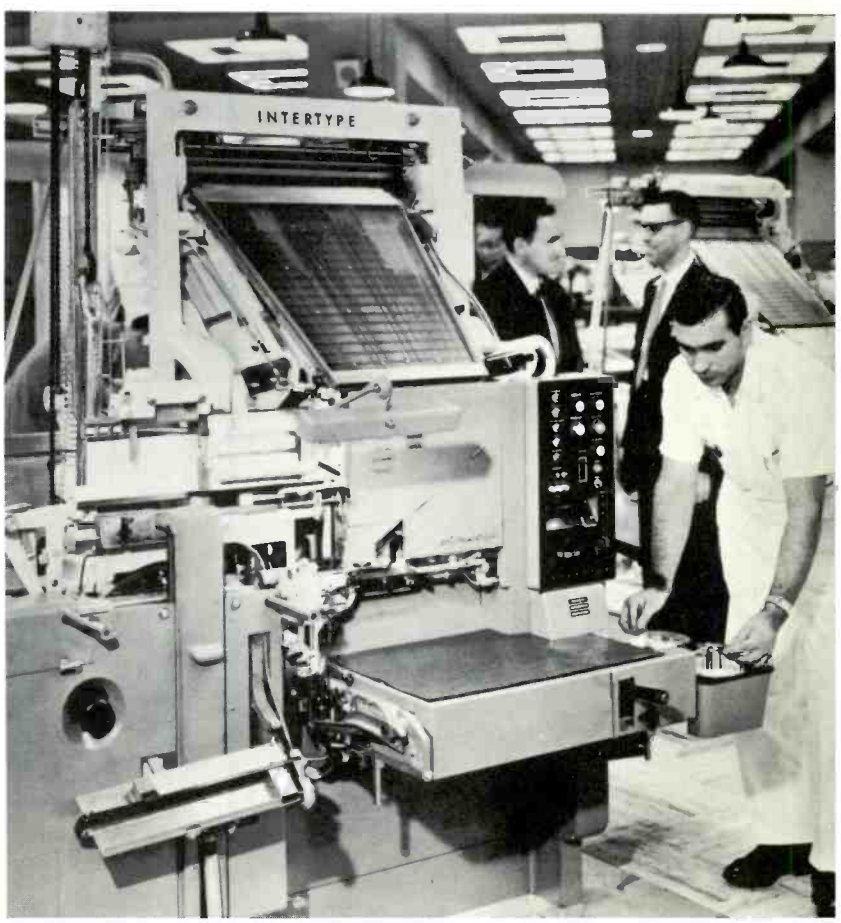


Diagram above depicts how news copy was sent from United States to Great Britain by Relay satellite. Below at left (Relay model in foreground), tape is prepared for use in linecasting machine (below, right).



computers, regardless of intervening distance, and feeding data directly into the systems from remote locations.

The National Aeronautics and Space Administration and the Harris-Intertype Corporation cooperated in the tri-continent experiments, along with United Press International and the Associated Press.

The Relay I satellite, which was designed and built for NASA by RCA, has the capacity to accept and retransmit the entire news content of a standard newspaper in five minutes if all its channels were to be utilized. In the RCA 301 demonstration, however, only limited capacity was required.

The RCA 301 electronic data processing system at Camden handled the intercontinental news copy in very much the same manner as similar computers used by the Los Angeles *Times* and the Palm Beach, Fla., *Post-Times.*

With an automatic typesetting system at the Los Angeles *Times,* built around an RCA 301, news copy or advertising matter is processed automatically from the writer's typewriter until set in type. The system incorporates editing changes and corrections, divides the copy into lines of proper column width, and decides where words are to be hyphenated.

The system employed by the Palm Beach *Post-Times* differs primarily in that it employs a "dictionary" of some 30,000 words stored in the computer's memory.

The new RCA TIES equipment acts as an interpreter for computers and remote sources of data, accepting messages in different codes and at varying rates of speed. Data may originate at outlying locations in a variety of forms — punched cards, paper tape, or by means of direct keyboard transmission. Terminal equipment automatically converts the incoming material where necessary to computer language for handling by an RCA 301 data system.

In effect, TIES serves as a "hot line" for the rapid interchange of information by RCA 301s regardless of the distance separating them.

One of the key TIES units is the Communications Mode Control which scans as many as 80 communication lines simultaneously, relaying data directly to and from computer high-speed memory for processing. The lines under electronic surveillance can be a combination of telephone and telegraph circuits for data communications.

A second unit in the RCA TIES "package" is the Data Exchange Control, which permits RCA 301 processors at the same location to communicate with one another on a memory-to-memory basis at a maximum rate of 285,000 data characters a second. This represents the high-speed transfer of nearly 2,500,000 words an hour.

A Communications Control is designed for memory-to-memory data transfer between separated computers via single voice grade circuit at the rate of 300 characters per second.

These three fully transistorized scanning and control devices are housed in the RCA 301 computer rack. The three, with associated buffers and data subsets where required, give the RCA 301 the ability to move information from many locations to one or more data processing centers and at the same time deliver finished data to a number of outlying locations, automatically and at communication line speeds.

A manufacturing firm using TIES can have a direct two-way data "highway" system connecting the home office, factories, sales offices, and warehouses. Computer data and general communications traffic may move over the same circuits.

TIES is designed to match the user's current needs with provision for on-site expansion of the system from the basic 20-line capacity to as many as 80 lines in increments of 20.

TIES makes use of a wide range of existing telephone or telegraph services and terminal equipment.

The Communications Mode Control has been engineered in two forms. The single-scan CMC handles all communications lines at a common speed, while the dual-scan version reads up to 10 telephone lines at high speed while scanning other circuits at proportionally slower speeds, depending on the transmission potential of the lines being employed.

By integrating the versatile RCA 301 and advanced communication techniques, TIES serves to broaden and strengthen management control, making available more timely field data on which to base management decisions.

TIES also can accelerate the handling of customer inquiries and orders, in effect extending a company's computer capacity right to the branch office or distant plant. ■

The Scientist Theoretician

by Bruce Shore

The man paid to create theory is increasingly more important to American business.

Theory is the poetry of mathematics and, like poetry, its essence is metaphor — the sudden equation of separate ideas that elucidates, systematizes, and unites them for the first time.

"All the world's a stage," cries the poet.

"$E = mc^2$," exclaims the theorist.

Both statements are metaphors, in their own language, and both equate hitherto unrelated concepts in new and powerful ways, affording fresh insight into their nature and a deepened understanding of their meaning.

Mathematics is a language, in much the same way that English is a language. It has subjects, objects, predicates, modifiers, and syntax. Its nouns are numbers and its verbs are *add, subtract, multiply, divide,* and *equals* — its verb *to be.*

Still, it is a peculiar sort of language. It always speaks in the third person and always in the present tense. Its nouns have the stark, indisputable meanings of number, and its sentences are equations that describe the interdependence of these numerical nouns and nothing more.

Herein lies its secret, however. For, an interdependent relationship, whether of people or things, is one of cause and effect — a principle considered basic to the structure of every event in nature from the formation of a galaxy to the fission of an atom.

Thus, mathematics is a language designed to express cause and effect either abstractly, in the context of pure numbers, or concretely, in a context of natural phenomena whose values have been numerically coded. In the first case, it is the idiom of the mathematician; in the second, of the scientist.

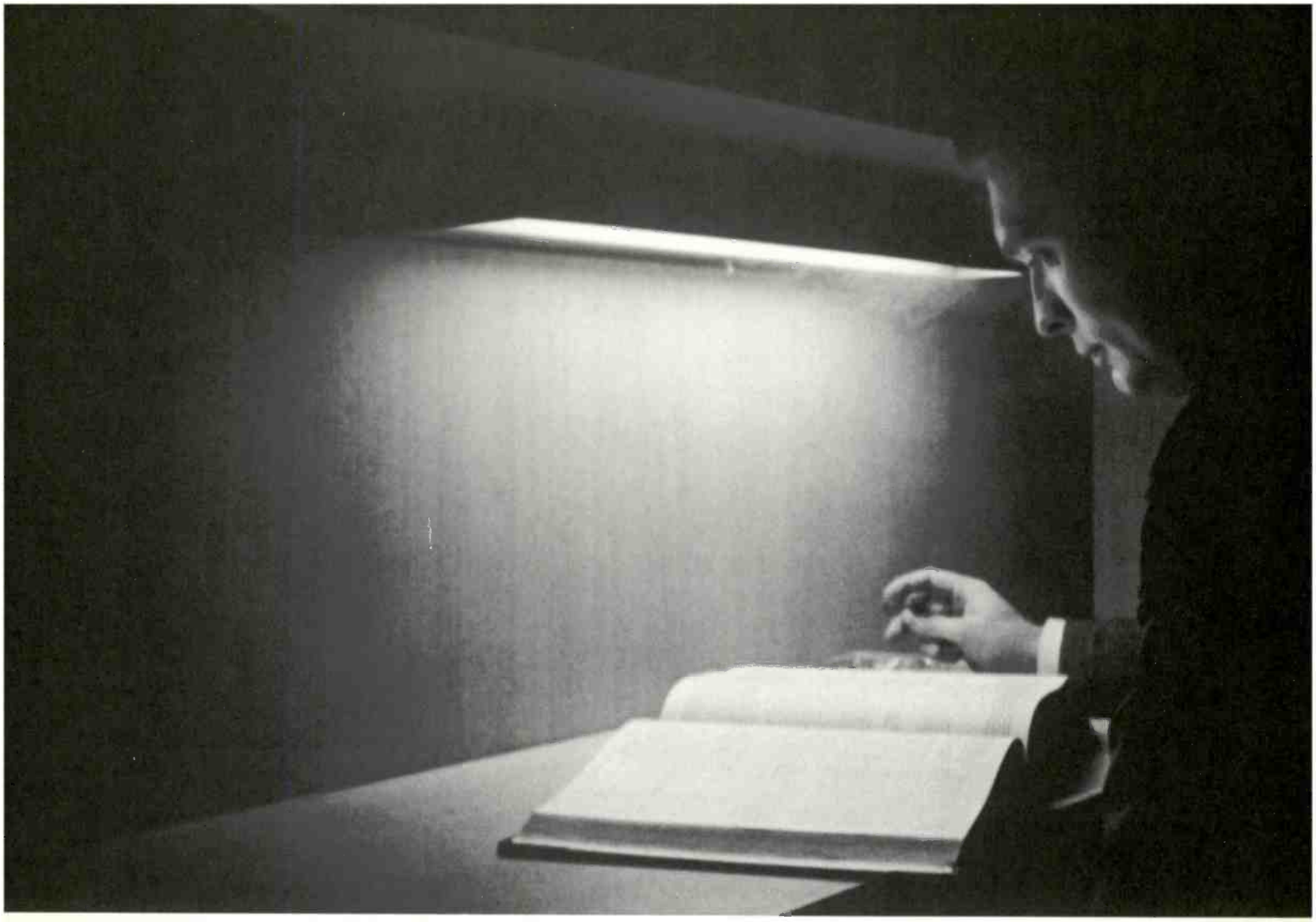
There are many kinds of scientists, however, and they use this language in many different ways. What distinguishes the theorist among them is his use of mathematics not only to describe cause and effect in nature but to discover it. He uses his language like a poet, not merely to register but to relate his observations and, by so doing, to explain them. Like the poet, he depends upon insight and linguistic invention, upon metaphor and figures of speech, upon form and meter. The principal difference is that his medium is mathematics, his metaphors are equations, and his meter is the universal rhythm of nature.

There is one more difference. The truth of a poet's insight can never be finally shown. It is valid subjectively, only as we think it is. Not so the insight of the theorist. Theory must be objective. It must be able to explain events and to predict them, not only for this generation but for all generations. It is poetic, yes. But it is more than poetry.

The theorist's fluency in mathematics coupled with his poetic power to fashion from it valid metaphors that unite matter and energy, time and space in original and compelling ways has won for him, recently, a numerically small but vital role in American industry.

This is especially so in electronics where the need for theorists became acute following the introduction of the transistor in 1948.

Here was a device that could switch, amplify, or modulate an electronic signal passing through it just as a vacuum tube could. There was one mo-



Dr. Robert Parmenter: Theory of Superconductivity and Superfluidity.

mentous difference, however. Whereas the tube was a precise assembly of separate parts – cathode, grid, anode – mounted in a glass-enclosed vacuum, the transistor was a single chunk of solid germanium no bigger than a grain of sand. (Later on, with the introduction of the silicon transistor in the mid-1950's, it quite literally became a product of sand – man-made, of course.)

The significance of this unexpected development was that the electronics manufacturer, like the U.S. Government before him, abruptly found himself catapulted into his own phase of the Atomic Age. His next generation of components could not be assembled from mechanical parts. It would have to be synthesized from raw atoms.

But, what atoms? What were the laws governing their behavior? What were the binding forces that fastened them together to create the crystals from which the transistor would be wrought? How did electrons act in such a strange environment, and how did one condition this environment to produce useful electronic phenomena?

These were tough questions with important business overtones, and there were no ready answers inside the electronics industry. What was needed was someone who understood solid-state theory and knew how to apply it. The only man fitting this description was the solid-state theorist.

Fortunately, the electronics industry was not caught unprepared. It had been conducting solid-state research of various kinds for more than two decades. For instance, two years prior to the announcement of the transistor, the Radio Corporation of America had formed a special group of solid-state researchers at RCA Laboratories in Princeton, N.J. Headed by Dr. Dwight North and Dr. Lloyd Smith and including Dr. Leon Nergaard, this group sought to learn why the current flow through the oxide surface of the cathode in a vacuum tube started out large and then fell to a

steady but relative trickle. Certainly an obscure investigation, but one which gave unexpected insight into the fundamentals of electron conduction in semiconductors – the basis of the transistor.

Because of this pioneering investigation, RCA was able to act immediately when Dr. William Shockley, a member of the Bell Telephone Laboratories team that developed the transistor, published his definitive book on the subject in 1950. Dr. North and Dr. Smith, together with other RCA theorists including Dr. Edward Ramberg and Dr. Frank Herman, quickly instituted a series of lectures, conferences, and seminars to educate other RCA personnel in the new discipline.

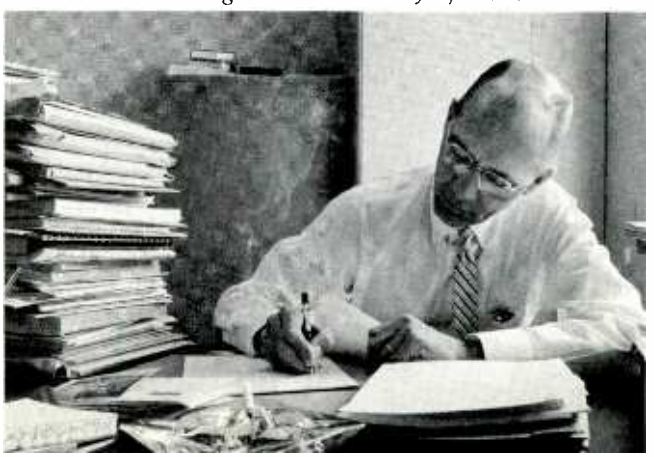
Shortly thereafter, RCA moved from theory to practice and by 1952 was producing germanium transistors for hearing aids and pocket radios at its Electron Tube Division plant in Harrison, N.J.

Again, as with the achievement of controlled nuclear fission in 1942, the theorist had proved his economic worth. His equations and formulas, his theorems and proofs were not just abstract exercises. They had profound bearing on the real world and could be used to afford man an elemental mastery over nature. American industry was impressed and, in the personnel files of many large companies, "theorist" began to crop up as a job classification alongside such venerable titles as "engineer," "chemist," and "physicist."

Why had it taken industry so long to appreciate the power of theory to strengthen its going product lines and lay the foundations for those of the future? At least three answers must be given.

First, the body of physical theory which has now made it possible for man to split the atom, harness the electron, and ride the electromagnetic wave did not even exist a generation ago. It was brought into being in the incredibly short span of only 52 years. Its compilation began in 1873 with publication by James Clerk Maxwell of his theory on the electromagnetic nature of light and was consummated in 1925 with publication of Erwin Schrödinger's epochal wave equation relating the wave and particle properties of matter.

Dr. Dwight North: Theory of Noise.



In between came the profound contributions of such gifted men as Ludwig Boltzmann, Josiah Willard Gibbs, Max Planck, Albert Einstein, Niels Bohr, Werner Heisenberg, and Louis de Broglie. As a body, these were the men who comprised the Constitutional Convention of modern physics, who wrote the laws and framed the articles by which we are still bound in our relations to physical reality. Interestingly, all of them wrote in cogent metaphor...

.... light is electricity and magnetism
.... heat is atomic motion
.... mass is energy
.... gravity is acceleration
.... matter is both particle and wave.

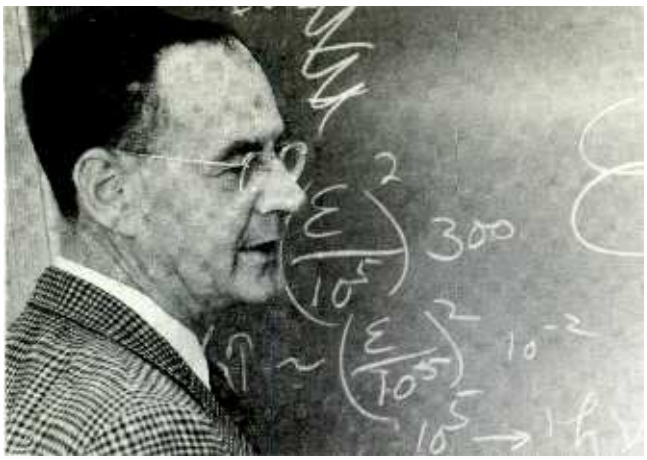
The second reason for industry's delay in hiring the theorist lay in the character of the theorist himself. He was and is a loner, a man inured to privacy and the quiet monasticism of thought. His instincts, his background, his training – all combined to direct him toward a position in the physics department of a university. Thus, he was ill-disposed to enter the pragmatic hurly-burly that marks commercial life.

Finally, there was industry itself. It was a doer. Design products, get into production, cut costs, raise profits, beat the competition – that was the ticket! If a new product was needed, invent it. If one material failed to work, use another. In such a milieu, it was hard to see the worth of paying a man just to sit there and think!

By the end of World War II, however, all this had begun to change. The practical power of theory had been demonstrated at Alamogordo, in New Mexico, and the theorist had begun to see that his numerical metaphors could have social, political, and economic meaning.

The industrialist, too, had begun to change. The war effort had pushed him to the limit of his existing technology into a regime in materials and phenomena beyond his competence. At this juncture, in the electronics industry, the transistor materialized and, on its heels, the digital computer.

In the case of the transistor, the need for theorists was immediate and obvious. In the case of the computer, it was less so, at first. Was not com-



Dr. Albert Rose: Electron Physics of Insulators.

puter manufacture simply an assembling of parts, a procedure that industry already knew well?

It was, indeed, but it was more than that. The computer was potentially capable of solving just about any problem that could be reduced to the language of mathematics, from the orbital velocity of space satellites to the production of bottlenecks of industry. It could have a kind of "mental life" all it's own, if one but knew how to program for it.

What was needed were not physical theorists but design theorists skilled in the morphologic rigors of information processing. Fortunately, the world's universities had been producing such wizards steeped in the lore of symbolic logic, propositional calculus, combinatorics, the theory of sets and the theory of probability, since about 1940. They were there and industry hurried to enlist them. Today, they are behind the computer's growing mastery of a thousand different tasks.

At RCA Laboratories, for example, Dr. Saul Amarel, a member of this select fraternity, is leading a crack team of information processing theorists across a no man's land of switching networks and stored programs toward such astonishing goals as machines that adapt to changing situations, that read print, and that may even display intelligence.

To explore new ideas, to create new metaphors that bridge the discontinuities in nature, to build mathematical models of reality — these are still the paramount business of the theorist, even in industry. But with time and usage have come other tasks and other responsibilities.

For example, the theorist at RCA Laboratories is frequently asked to use his descriptive powers in mathematics to interpret, within the limits of accepted theory, the events going on in new materials or new components emerging from the materials and devices laboratories. Thus, Dr. Robert Parmenter currently divides his time between trying to solve the riddle of superconductivity *per se* and trying to describe the behavior of superconductive materials presently available.

It is also important, in an industrial laboratory, to know the limitations of the devices and systems already developed. At least, such knowledge prevents trying to do the impossible. At most, it delineates what performance goals can be set. This was the effect of Dr. North's classic study on the sources of noise in pulse radar systems. This paper has had world-wide circulation and is still considered to be, 20 years after its composition, the basic reference for anyone wishing to build such systems.

Following the scientific literature, maintaining personal touch with key members of the scientific community, staying abreast of critical research going forward in the laboratories — these are other functions carried on by the industrial theorist both for his own benefit and that of management.

Probably one of the theorist's most valuable ancillary roles, however, is as a catalyst to invention. Since he does not do experiments himself and does not synthesize materials, he must content himself with inspiring others to do so. Thus, he circulates a lot, pokes into various laboratories that interest him, buttonholes colleagues he feels can benefit from his ideas, encourages others to air their research problems with him, and, in general, attempts to spark the inventive process.

Finally, there is the theorist's responsibility to advise research management on what significant scientific trends are developing, what new lines of research should be opened, where current activities should be curtailed, and so on through the thousand natural cares that such managers are heir to.

To counsel, to catalyze, to create — these are the responsibilities of the modern industrial theorist. In the final analysis, all three stem directly from his power not only to describe but to discover the secrets of nature in the metaphors of mathematics. ■

Dr. Saul Amarel: Computer Theory.

STUDENTS and SCIENCE

A pictorial report on a day-long field trip concluding the first year of the David Sarnoff Industry-Science Teaching Program pilot project.

A field trip to Princeton, N.J., on June 6, by 160 junior and senior high school students from Brooklyn climaxed the David Sarnoff Industry-Science Teaching Program launched October 15, 1962, as a cooperative endeavor of the Board of Education of the City of New York and the Radio Corporation of America.

The day-long field trip, made at the invitation of Board Chairman David Sarnoff, permitted the students and their science teachers to visit the RCA Laboratories and the Space Center of the RCA Astro-Electronics Division and renew acquaintances with scientists they had first met in their Brooklyn classrooms.

"The scientists brought our students a realistic look at the Space Age with a series of 52 lectures at Midwood and Erasmus Hall High Schools and Andries Hudde and Ditmas Junior High Schools," said Samuel Schenberg, Director of the Office of Science Education of the New York City schools. "And now this trip to Princeton has made it possible for our students to see these same scientists in the workshops of the Space Age – the laboratory and the testing chamber.

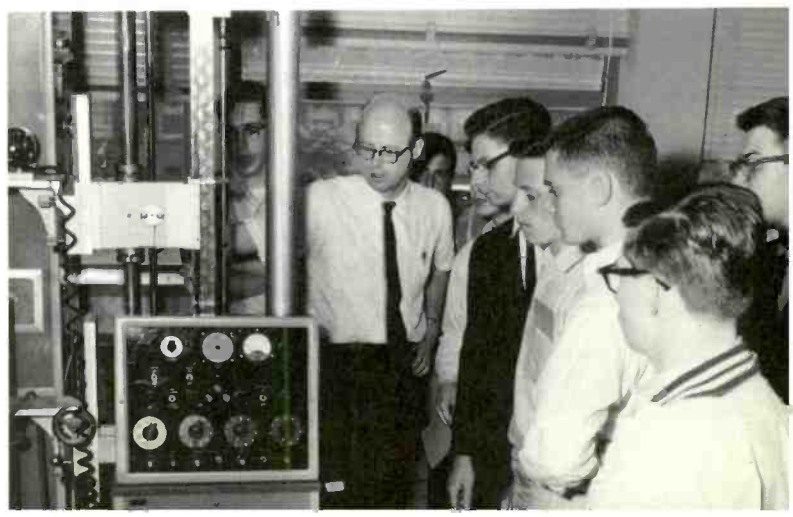
"The program," he added, "has stimulated tremendous student interest in such fields as nuclear physics, cryogenics, and space technology."

General Sarnoff, who proposed the pilot program as a practical means of encouraging more young people to pursue careers in science, has expressed the hope that similar programs can be established throughout America.

"If only 5 per cent of the 1,300,000 physical scientists and engineers in the United States were to devote a few days each year to educational instruction, our junior and senior high school students would have direct access to 65,000 of the finest technical brains available anywhere in the world," General Sarnoff has said.

In a message to the students visiting Princeton, he announced that RCA plans to continue its participation in the program launched last October in Brooklyn.

"In so far as RCA is concerned," General Sarnoff's message said, "our scientists will be back in New York schools during the next academic year. Elsewhere in the United States and Canada, we are considering similar programs. And it is our fervent hope that other industries, both in New York and throughout the country, will enroll their scientists and engineers in similar projects." ■



Repertory Theater Comes to TV

by Charles Gregg

A new television show is helping to revitalize a 2,500-year-old theater tradition.

The world's oldest and most distinguished drama form – repertory theater – becomes a new dimension on network television this fall when NBC-TV premieres "The Richard Boone Show" as television's first regular repertory company of a dozen or more actors, headed by Boone.

The great drama of the classical world – in ancient Greece and Rome, and medieval England and France – was drama of this type, for want of skilled actors and playwrights.

Beginning with Thespis, the great 6th century B.C. poet whose name marks all drama and is synonymous with tragedy, and continuing through the early Greek dramatists (Aeschylus, Euripides, Sophocles, Menander, etc.), civilization's earliest theater was repertory in nature – and, in a sense, is similar to what NBC-TV's "The Richard Boone Show" is pioneering on television nearly 2,500 years later.

Writers' works so inspired public adulation that actors were created to perform them, and writers and actors worked and lived together dedicated to their art.

When Mediterranean culture shifted to Rome, so did the classic theater of the Roman dramatists (Plautus, Seneca, etc.). Plays were performed and staged in the same manner, with the exception that actors like Aesopus and Roscius became nearly as popular as authors of the works they performed. Here, too, is a parallel with "The Richard Boone Show." Television audiences can expect the very best when an actor as distinguished as Boone performs in a drama by an author as skilled as Clifford Odets, who will write at least six originals for the NBC-TV series.

Repertory, too, was the mark of drama when it revived after the fall of Rome and the Dark Ages. Drama was reborn as if it had never existed before. Acting companies were formed in medieval England, France, and Germany. The actors, whose social status was that of servants in the households of powerful lords, gave public exhibitions of their art in public squares and on improvised wooden stages. These became, in fact, repertory theaters, leading eventually to the Globe, which, presenting plays of Shakespeare (who was a resident and part-owner), became the most famed of all repertory companies.

And, although new to television, repertory is no stranger to broadcasting. Network radio's "Mercury Theatre" – featuring such outstanding performers as Orson Welles, Joseph Cotten, and Everett Sloane – was one of radio's top dramatic series and also produced what several critics' polls have labeled as the top motion picture of all time, "Citizen Kane."

London's "Old Vic"; New York's myriad off-Broadway companies; Stratford Shakespearean troupes in the U. S., England, and Canada; and summer stock and collegiate and neighborhood actors' workshops are evidence that repertory remains one of drama's most accepted and distinguished forms.

Although it has been a long time coming, this kind of theater now is finally finding a niche in prime-time television.

*Acting company of television's first repertory theater.**

According to Boone, who will be host on each of the programs and will appear in all as an actor, this is because "there's too darn much talent around to put on a drama show any other way." The filmed, hour-long series will be broadcast on NBC-TV Tuesday, 9 to 10 P.M. New York time. The premiere is September 24.

Boone and his two associates on the program — dramatist Clifford Odets who will serve as head writer and story consultant, and producer Buck Houghton — have at this writing assembled a permanent company of 11 players, eight of whom have distinguished themselves as regular stars of their own TV series. The company includes:

Boone ("Medic" and "Have Gun, Will Travel"); Lloyd Bochner ("Hong Kong"); Harry Morgan ("December Bride" and "Pete and Gladys"); Guy Stockwell ("Adventures in Paradise"); Ford Rainey ("Window on Main Street"); June Harding ("As the World Turns"); Jeanette Nolan ("Hotel de Paree"); Warren Stevens ("77th Bengal Lancers"); Bethel Leslie; Robert Blake; and Laura Devon.

"Each one of our performers," Boone declares, "will rotate from starring to featured to bit roles, depending on the individual script. I will be the only exception in so much as half of my parts will be major ones." Boone adds:

"Nearly all of our dramas will be originals, and nearly all will have a contemporary setting. They will not beat around the bush — but they will be hopeful, optimistic in tone. First and foremost, we plan to entertain and to reach a larger audience than any filmed dramatic series on TV has before."

To attain this goal, in support of Boone's large and talented company, Odets has rounded up the greatest assemblage of writing talent in TV history to provide scripts for the pioneering series. The roster of distinguished writers includes Odets himself, John Steinbeck, Edward Albee, Rod Serling, John O'Hara, and A. E. Hotchner.

Directors who have been secured by producer Houghton include Lewis Milestone, Lamont Johnson, Walter Grauman, and Robert Gist.

"Each of the writers and directors has been signed for more than one program in keeping with the concept of this series," Boone says. "Our group represents television's first permanent repertory company in prime time, and this will give continuity to the series — and also enable the performers to have identity as actors rather than as continuing characters.

"We will become so completely familiar with one another's styles and abilities that everyone should be able to do his best work with each performance. We will have continuing actors, rather than continuing roles, which should make a big difference in audience loyalty and in the ratings."

Viewers accustomed to Boone type-cast as Dr. Steiner of "Medic," Paladin of "Have Gun . . ." or even as Abraham Lincoln of Broadway's "The Rivalry" are in for a once-a-week surprise after "The Richard Boone Show" is launched.

The actor will star as a down-and-out Santa

* Front, left to right: Bethel Leslie, June Harding, Richard Boone, Laura Devon, Jeanette Nolan; rear, left to right: Robert Blake, Harry Morgan, Warren Stevens, Ford Rainey, Guy Stockwell, Lloyd Bochner.

"I believe that you can attract a large audience if you give them vital, fresh, exciting theater..."

The repertory company enacts a scene before the cameras for a forthcoming television production.

Claus, a Mexican pearl fisherman, a leper, a Roman Catholic bishop, an airline pilot, a tramp, and an 83-year-old business tycoon, among other roles.

Boone is thoroughly convinced that good drama can also be popular.

"I believe that you can attract a large audience if you give them vital, fresh, exciting theater," he states. "I think that you can do something that's meaningful and that's popular — if it's done well.

"We're not interested, for instance, in winning a dozen Emmy Awards with a show that has only limited popular appeal. We're not interested in so-called "misery theater" either. What we mean to do is explore contemporary American life from top to bottom, dealing with real human problems and comic situations everyone can understand. I call this 'hopeful' drama."

Boone chooses to describe his company of actors, directors, and writers for "The Richard Boone Show" as "a complete and many-faceted theater." In addition to the TV repertory players, Boone, Odets, and Houghton have created a workshop on the M-G-M lot for the training of young actors and writers.

Frank Sinatra, Jr., Ivan Dixon, Joyce Van Patten, Lonny Chapman, Brenda Scott, Woodrow Parfrey, Charles Aidman, and Sandy Kenyon are some of the 30 talented performers who have been assembled. This company will serve as a casting reserve for some of "The Richard Boone Show" dramas and, with the repertory company, will present at least two West Coast stage productions a year, one at the University of California (Los Angeles) and another in San Francisco. A motion picture is also in the offing.

For his NBC-TV series, Boone's hosting will be done in an unconventional way. "I loathe the kind of TV anthology," Boone declares, "where the host comes out in white tie and says, 'Ladies and gentlemen, tonight we present . . .'

"We're not going to be stilted like that, nor are we going to throw key scenes away as a teaser or throw stills on the screen. Instead, each drama will have a prologue, setting the scene and pace. I'll appear in costume and makeup as the character I'm going to play."

How does Boone think his many years (six years and 234 episodes) as Paladin on "Have Gun, Will Travel" will affect his workaday schedule and his public image?

"Life will be easier," Boone states, "because the battles will be a different — and simpler — kind of warfare. It will be 'how-good-can-we-make-this-story' rather than breaking my head trying to do something new and different within a rigid mold."

In summation, Boone declares: "I'm a lion; and, although I have a face that resembles a relief map of the state of Nevada, I can act. Clifford Odets is in charge of the writers, and I'm not about to give drama lessons to the country's most skilled dramatist. Buck Houghton is in charge of the actors, and they're like the Yankees ball team. We will have no apologies to make. . . ."

Boone's 1963-64 prime-time dramatic showcase on NBC-TV represents the achievement of the theater's most exciting and historic heritage. TV's first regular-season repertory company of skilled actors, presenting original dramas written by America's major playwrights, is a sound investment in TV's future. ■

The Frog's Eye

by Robert L. Moora

A significant and unusual device electronically simulates the amazing information-processing functions of a real frog's eye.

If frogs could play baseball, you might picture this sequence of events at the Stadium, with the Yankees facing the Croakers. Staunch Greeny Pondside, the Croakers' left fielder, neatly gathers in a long fly hit in his direction by Roger Maris. Minutes later, Mickey Mantle poles one over Greeny's head into the left field stands. Greeny doesn't blink an eye.

What's the matter with Greeny the frog? Wasn't he even interested in reaching for that Mantle homer — or didn't he see it? The latter is the answer. He never knew the homer was going over. His eye detected it, but since the ball was obviously out of reach the eye never bothered to transmit the information to Greeny's primitive brain.

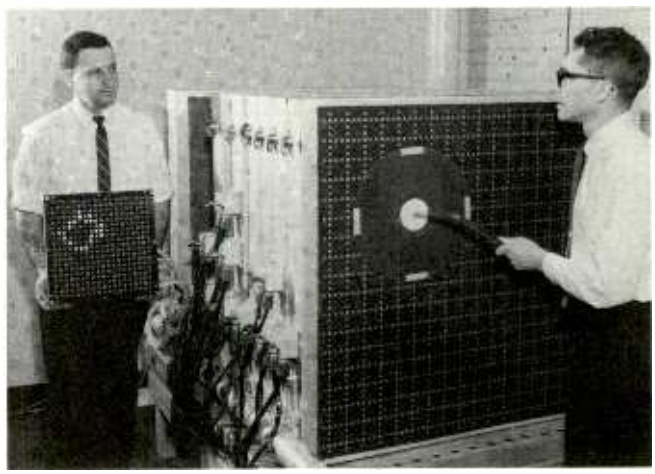
That's the way a frog's eye works. It's a computer that screens the information it sees and sends to the brain only what is important to the frog. The approach of a luscious green fly is transmitted instantly from eye to brain, but a fly flying away is ignored. A sudden shadow — indicative of danger — is immediately recorded but the gradual fall of darkness is not.

Scientists at the Massachusetts Institute of Technology long ago detected the unique capabilities of the frog's eye — the simplest, most basic retina in the animal kingdom — and did comprehensive research on it. RCA scientists became interested back in 1959, theorizing that the frog's retina could be duplicated electronically for purposes useful to man. They studied the problem, submitted a proposal to the U.S. Air Force, and in 1961 were authorized to build a pattern recognition machine based on the function of the frog's eye.

In the spring of 1963, RCA's Applied Research Organization, in Camden, N. J., delivered the finished machine to USAF's Aeronautical Systems Division at Wright-Patterson Field, Dayton, Ohio. Three and a half feet square, six feet long, and weighing hundreds of pounds, the machine duplicates the functions of the frog's nerve cells by means of printed circuits, photoelectric cells, neon bulbs, and relays. All told, it has 33,000 electronic components.

Its purpose? The Air Force hopes that the electronic frog's eye ultimately will lead to ways of providing data interpretation — and even decisions — in a variety of fields, including air-traffic control, missile detection, photo reconnaissance, and the like.

Its significance? It is the forerunner of a new generation of information-processing devices on an animal nervous system or neuron logic. As Donald J. Parker, Manager of RCA's Applied Research, puts it: "In the past, we have extended man's senses greatly by telephone, radio, television, radar, and a host of other developments. In building the frog's-eye model, we embark on substitution of machines for the senses themselves." ■



RCA engineers demonstrate an electronic device that "sees" like a real frog's eye.

Industry's Pursuit of Cleanliness

by Jules Koslow

Space Age requirements for success demand accuracies up to 50/1,000,000 of an inch. One speck of dust, one fingerprint can cause failure. The "White Room" is industry's answer to this problem.

Since the Space Age began, and with the recent developments in space technology and micro-miniaturization, dirt-free precision parts have become an absolute must. For example:

A speck of dirt on a sensitive instrument locked within a rocket headed for the moon could cause it to go off course by thousands of miles.

A fingerprint inducing oxidation or corrosion on a machined part intended to be accurate to 50/1,000,000 of an inch could result in the failure of a guided missile to hit its mark or go off on signal.

"Cleanliness in certain assembly and inspection functions is as vital to the success of our space and defense efforts as cleanliness is to the life of a patient in a hospital operating room," an industry spokesman recently remarked.

Today, in more than 200 industrial plants throughout the country, specially constructed rooms, varying in size and function and known by such names as "White Rooms," "Clean Rooms," or "Dust-Free Rooms," have been established to attain what engineers call "high reliability." Companies that have established White Rooms include Radio Corporation of America, McDonnell Aircraft, Hughes Aircraft, Sperry Rand, Sylvania Electric, Western Electric, Boeing, and North American Aviation. Time, effort, and expense go into building and maintaining these White Rooms so they will meet stringent cleanliness standards.

Compared to a high-standard White Room, the spic-and-span living room of the most meticulous housewife is way above the dust-tolerance level. Even the sterile operating room of a hospital is low on the cleanliness totem pole.

A striking example of the need for high reliability is the vital Minuteman Weapon System, one of the key elements in our national defense arsenal.

Vital military electronic components on the production line in the White Room of RCA's Cambridge, Ohio, plant.

Briefly, the Minuteman is a three-stage, solid propellent, intercontinental ballistic missile. The mission of Minuteman is the destruction of strategic targets whose ranges vary from 2,000 to 5,500 nautical miles. The Minuteman Weapon System and its ground components are expressly designed for simplicity and high reliability so that the personnel required to support the system may be held to a minimum. By utilizing America's mass-production techniques, Minuteman missiles can be made — and deployed — in great numbers.

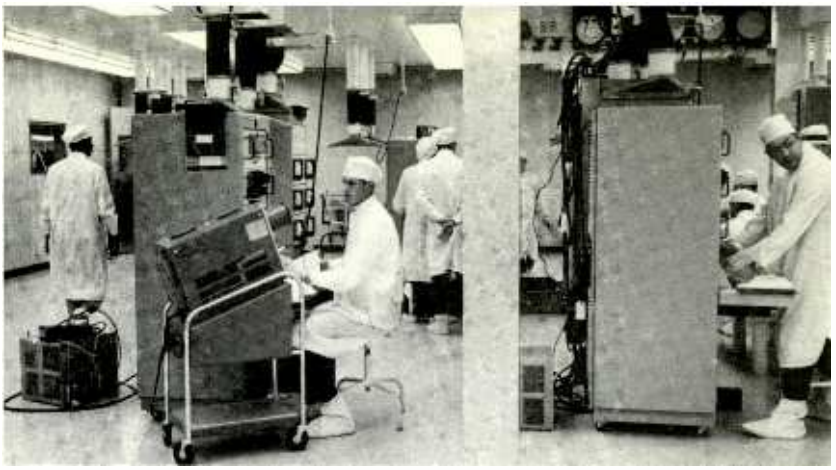
Because of Minuteman's high reliability needs and the mass-production techniques used in producing it, the world's largest White Room is now in operation at the Radio Corporation of America's Cambridge, Ohio, plant. Here, RCA, as subcontractor to The Boeing Company for the Sensitive Command Network of Minuteman, is faced with an array of formidable technical and management tasks. One of the most important is assuring reliability of such high quality that the term "Minuteman Reliability" now has a meaning of its own, signifying a level well beyond existing current practices. In fact, present requirements call for a reliability 100 times greater — and a goal 1,000 times greater — than the reliability required for average military equipment.

Engineers talking about reliability use terms like "Mean Time Between Failure" and "Probability of Survival" that have precise mathematical meanings. But what does Minuteman reliability mean to the non-engineer citizen?

Simply stated, Minuteman reliability is a measure of the certainty that the Minuteman missile be launched and reach its target when directed.

Hundreds of thousands of parts — accurately made — are used in the ground system that controls the missiles. Accuracy is so critical that in many

. . . "clean-up" measures that would drive the most fastidious housewife out of her mind. . .



Hospital-like cleanliness prevails in White Room.

cases a speck of dust or corrosion caused by perspiration from a person's fingers handling a part would be enough to cause that part to fail.

To prepare adequately to meet Minuteman's formidable reliability requirements, in February, 1961, RCA began converting a section of its 355,000-square-foot Cambridge plant into a White Room. Today, this plant-within-a-plant occupies approximately 70,000 square feet, an area one and one-half times as large as a football field. The conversion cost — more than $1.5 million.

To control dust, extreme care was taken in the design, construction, and furnishings of the White Room. Gaskets were used between walls and ceilings as well as around pipes. Easy-to-clean materials such as stainless steel and Formica were used for tables and storage racks, pure vinyl for the floors, and nonstatic washable-type material for the walls. An air-pressure system was installed so that, when a door is opened to the contaminated outside world, filtered air goes out of the White Room and dust-laden air is prevented from entering.

Most White Rooms are small assembly or testing rooms, employing a relatively small number of persons. RCA's one-and-a-half-acre White Room is unique in that it is an actual production plant, with more than 700 employees at the present time.

Herculean efforts are needed to control the physical environment of the huge Cambridge White Room, through which each day pass thousands of pieces of material and hundreds of people.

A 360-ton air-conditioning system — about 90 times larger than used in a six-room house — keeps the White Room at around 72° F. temperature and at about 45 per cent relative humidity. The filter system screens out dust particles, the smallest of which are about 100 times tinier than the dust one sees when the sun streams into one's living room. About every six minutes, there is a complete air change provided by the air-filtering system.

Operating requirements demand that dust be filtered down to 1,000 particles per cubic foot larger than 10.0 microns (a micron is about 40 millionths of an inch). Actually, the White Room runs at less than 1,000 particles per cubic foot, over 10.0 microns.

In the Cambridge White Room as well as in other industrial "homes" where reliability is an absolute necessity, the pursuit of cleanliness is an endless task requiring "clean-up" measures that would drive the most fastidious housewife out of her mind. In addition to filter systems, air conditioning, and other mechanical means, plain old-fashioned scrubbing goes on constantly. For example, at Cambridge the clean-up schedule calls for the material entrance and decontamination areas and entrance hallways to be scrubbed twice daily. The air showers and gelatin mats must be damp-mopped after each mass movement of personnel; namely, shift changes, breaks, lunch, etc. The solder room must be wet-mopped twice daily, and the hallways and remaining White Room areas must be damp-mopped daily and scrubbed weekly. The work area must be cleaned daily with a damp cloth, and the entire work area must be thoroughly cleaned weekly. All this — remember — while vacuuming is continually in operation.

The various materials and components destined for the communications system of Minuteman are handled with the utmost care and accuracy. Materials from the outside are unpacked in a special area and then packaged in small plastic containers or plastic envelopes. They are then thoroughly cleaned with vacuum hoses in a material decontamination room, and every component, such as resistors, capacitors, transistors, and diodes, is individually inspected. Throughout the assembly process, each individual component's "case history" is

Constant checking helps to assure reliability.

registered on data cards by electronic accounting machines. If an assembler or inspector drops a component on a workbench — a distance of only a few inches — the component must be reinspected.

Almost all White Room experts say that the most difficult problem in assuring super-cleanliness is the personnel working in the room. Though at first glance this appears to be a harsh judgment, actually it cannot be otherwise. White Room personnel must go back and forth every day from the contaminated outside world to their super-clean working atmosphere. And since people are — well — people, they have dandruff, falling hair, flaked skin, all of which help to "dirty up" a White Room. Even normal activities such as walking and speaking help to stir up the air. Certain actions that in the outside world are considered part of modern living — for example, women using cosmetics — are forbidden within White Rooms.

All this adds up to the fact that precautionary measures and work rules for White Room personnel have to be established and rigidly enforced.

Upon entering the Cambridge White Room area locker rooms, all persons walk over a "sticky" mat, which catches dust and dirt from their shoes. They then walk through two corridors containing high-pressure blowers that remove dust and lint from their street clothes. In the locker rooms, they put on a snap-closure Dacura snood or cap that covers their hair; a laundered-to-specifications lint-free, no-pocket, snap-closure Dacron-blend white smock over their clothes; and nylon or Dacura elastic-closure booties over their shoes. They are now ready to enter the White Room.

A guard at the door inspects each worker to make sure he is properly dressed in appropriate White Room clothing, and that women are not wearing cosmetics. If a female maverick wearing powder or lipstick tries to slip through, the specially trained Hawkshaw usually spots her. In no uncertain terms, she is told to wash her face.

Within the White Room itself, employees must not chew gum or eat. They can not use paper products. They must not use wooden pencils; only liquid lead and ball-point pens are permitted. Many of them wear lint-free white gloves so that no skin oils come off on a component. And, of course, smoking is absolutely forbidden.

Instances of employees trying to circumvent the rules are rare. One contributing factor is that they are motivated by specially prepared training courses on *why* super-cleanliness is a vital factor in our space and defense efforts.

Although occasionally an employee balks at the sameness of costume or the strict rules and asks to be transferred to more conventional surroundings, the overwhelming majority of employees like working in the White Room. They are pleased by its cleanliness, its comfortable temperature in both winter and summer, and by the fact that they are engaged in important space and defense work that requires meticulous care.

With all the stringent measures and precautions, involving everything from material handling to personnel, how dust-free are industry's White Rooms? Well, the slide-rule men say that at RCA's White Room in Cambridge, for example, it would take 7,000,000 deep breaths to fill the area with air, yet there is less air-borne dust present in the entire White Room area than would be expelled from two long drags on a cigarette!

Do achievement statistics such as this make reliability engineers smug and satisfied? Not at all. They are continually striving for more improvements in White Room conditions and procedures.

Industry's Space Age pursuit of cleanliness — like man's ages-long pursuit of happiness — is never-ending. ■

Modern "Patronage": Fusion of Art and Industry

by Alan Kayes

Increasing industry support for talented young artists is producing a system reminiscent of the cultural patronage of bygone years.

One of the most significant aspects of the "cultural explosion" in the United States is the fusion of art and industry. Industry, by definition under our economic system, is based on an ultimate motive of profit. However, it has been this very motive of insuring a reasonable return on capital invested that has prompted American corporations to make varied and substantial contributions to the community and to assume the role of patron of the arts. While such contributions and patronage are profit-oriented, nevertheless this new role for industry has re-created, on a far more lavish scale, the age of patronage of the arts that was associated with the royal families of Europe a century or two ago.

Curiously enough, the role of industry and corporate foundations in the broadened cultural scene is in itself a replacement of the type of patronage provided by individual and family philanthropy. Eleemosynary institutions that rely almost solely on donors to meet operating budgets and deficits have been the first to recognize this shift in the source of their income.

Observers of the contemporary scene have noted repeatedly that, whereas an Otto Kahn almost singlehandedly guaranteed the deficits of the Metropolitan Opera in an earlier day, and a Colonel Higginson was solely responsible for the financial support of the Boston Symphony Orchestra until the second decade of the twentieth century, such largesse was unique in its time and showed signs even then of disappearing.

The Wall Street debacle in 1929 may have been the *coup de grace* for many private family ventures of this sort. In the thirties and forties, it became increasingly apparent that, while there were still to be found individual patrons of the arts, the responsibility was shifting slowly but surely toward corporate and industrial patronage. Thus, the names most frequently associated with cultural patronage in this day and age are associated with huge industrial and corporate resources. Large foundations, bearing the family names of Ford, Rockefeller, and Carnegie, and others of similar magnitude that have resulted from industrial enterprises, are assuming cultural responsibilities on a scale that dwarfs the efforts of the Esterhazy family and other noble patrons of previous centuries.

Although patronage in itself is a noble concept, its implications today are far more democratic in principle; implicit in the support of corporations and foundations is the idea of providing greater cultural good for a greater number of people while at the same time permitting the patron to receive attendant financial benefits. While a composer such as Haydn owed allegiance to the Esterhazy family of Hungary, it might well be argued that those patrons of music were indulging a private pleasure, notwithstanding the fact that composers, authors, and artistic leaders were invited to the Esterhazy

As a boy (top), pianist Lorin Hollander demonstrated talent that propelled him through a progression of concerts to a record premiere performance at 19 with the Boston Symphony Orchestra's Erich Leinsdorf (bottom, right).

At 10, violinist Erick Friedman performs with an orchestra . . . Later, he plays a duet with Heifetz for a recording . . .

. . . if the musical performer cannot overcome the problems of having a

"trial stage" to hear the output of contemporary creative talents.

Certainly, if comparison is in order, and cost is the yardstick, the founding and maintenance of the NBC Symphony Orchestra over a period of years might well outstrip the financial outlays of a substantial number of such royal patrons over a considerably longer period of time.

Underlying the shift in support that has characterized the American cultural explosion is another fact frequently glossed over. There was a time when creative and performing talent was a rare commodity and hard to come by. If anything, the American scene today presents a broad palette of creative and performing talent of such plenitude that the problem becomes more one of selectivity than of search.

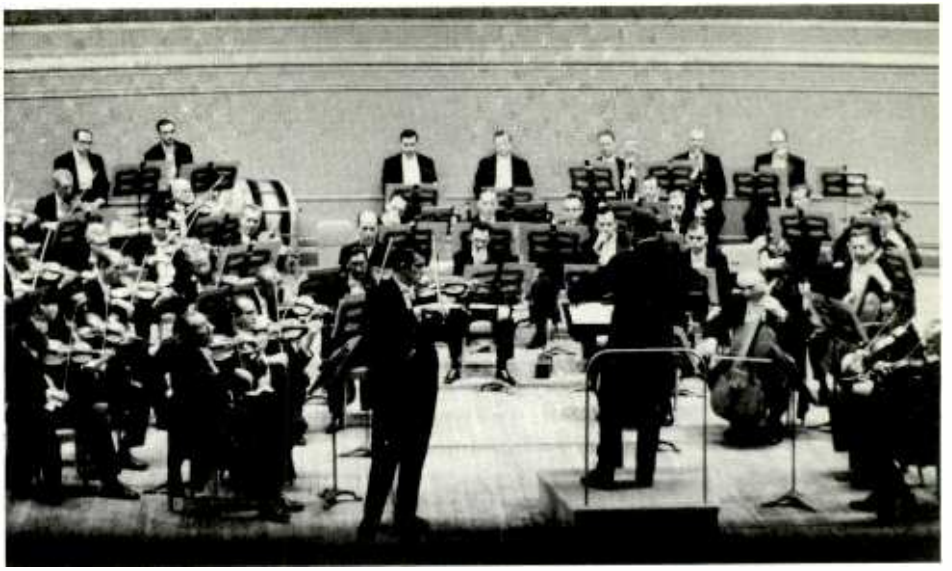
It was this fundamental fact that prompted RCA Victor some time ago to undertake a program of including in its recording contracts with promising young musicians and vocalists provision for study and training prior to actual recording activity for commercial release. This served the three-fold purpose of giving deserving talent recognition at a time when it was sorely needed, and at the same time supplying the musicians and vocalists with modest financial means so that they could pursue their studies, and also enabling RCA Victor to develop new talent which it might someday feature with pride on its phonograph records.

The program itself had no formal origin, but its inception can be traced back more than 15 years when a young singer named Mario Lanza, endowed with a remarkable vocal talent, was first signed to a contract by the RCA Victor Record Division. Lanza was given a sum of money with the admonition that it was to be used solely for study, and that he would not be called upon to perform for records until his teacher felt that he was qualified. Lanza's success came soon afterward.

The painter who starves all his life can leave behind canvases which can document his having existed as a creative force. The writer who never sells a story can have his name remembered if someone opens his trunk, discovers his manuscripts, and gets them published. But if the musical performer cannot overcome the problems of having a hearing, he may be courting oblivion.

Thus, what might be called "the RCA Victor grants to students" came into existence as a means of ensuring that musical talent, when selected as worthy of being heard ultimately, is provided a period of time for growth and development.

Six years ago, RCA Victor heard a 12-year-old pianist named Lorin Hollander. Lorin had mastered the technical proficiencies usual only to a very few of the most gifted mature artists. He had a growing musical intelligence that was embedded in a tremendous personal identification with the loftiest purposes of music. All this suggested the



At end of student days, he signs Red Seal contract . . . Subsequently, he makes first solo album recording.

hearing, he may be courting oblivion.

possibility of a career of the rarest sort. But Lorin needed time to learn, to mature musically as his association with the repertory grew and his musical notions became more profound.

Lorin Hollander was also signed to a contract, some aspects of which might be called a student grant or scholarship. As the years passed, RCA Victor followed Hollander's development with the concern of a parent as the youth's genius flowered.

When Hollander reached his eighteenth birthday, RCA Victor decided that the period of speculation had ended. With the help of the financial support which had provided a period of study and growth, young Hollander had become an artist of consummate taste and ability. In addition, he had that rare quality of being able to project his genius in such a way that the public could be expected to respond and understand.

The next step was to choose the way of formally presenting the new giant of the piano. It was decided to give him the benefit of the most ideal arrangement for his initial Red Seal recording — a collaboration with the Boston Symphony, the aristocrat of orchestras, and its new music director, Erich Leinsdorf.

In this brilliant showcase, Hollander was presented in the premiere recording of Dello Joio's *Fantasy and Variations,* a work which had been written expressly with Hollander's great technical virtuosity in mind.

The recording was issued, and critical response has indicated that the years of patience, of study and training, were not wasted, that Lorin Hollander has served his notice that he very well may be the Rubinstein of tomorrow.

Another instance in which the success of the program instituted by RCA Victor has been proved is the case of Erick Friedman.

Friedman, a New Jersey youth, had studied the violin since his childhood. By the time he reached his late teens, it was evident that he was a violinist of enormous talent but that he also needed the benefit of further study.

When Friedman was 19 years of age, RCA Victor entered into a contract with him providing for study and training. He became one of the few persons ever to be accepted as a student by the great Heifetz. In the following years, his promise of genius was given the impetus of a most excellent background for the ultimate launching of his career.

Heifetz was greatly impressed with the youth's potential, and when the time seemed right to introduce Friedman to the world, he asked that the student become his collaborator in a recorded performance of the Bach Double Concerto.

Lanza, Hollander, Friedman. These are but a few of the musical talents that have been aided by the fusion of art and industry. Modern-day "patronage," as exemplified by the RCA Victor program, is constantly searching out the musical talents of today in order to give them the opportunity of developing into the musical masters of tomorrow. ■

Electronic Poetry

In addition to business and scientific applications, a computer shows its versatility by composing blank verse at the rate of 150 words a minute.

There is apparently no limit to the versatility of electronic computers. They are proving invaluable in helping man to attain more effective communication systems, improve industrial controls, advance medical research, and further his conquest of space. In addition, computers are now reaching into areas of how men think; how they react to situations; and how they communicate by the thinking process.

An example of the unusual areas in which computers can function was recently demonstrated by Clair Phillippy, an RCA Computer Site Leader at Lancaster, Pa. Phillippy, who was then a laboratory instructor of the Electronic Data Processing Service function of the RCA Service Company, worked with an RCA 301 — a completely transistorized, general purpose electronic data processing system.

For his experiment, Phillippy programmed a basic vocabulary of 100 words which the computer organized and presented on paper as blank verse — some of which are reproduced on these pages.

To establish a system for the machine, Phillippy selected 10 of the 100 words as "starters" — those to be used to begin each line of verse. Other words were segregated depending on whether they were nouns, adjectives, verbs, and adverbs. Phillippy then settled on a format of four-line verses. Each of the first three lines was to contain seven words with the final line held to three.

When Phillippy and the computer collaborate, he makes use of an "interrupt" pushbutton on the console to achieve a variety of verse content. As the computer "reads" its programmed vocabulary from tape, Phillippy depresses the "interrupt" button at random and the computer picks a word at that given instant. The same procedure is followed in picking the subsequent nouns, verbs, and so forth. Phillippy has no way of knowing, until he takes a look at the printer output, what the choices were.

The three-word final line comes from an additional vocabulary of 30 words.

To date, Phillippy and the RCA 301 have produced more than 500 selections of verse. These selections by computer, though electronically composed, are at times reminiscent of Donne, Blake, and such modern poets as Eliot and Cummings. Even the most prolific poets would be hard put to match the computer which has the capability of producing 150 poems a minute.

Actually, this somewhat whimsical computer programming may have a practical application. Phillippy sees it as an exercise in improving an operator's programming skill in practical computer applications. ■

At the rate of 15 feet of copy every 60 seconds, this RCA 301 printer can turn out business reports or the poems shown at right.

POEM NO. 027

WHILE LIFE REACHED EVILLY THROUGH EMPTY FACES
WHILE SPACE FLOWED SLOWLY O=ER IDLE BODIES
AND STARS FLOWED EVILLY UPON VAST MEN
NO PASSION SMILED

BY THE RCA 301

POEM NO. 929

WHILE DREAM FLOWED BLINDLY ON BROKEN HOPES
STILL SPACE DRAINED SICKLY O=ER BROKEN LOVES
YOUR LIGHT DRIVEN SLOWLY FROM FURTIVE MEN
NO HEAVENS SLEPT

BY THE RCA 301

POEM NO. 078

THOUGH STARS DRAINED SICKLY UPON IDLE HOVELS
FOR LIFE BLAZED FAST UPON EMPTY FACES
WHILE BLOOD LOOMED BITTER ON IDLE FIELDS
NO MARTIAN SMILED

BY THE RCA 301

POEM NO. 105

OUR WATER FLOWED MEANLY AGAINST EMPTY SKIES
OUR BLOOD DYING EVILLY NEAR EMPTY BODIES
AND GLOOM FLOWED MEANLY THROUGH GAUNT FACES
OUR FOE PALLED

BY THE RCA 301

POEM NO. 140

YET LIGHT REACHED BITTER FROM FURTIVE LOVES
YOUR BLOOD DRIVEN FOULLY =NEATH INHUMAN HOVELS
FOR STARS DRAINED FREELY =ROUND BLACK DEEDS
THE HEAVENS PALLED

BY THE RCA 301

Electronically Speaking

News of current developments briefly told.

FLIERS' ELECTRONIC YARDSTICK

One of the concerns of pilots since the time of the old Jenny biplane — and especially in the crowded air of the Jet Age — is knowing exactly where they are in flight at any given time as fast as possible.

To give pilots this fast and accurate information, RCA's Aviation Equipment Department in West Los Angeles, Calif., is producing a distance-measuring device for commercial airlines that is called "one of the most sophisticated pieces of electronic air-borne equipment in existence."

The device, known as AVQ-70, provides pilots wtih continuous distance information from a given ground station, with an accuracy of a little above or a little below one-tenth of a nautical mile up to five nautical miles. The variance at 200 nautical miles is only two-tenths of a mile.

CATALOGUING BY COMPUTER

A synchronized team of five computers — three RCA 501s and a pair of RCA 301s will take on the staggering and seemingly endless cataloguing of more than 674,000 industrial supply items for the Defense Industrial Supply Center (DISC) in Philadelphia. The items being catalogued range from rope, tackle, and paint to metals, hardware, and bearings.

As an example of the time involved, it would require four clerk-typists working 21 days and averaging 300 stock numbers a day to update a list of just 25,000 stock numbers. In addition, two clerks would have to cross-check for 50 days, averaging 1,500 lines a day for 75,000 lines typed. Similarly, a single clerk would have to work a full year on the entire job at an approximate cost of $6,000.

Now, the same job can be handled by computer application in six hours at a cost of $825. In addition, the electronic data processing systems turn out the printed pages for final reproduction and binding.

BRAIN WAVES FROM SPACE

Relay, the National Aeronautics and Space Administration's communications satellite built by RCA, has just become a new, intercontinental diagnostic tool for doctors.

Recently, it transmitted electroencephalograms (recordings of "brain waves") from the Burden Neurological Institute in Bristol, England, to a meeting of the National Academy of Neurology being held in Minneapolis, Minn. The diagnosis was made, and results were interpreted within one minute and sent back to England.

The test was conducted on a person with normal brain waves. However, Dr. Reginald Bickford of the Mayo Clinic, Rochester, Minn., said, with the combination of satellite transmission and computer analysis, it is possible to diagnose brain disorders over long distances and determine which part of the brain is affected. In countries without adequate neurological services, such communication would be extremely valuable.

10-TON LOAD OFF THE NAVY

The massive 15-ton pile of maps and charts normally carried by a U.S. Navy carrier at sea may be replaced by a new electronic device, five tons of blank paper, and a library of film.

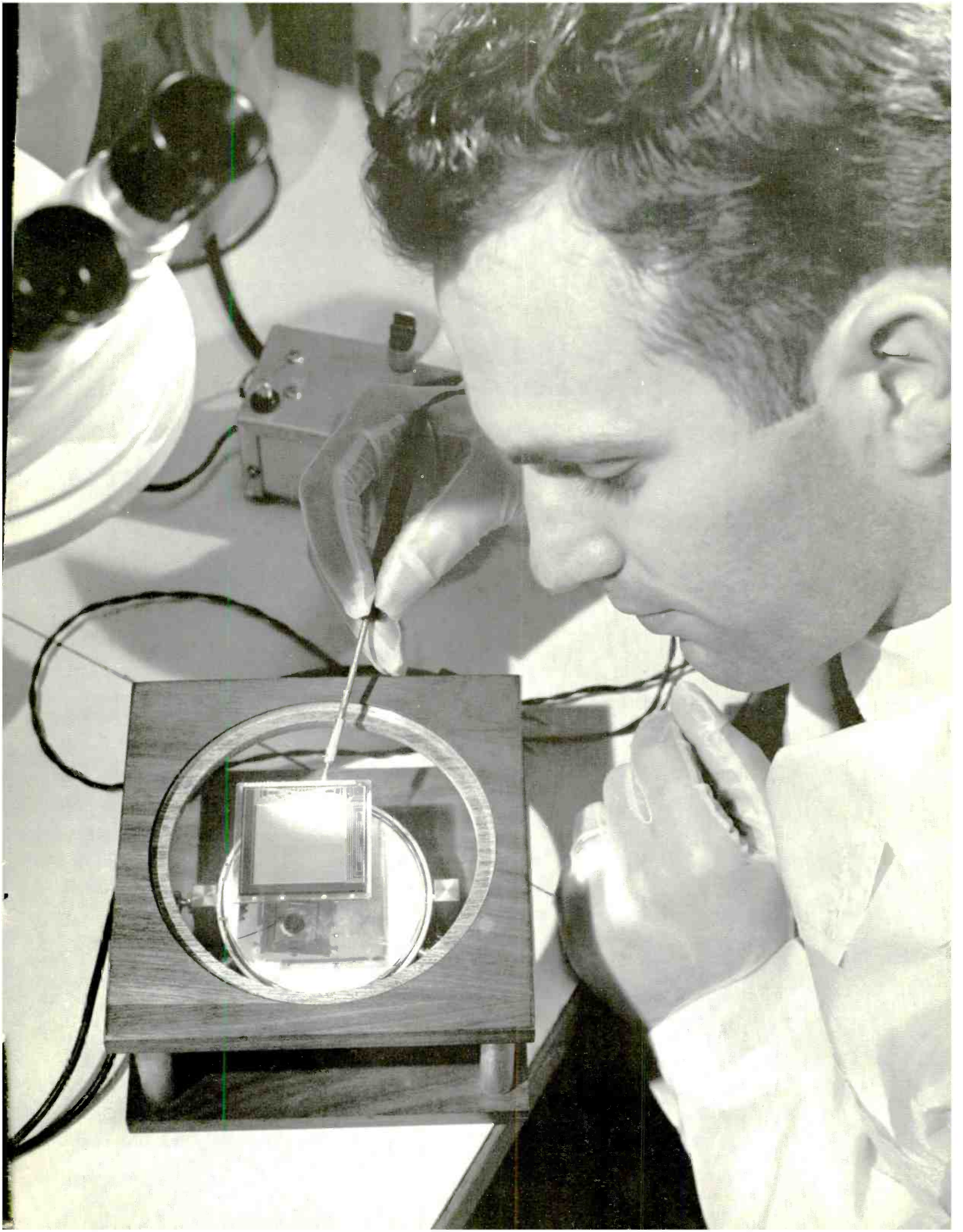
Known as an "Electrofax" reproducer, the RCA-developed household-refrigerator-sized machine reproduces maps and charts in color directly from 70-millimeter film positive separations. It reproduces them in five colors at a speed of about 25 an hour.

ELECTRONICS' ELEPHANT MEMORY

The thin-film superconductive computer memory being immersed in liquid helium at right represents a long-sought-after goal in computer research — the first thin-film superconductive all-electronic memory, offering in one unit a practical combination of high speed, large capacity, and compactness.

Developed at RCA's David Sarnoff Research Center at Princeton, N.J., the revolutionary experimental memory can store 16,384 bits of computer information in an area smaller than a playing card and only 120 millionths of an inch thick.

This experimental RCA memory employs extremely thin layers of materials that become superconductive at very low temperatures — that is, they lose all resistance to the flow of electricity and thus can store indifinitely computer information in the form of electric currents. To acquire and keep this superconductive property, the memory is immersed in liquid helium at temperatures that are close to absolute zero.



Front row every night

Now you can enjoy the grand sound of FM/AM in this neatly proportioned radio triumph from RCA Victor. Owning one is almost like being in the front row every night at the finest concerts.

You wouldn't believe such rich, full-fidelity sound could come from such a stunningly sized cabinet!

Automatic Frequency Control (AFC) keeps stations "on target" for hour after hour of static-free, drift-free reception . . . with all the pure tonal beauty of famous "Golden Throat" sound! Large 5" x 7" speaker. Continuous tone control.

You can own this RCA Victor FM/AM, the Liberty, for only $69.95-manufacturer's nationally advertised price, optional with dealer. Slightly higher some areas West, South. Price, specifications subject to change.

See Walt Disney's "Wonderful World of Color," Sundays, NBC-TV Network.

RCA The Most Trusted Name in Sound

Tmk(s) ®