SPECIAL SECTION

It was a mere 50 years ago that Radio-Electronics magazine was first published under its original name of Radio Craft. In memory of that occasion, this special section has been assembled by our editors. It provides a rather special look at the field of electronics that we love and is assembled to depict our industry as seen through the pages of Radio-Electronics. It extends on with our views of 2029, only 50 short years in the future. It makes fascinating reading. We found it a joy to put together. We present it to you as an expression of our thanks to you and our wonderful industry that has worked its special magic to keep us 50 years young.

. . . *The Editors*

“in the

. . . ”

. . . there was **Radio-Craft**, the magazine that evolved into the issue of **Radio-Electronics** that you are reading now. In this special 50th Anniversary edition, we are going to do many special things; present some forgotten, yet important events; talk about the state of electronics in 2029, some 50 years in the future.

So get ready to relive the past, enjoy the present and anticipate the future . . . your future . . . the future of this wonderful world of electronics.

50th Anniversary Issue Contents

50 YEARS of

As seen through the pages

FRED SHUNAMAN

IN 1929 WHEN HUGO GERNSBACK STARTED **Radio-Craft** (as **Radio-Electronics** was called until 1948), he had been publishing magazines in the electrical and radio fields for more than 20 years: *Modern Electrics* 1908-1912, *The Electrical Experimenter* 1912-1922, and *Radio News* 1919-1929.

THE FIRST ISSUE of *Radio-Electronics*, then titled *Radio-Craft* appeared July 1929.

From the beginning, he had always attracted a strong personal following, comparable to that of old-time philosophers or religious leaders. To this day, one prominent scientist feels compelled, whenever the name Gernsback is mentioned, to testify that it was Hugo's influence that led him to his present career. In another case, an Australian engineer in Canada on an exchange, came to New York to meet and photograph the man who had started him on the path of electronics. But first he made a pilgrimage to 233 Fulton Street, home of Gernsback's original Electro Importing Company from 1908 to 1921.

In early 1929 Gernsback did a mailing to radio enthusiasts of the day, telling them he was starting a new magazine and asking for subscriptions. (The coming


Radio-Craft

HUGO GERNSBACK, Editor

The Reason For Radio-Craft

By HUGO GERNSBACK

"THE REASON FOR RADIO-CRAFT" told our readers why we came to be.

Great Depression was unsuspected, save to a few economists.) The new publication, he told them, would have "no pictures of the latest radio mast in Timbuktu, no stories of how Roxy killed a fly on the mike, no radio announcers flanked by goggle-eyed sopranos, and no radio mathematics that would be swell food for Einstein, but useless to the practical experimenter." Instead, it would deal with "every new article and apparatus brought out, radio construction galore, servicing data, short-wave dope, blueprint articles and a real section of questions and answers."

The response was phenomenal, and the first issue of *Radio-Craft*, dated July 1929, came out on June 5th. It showed strong support from radiomen—that first issue had authors like John Geloso, an early television experimenter who later became the largest radio-TV manufacturer in Italy; Kenneth Harkness of the then-famous Harkness Reflex; H.G. Cisin, later to be credited with inventing the AC/DC radio; Charles Leutz, designer and manufacturer of top-of-the-line radios; Clyde Fitch, to be known for years as a versatile inventor and writer; plus shorter items by Charles Golenpaul of Clarostat and D.E. Replogle.

Advertisers were not as cooperative, though 12 full-page ads and a number of smaller ones appeared in the issue. School ads were in the ascendancy, and one of them—on the inside front cover—was for the National Radio Institute, (N.R.I.) with its picture of J.B. Smith. (N.R.I. has been a continuous advertiser since that first issue.)

How the magazine managed to survive the tough 1930's is something that Gernsback himself probably could not have explained. Although he could not have known it at the time, 1929 was probably the worst year in the first half of the century to start a new business venture. Before the seventh issue of *Radio-Craft* reached the readers, an epidemic of business failures had begun. Prospective advertisers went out of business, and probably thousands of potential readers found themselves unemployed and forced to choose between buying a sandwich and buying a magazine—if indeed they had the price of either.

Costs had to be cut to the bone. One of the results was a unique editorial style. Two headlines appeared on many of the

CLYDE FITCH

In 1923 I submitted an article entitled "Talking Newspaper" to the Experimenter Publishing Co. It was used for a cover story in *Science and Invention* magazine, and as a result Hugo Gernsback offered me a position in the editorial department of *Practical Electrics* magazine, which I fortunately accepted.

My association with Mr. Gernsback (HG) has long been a cherished memory. He did much to stimulate the creative imagination of his readers and to promote the technology of radio and electronics. It is amazing how many of the predictions in his editorials turned out to be true. I especially remember one, written before Social Security, in which he said we would eventually be assigned numbers and processed by computing equipment.—*Clyde Fitch*

Clyde Fitch is a versatile inventor, engineer and author who had an article in Volume I, No. 1 of *Radio-Craft*. He is now living in retirement in Florida after a long career in the electronics field.

ELECTRONICS

of Radio-Electronics

pages—one at the top of the page, the second about half-way down. Thus, a large number of items could appear in an issue, and it was possible to use brief excerpts from manufacturers' literature that otherwise could not have been extended to full-page articles.

Though all the articles in the first issue were about commercial receivers, they included complete schematics with all parts values. That was noteworthy in a period when many manufacturers considered their schematics proprietary information. The screen-grid tube dominated the field both in commercial sets and construction articles; in the earlier issues, the superheterodyne circuit being described only by RCA. Other circuits—notably the neutrodyne—were still being widely used.

R.D. Washburne, formerly on the staff of *Radio News*, was listed as technical editor. Gernsback was the editor-in-chief. Prominent authors continued to appear throughout the year. Robert Hertzberg (who still writes an occasional article) and David Grimes of Grimes Reflex fame appear in the second issue, the latter heading a department called "The Cooperative Radio Laboratory." A shortwave department also appeared. Gernsback's feeling was that a new era, "The Short-Wave Cycle," was opening up, and that shortwaves were "destined to become vital in radio and television."

Early television, radio servicing

Television appeared in the third issue, with an article by D.E. Replogle. Apparently, Jenkins scanning discs—with lenses instead of small holes—were available to experimenters.

In the third issue, a "Special Announcement" revealed that 80% of *Radio-Craft* readers were engaged in radio professionally, and wanted to see more technical articles "that would appeal to the professional man, the serviceman and the radiotrician." The first two data sheets appeared the next month, and *Radio-Craft* became definitely a serviceman's magazine. A new department, "Service Man's Data," also started that month.

Going to bat for the "serviceman" in the editorial, "Frenzied Service" in February 1930, Gernsback said, "When the Service Man wants information, the manufacturer will almost never give it." Unbelievable as it may seem today, manufacturers of the '20's did not part with their data readily, but retained it for the exclusive use of their "authorized outlets." Those outlets were often music and auto-supply stores, while most of the service technicians were ex-hobbyists or amateurs. The results were, therefore, understandably unhappy. Replies by manufacturers in the May 1930 issue made it clear that Gernsback had not overstated his case. One company, famous for using garages as sales outlets, with repairs consequently being made by automotive experts, states that "of course" it would not fill orders sent by "unknown people" because the parts might be used incorrectly, but suggested they might contact the company's nearest jobber.

John F. Rider, later to become the top writer and publisher of books for the service technician, joined the magazine as editor of the Service Men's Department early in 1930, and Laurence M. Cockaday, former Editor of *Popular Radio* and designer of the then-famous Four-Circuit Tuner, also became a regular contributor that year.

Radio-Craft

HUGO GERNSBACK, Editor

How to Become a Service Man

By HUGO GERNSBACK

"HOW TO BECOME A SERVICE MAN" was another of Hugo's early editorials.

In the November 1930 issue, Gernsback told us that "television is coming to the home" in the next couple of years. He felt that the scanning disc would eventually be replaced by some electronic means. A list of 27 experimental television stations was printed in the middle of the editorial page. In the December issue, Philo Farnsworth had an article on an "image dissector" that scans electronically. (Now known as the *Emitron*—the British trade name—it is still used in some applications.) He also spoke of an *oscillite* cathode-ray receiving tube, of sawtooth oscillations that scan and synchronize and of blanking. A transmitted picture of de Forest (*which the editor believed was recognizable*) was part of the article.

LATEST THINGS IN RADIO

IN 1929 THE 4-ELECTRODE screen-grid UY-224 and a 0.125-watt potentiometer were the latest developments in radio.

Early in 1932, Gernsback hailed the improvements in tubes over the last 20 years—while pointing out that they were still inadequate—and asked: "Imagine what tubes (if we still have tubes) will be like 30 years hence." He continued, "The lowly crystal still has inherent qualities that will bring it back to its former popularity if it is properly engineered." (And, indeed, by 1962 "the lowly crystal," now dignified by the title "solid-state," had begun to surpass the vacuum tube.)

MANFRED VON ARDENNE.

It was a great experience for me when in 1926 I met the great American electronics pioneer, the inventor of the first grid-controlled high vacuum electron tube, Dr. Lee de Forest, and showed him the Loewe Triple tube which I had developed in Berlin at that time. The triple tube (Fig. 1), which was manufactured by the millions, contained three electron tube systems with their coupling elements in a single envelope and therefore represented the first integrated circuit. In 1927, at the age of 20, I went to New York, and then again met with Lee de Forest who was then continuing his work which he had begun in the early '20's on sound-film technology. After lectures to the Institute of Radio Engineers in New York, concerning the broad-band amplifier I had developed with especially low capacitance design in the form of a double tube (Fig. 2), I met H. Gernsback personally.

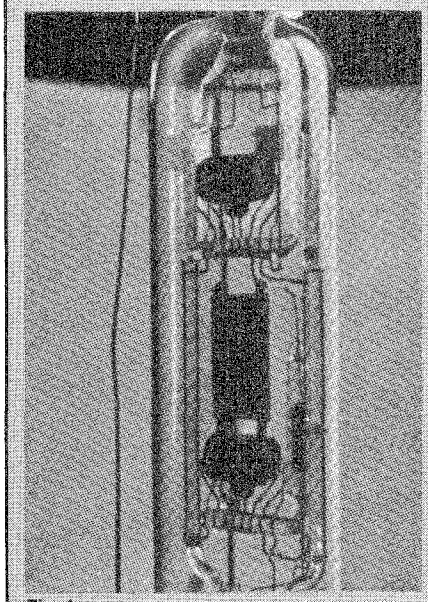


Fig. 1

This acquaintanceship led to my sending regular reports on the results of our work in Berlin-Lichterfelde for publication

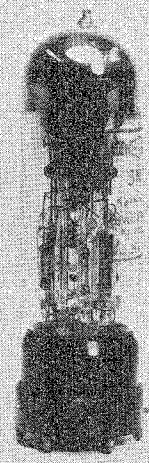


Fig. 2

in his magazine, the trailblazer in field of publicity in radio, television, and electronics. Specifically, the reports in his magazines were very helpful in making our new developments known, not only in the U.S.A., but in Europe as well, and putting them into practice. Gernsback was a technical editor with unique requirements. He was there from the first days of radio and was a good friend of many historical personalities of this technology: Lee de Forest, David Sarnoff, the long-time president of RCA, with Vladimir K. Zworykin, among others.

A few months after the English television pioneer, J. Baird, saw the television with electron beam tubes at my laboratory in Lichtefelde, H. Gernsback visited me in Berlin-Lichtefelde on 26 June 1932 (Fig. 3). Before that, Gernsback had repeatedly reported in his magazines in

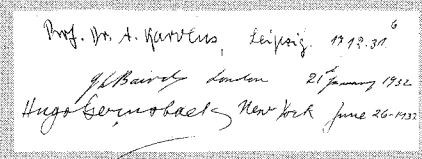


Fig. 3

great detail about my television system with electron beam tubes in the transmitter side (flying spot scanner) and on the receiving end which was first demonstrated at the end of 1930. Thanks to the development of electron beam tubes, with very bright light spot, light control electrodes and step-by-step improved spot focusing methods, we were able to demonstrate at the Berlin Broadcasting Exhibition in 1931 the technical deliberation which in 1932 led to the conversion of all laboratories and firms working on tele-


The New York Times.

Cathode-ray television station on which Baron von Ardenne of Germany has been experimenting since 1928. The transmitter and receiver (inset) will be exhibited at a forthcoming Berlin Radio Exposition. The images are seen on the end of the tube in the square aperture of the receiver.

The Flying Spot Scanner

Fig. 4

Bob Hertzberg's article on New York's famous Radio Row, Cortlandt Street, appeared in the September, 1932 issue. Along with its photographs it almost projects the feel of that fantastic street to those who have not seen and cannot possibly imagine it. (One newcomer described it as an area "where unavailable parts are piled up on counters—for pennies!") The article mentioned "the Stromberg-Carlson Treasure Chest—once the finest radio in existence" on the sidewalk with a $3.00 price tag on it, exactly 1 percent of its $300 list price, 6 years earlier. (A trip to Cortlandt Street the week after the article appeared found no Treasure Chest—and the Grebes in a nearby store window had also disappeared!)

The first true midget radio—the International Kadette—appeared in 1933. In a bakelite cabinet measuring 5.6 x 6.5 x 4 inches, it weighed 6 pounds. Transformerless, it would work on AC or DC, and, with adapters, on 6 or 220 volts. It became the universal small receiver, and according to the magazine, "enjoyed a greater sale than any other set on the market." Not a superhet, it had three tubes plus a tube rectifier.

The mighty "Westingmouse"

Gernsback's "Westingmouse" Superhetero-Ultradyne, a set so small that it could (almost) be carried in the pocket, appeared in the May 1933 issue which reached the readers early in April. The seven tubes shown in the photograph were pilot lights with faked bases of shiny black paper. Although it was plainly tagged as an engineer's nightmare, and the story ended with the words APRIL FIRST in capitals (even the tubes were APR-1's), readers were so eager to have such a set they refused to believe their senses. Orders flooded in, not only to *Radio-Craft* but to a large company whose name somewhat resembled that of the alleged manufacturer of the wonderful set.

The "Radio Month in Review" department started in the November, 1933 issue, and continued to this day under different titles. Because of the time-lag between the event and the magazine's reaching the reader, the "month" was often three months past. (At various intervals attempts were made to "modernize" the page by referring to each item as "last month.") The first installment had an item by Nikola Tesla (then in his 70's) who suggested destroying tornadoes by using robot planes to drop a bomb in the mouth of the funnel.

Events moved fast in 1934. Station WLW in Cincinnati was granted permission by the government to experimentally increase its power from 50-kW to 500-kW, blanketing large areas. Power had to be reduced temporarily until arrangements to avoid blanketing certain stations were made. All-wave radios became increasingly popular, in spite of Gernsback's prediction that the shortwave expert would never use switching—only plug-in coils could give maximum results. Bell Labs engineers gave a demonstration of "solid sound" (stereo) to IRE and AIEE engineers.

Fig. 5

Fig. 6

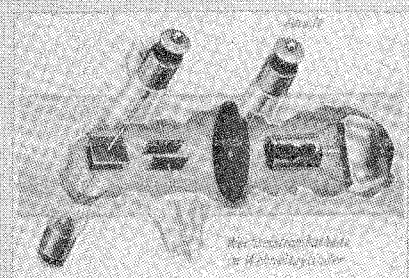


Fig. 7

Fig. 8

vision to the purely electronic approach.

A later conversation with the American pioneer of electronic television, Dr. Zworykin, revealed that our demonstrations preceded his famous demonstration with the iconoscope. It also appeared in the newspapers and technical journals of the USA, especially in the Gernsback magazines, with many detailed reports (Figs. 4 and 5). The number of lines in the TV picture in these first experiments was only about 100 (Fig. 6). Our electron beam tube (Fig. 7) would not permit a higher number of lines. In the advanced state of electronic technology in 1979, line numbers of, for example, 1250 would be appropriate.

In a letter, which I sent to my friend, Dr. Zworykin, (Fig. 8) in 1977, shortly before his death, I wrote to him: "The market will soon be saturated with color TV sets. Why shouldn't RCA start introducing in the USA a new color TV system, with, for example, 1250 lines, in-line color TV tubes and PAL system? Electronic technology seems to me to be ready for this new start. The progress in picture quality would fully justify the costs."

At an advanced age, Dr. Zworykin, as I did, turned to biomedical technology. Since about 1960, I have concentrated on transferring the selection principles of radio technology (feedback, series-connected similarly tuned selective elements) into biology. Our goal, to which we have come very close, is the creation of a highly-selective cancer therapy (cancer multistep therapy) which will destroy only the cancerous tissue, but not sound tissue in the human organism. We reported on the state of our Dresden work in which new types of high frequency process, with Raster movements of the applicator were extremely important, in New York at a symposium on fighting cancer with hyperthermia (March 15, 1979). The symposium was sponsored by the New York Academy of Sciences, and we presented the paper, "The Use of Hyperthermia within the Frame of the Cancer Multistep Therapy" by M. von Ardenne and W. Krüger.—*Manfred von Ardenne*

Manfred von Ardenne was one of the earliest advocates of cathode-ray television, practically "a voice crying in the wilderness" in the early '30's. Though Gernsback had serious doubts about the possibility of using the tube for TV, he printed all the articles the youthful von Ardenne sent him. (Other authorities, among them Lee de Forest, thought that the cathode-ray tube was too expensive, too unreliable, too complex, and too dangerous to be used in TV.)

Manfred von Ardenne is now head of the research institute named after him, and is chiefly engaged in electronic medical work, with the emphasis on cancer.

The year 1934 was also the year of prediction. The April cover that year showed a man picking up the morning paper from a slot in the front panel of his radio, and had an article describing facsimile equipment already manufactured by RCA and others that would make that possible. The June cover showed a foot patrolman wearing a radio unit resembling some of those actually used later on. The radio was a receiver, intended only to pick up broadcasts from police headquarters. Even Gernsback did not expect police to be equipped with hand-held two-way radios.

A 1934 cover also showed the Gernsback Phonosone, a bone-conduction hearing aid that was an improvement on the Gernsback Osophone of 1923 that permitted a deaf person to hear a radio broadcast through his forehead. Despite two cover articles with illustrations on this device, an inventor was issued a patent on a bone-conduction aid in the late '30's. Gernsback never protested: "I didn't intend to manufacture it," he said. "Why bother somebody else?"

In September 1934 the first article in *Radio-Craft* to use the words high-fidelity appeared, when the story "A New High-Fidelity Dual-Channel Amplifier" was published.

A "four-dimension" audio system is also mentioned in 1935. It used four mikes and four speakers; a pair of headphones center-tapped to make stereo phones is also shown. The avalanche of new tubes reached a new peak the same year. New types had been increasing for a few years; "new tube" articles that described two or three types began to cover a half-dozen, then more, and finally the metal tube was released about the middle of the year. October was a special metal-tube issue, and it was stated that glass tubes were now on the way out.

"Armstrong Invention Ends Static," announced the "Radio Month" in the June 1935 issue. Thus, FM was announced, purely as a static eliminator, though there are hints of other uses: "The new system may affect television, since it permits extremely wide modulation." Other 1935 events included a Connecticut law that would have banned auto radios. It was withdrawn before it was reported out of committee. Alfred Ghirardi, later known as the author of the "Radio Physics Course," contributed his first article to the magazine. Hugo Gernsback and de Forest agreed that the cathode-ray tube was not the solution to television—the young Du Mont insisted emphatically that it was.

Also in 1935, again ahead of the times, there were two hi-fi stories—"Putting High-Fidelity In Old Sets" and "How To Add High-Fidelity To Old Sets". In the May 1935 issue there were 5 articles dealing with hi-fi.

A news item in 1936 told of an Iowa farmer who put a radio in a box on his plow in order to be able to hear the baseball games. (Today, a radio is standard equipment on tractors.) The German television inventor/researcher Baron Manfred von Ardenne described a new cathode-ray television set that could be

viewed in a lighted room and had a definition of 400 lines. RCA was making million-dollar experiments in television with cathode-ray tubes. In February and March 1936 readers learned from a 2-part article by M. H. Gernsback how to build a high-fidelity TRF receiver.

A serial, "How to Build Your Radio-Craft Television Receiver" ran through the first several issues of 1937; it used a 5-inch CRT with a resolution of 441 lines. Marconi died in July. The so-called "machine-gun" microphone was described by M.H. Gernsback. It was highly directional and designed to pick up outdoor events at long distances. Hugo Gernsback's surrealistic art piece "Radio" was shown in the September 1937 issue. (Gernsback had visited a surrealist art exhibition, then had gone back to the office, dug up some items from the junk room, had them welded together and entered them in the show).

In 1938 the first foreboding of radio censorship appeared. Mae West played Eve opposite the snake (not stated who played that part). The FCC decided that the program had been "far below minimum standards" and hinted that it would be remembered at license-renewal time. Two states introduced bills for state control of broadcast programs (techniques for preventing programs from crossing state borders were not described). The Institute of Public Opinion found that 41 percent of the public favored government censorship of broadcasting; 59 percent opposed it. The radio industry decided to police itself.

"Radio Waves Flow Through Tubes," in the May 1938 issue, described Southworth's work with coax cable and waveguides. It included the fantastic experiment with 8-inch-diameter coax with quartz insulation, in which Southworth first removed the center conductor, demonstrating waveguide transmission, then the outer one, transmitting the waves by the different refraction characteristics of quartz and air.

High-power broadcasting was well on the way. General Electric threatened 1200 kW. Station WLW started broadcasting with 500 kW again, after erecting a "suppressor" antenna to prevent drowning out Canadian stations on their own territory. The latest television station list had 19 stations. Five stations were on 441 lines, with 30 frames-per-second. Some still used scanning discs. Power varied from 15 watts to 30 kW.

Foresighted Professor Rogers of the Massachusetts Institute of Technology advised graduating students: "Your most secure and profitable career will be on the public payroll, supported by the rest of the population." Television claimed its first life with the death of No. 1 amateur Ross Hull, who was electrocuted while trying to pick up New York from Hartford, CT, on an experimental breadboard set.

A January 1939 article described the absolute altimeter, which measured height by reflecting radio waves from the earth back to the plane. That was actually a type of radar, and the wartime censorship refused the magazine permission to reprint it in 1944, even though the term "radar" was already known to the public.

Extremist right-wing agitator Father Coughlin was refused air time by station WMCA for a talk explaining that Nazism was an outgrowth of Communism, unless he first submitted a text. "Broadcasts inciting racial and religious hatred are an evil not to be tolerated," said the President of the National Association of Broadcasters.

The Milwaukee Journal filed an application to broadcast TV programs on a commercial basis. Franklin D. Roosevelt was the first U.S. president seen on TV when he opened the New York World's Fair in the spring of 1939. The experimental NBC-RCA TV station in New York City broadcast the event.

JOHN R. PIERCE
My Hero and Yours—Hugo Gernsback

A number of years ago I was talking about Hugo Gernsback with several prominent members of the National Academy of Sciences—Lloyd Berkner and Detlev Bronk, former president of the Academy and then president of Rockefeller University, were among them. All had been introduced to radio by buying things from Gernsback's Electro Importing Company and through his early publications. As a result of that conversation, Bronk called Gernsback and had a pleasant conversation with him.

It is hard to overestimate Gernsback's effect on young people who later became members of the technical and scientific community. His publications certainly played a large part in my case. He published a brief note of mine on an improvised galvonometer when I was in high school. He asked me to write "How to Build and Fly Gliders," published in 1929, and published other glider articles of mine. He attracted me to science fiction and published my first story in Science Wonder Stories in 1930.

How well I remember Gernsback's various publications. He was always young, daring, interested in what was new and informative about it. A very few years before his death he invited me to visit him at his office and later took me to lunch. He was distinguished and charming, and I was delighted to meet again a man who had had such an influence on my life—and on the lives of others.

It is good to be reminded, by the fiftieth anniversary of *Radio-Craft/Radio-Electronics*, that what Gernsback began still endures.—*John R. Pierce*

John R. Pierce was director of electronic research at Bell Laboratories until his retirement some years ago. He is, as he points out, also a science fiction author—under a pseudonym—and a composer of electronic music. At present he is Professor of Engineering at the California Institute of Technology.

Nuclear age begins

In the June 1939 issue, "Radio Month" had noted in passing that a Dr. O. Hahn of Berlin had produced barium by bombarding the synthetic element ekauranium with neutrons. Neither the editor or readers seem to have considered the event important.

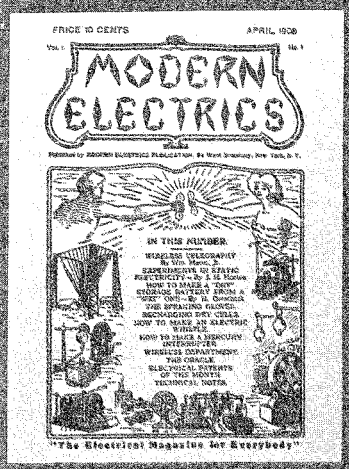
Dr. Edouard Branly celebrated his 95th birthday on October 3, 1939—with no radio. He said: "It bothers me to think I had anything to do with it."

Station W2QXR, New York City, started transmitting experimental FM broadcasts 42 hours a week in 1940. The FCC on Oct. 31, 1940 issued construction permits to 15 stations to build commercial FM stations. The band, 42-50 MHz was authorized to be used starting January 1, 1941. However, the first station to be licensed was W47NV which went on the air in Nashville, Ky. on May 29, 1941. The Indianapolis Power and Light Company found that replacing its two-way AM auto radios with FM radios doubled their range. Portable radios were at last becoming truly portable—the RCA Model BP-10 (measuring 9.5 x 3.5 x 3 inches) led the market with a "camera-type" set. A Galvin (Motorola) bicycle radio used permeability tuning. The April 1940 issue mentioned hearing-aid "microtubes" the size of pilot-light bulbs (exactly the same size as the "Westingmouse" APR-1's of the 1933 April Fools story.)

Commercial TV begins

The FCC authorized commercal TV broadcasts to start on July 1, 1941 using the 525-line standard and channels 2 to 13 (channel 1 was transferred from TV to

THE FIRST COVER of the first issue of every electronics magazine Gernsback Publications has ever produced is shown on the page at the right. How many do you remember?



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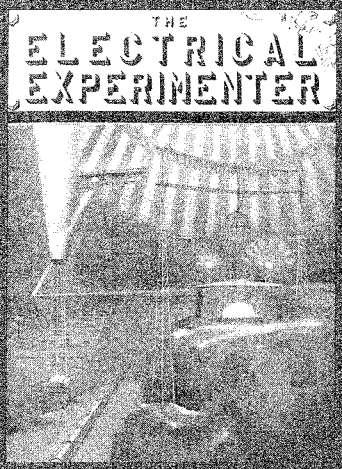

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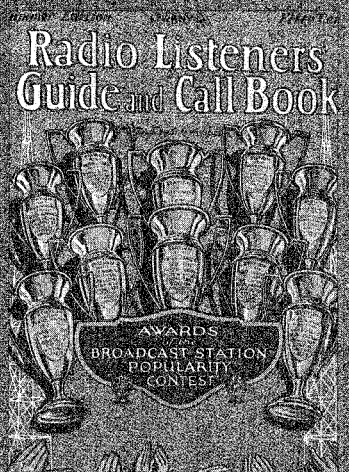

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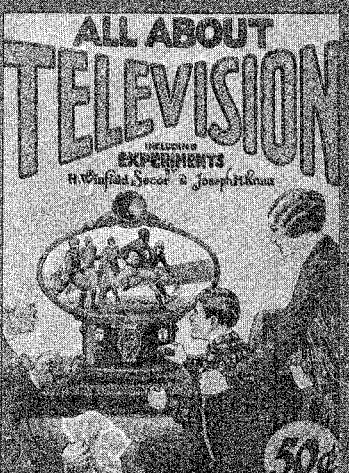

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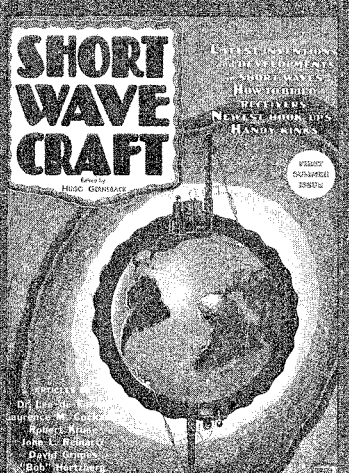

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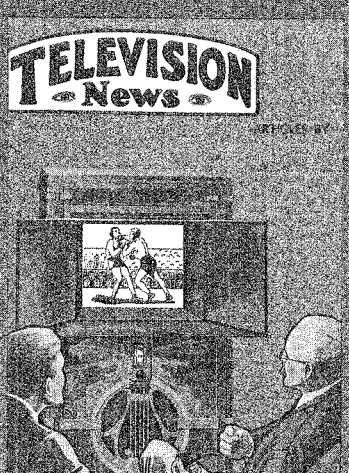
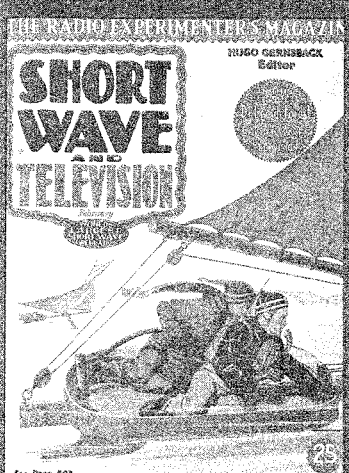
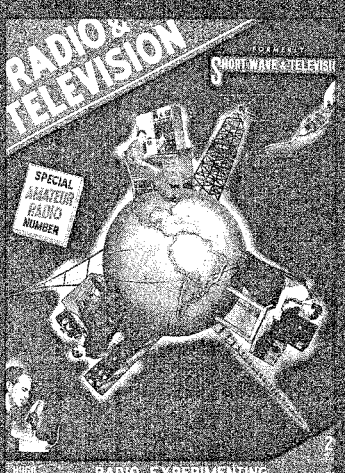


1931



1937



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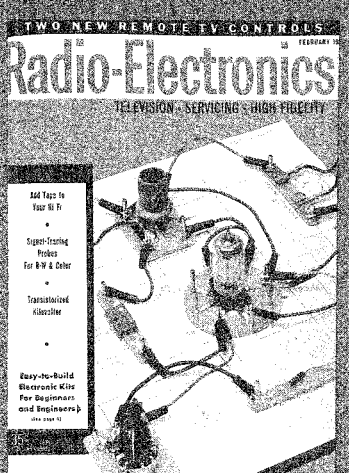


1957

FM broadcasting). Station WNBT (now WNBC-TV) in New York City received the first license on June 17, 1941. The outbreak of World War II in Dec. 1941 put a freeze on all new TV activity and

receiver manufacturing till 1945.

"Preparedness" was a theme that began to pervade the magazine in 1940. Editorials were entitled "Radio for Defense" and "Radio War Inventions." The news items in the "Radio Month" feature indicated that the U.S. was already looking ahead to war. A new section, "Radio Defense," appeared early in 1941; scarce metals were being swept up, and a correspondent made suggestions on saving scarce aluminum. *Radio and Television* (formerly *Short Wave Craft*) merged with *Radio-Craft* at the end of 1941. The publisher explained that in the "present emergency" advertisers were cutting their space and that the National Defense Program required conservation of resources such as paper.

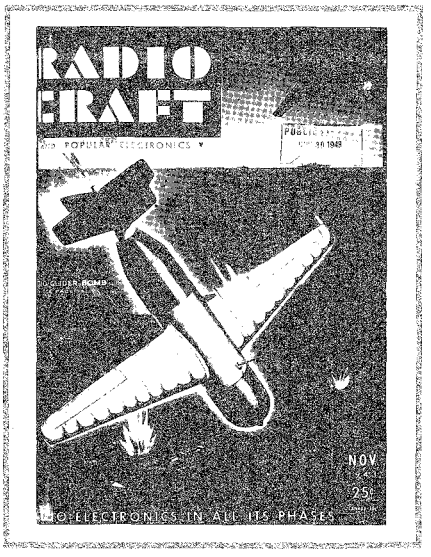
The magazine had survived through the depressed 1930's, though several others in the field had failed. But times became even more difficult as the 1940's began. "National Preparedness" was the countrywide issue. The government stockpiled raw materials, cutting down on materials available for civilian use and raising prices. Manufacturers cut back their advertising. Just to keep going was a constant struggle, and the consolidation of the two magazines was a sign of it. And the first two issues of *Radio-Craft* in 1942 were combined into one January-February number.

The "Roaring Forties"

The same thing happened with the August-September 1942 issue, though by that time there was already light at the end of the tunnel. The tide began to turn toward the end of the year. Practically complete employment and industrial output at 100 percent had a startling effect on circulation and advertising. And the war increased interest in electronics, especially radio. Circulation started going up, in an ever-rising curve that led the staff who survived to refer to the period as *Radio-Craft's* "Roaring Forties."

In 1941 the possibility of war was on everyone's lips. And, of course, with the Japanese attack on Pearl Harbor in early December, we were involved. Radio-Craft was also involved, facing an entirely new set of reader problems and presenting solutions to them.

By the time the January-February 1942 issue was printed, the country was actually at war, and *Radio-Craft* was faced with a new task—showing the service technician how he could keep radios playing without replacement parts. Ha-



rold Davis—technician from the Deep South—warned of the trouble in the March issue, but even he failed to see the full horror of the situation ahead. His article showed how the technician could get by with the five types of electrolytics permitted under the defense plans. Actually, the service technician's problem (within the year) was how to get along *without* them. The April 1942 editorial suggested that the young technician could gather up old sets and build new radios from their parts.

An article entitled "Stabilized Feedback," by Harold S. Black, its inventor in the June 1942 issue, describes negative feedback, which up to that time had been mentioned only in highly technical journals.

The July 1942 issue reported that the FM Broadcasters Association had discovered that FM listeners preferred serious music to all other programs, with less than one percent interested in news, lectures or drama.

A letter from Ben Miessner, inventor of electronic organs, says that Fritz Lowenstein, for whom he worked in 1911, used oscillating vacuum tubes in that year even before they were called vacuum tubes. (Lowenstein called them "ion controllers.") He had had a radiotelephone working between two of his laboratories

Hugo Gernsback . . . an appreciation
ROBERT HERTZBERG

He was the pioneer publisher of radio magazines in the United States. He was the father of the entire science-fiction cult, a visionary who far outdid Jules Verne. Many of his "wild ideas," as incredulous readers called them, materialized years later: network broadcasting, television, radar, moon-bounce transmission, guided missles, jet propulsion, nuclear fission, to name a few.

As a very young writer/editor, I worked for Hugo Gernsback in the 'twenties and 'thirties, and kept in close personal touch with him right up to his death in 1967. He was a private man, a bit on the formal side. I never heard anyone address him by his first name. He was always Mr. H to his staff.

Mr. H. came from Luxembourg, a tiny duchy squeezed into a corner formed by Germany, France and Belgium. He was well educated, and was fluent in German, French, English, and a native speech, called "Letzeburgish." He was a European gentleman of the old school, always meticulously dressed. He was a connoisseur of wines and women, and a practiced gourmet. One day he took me to lunch at a posh New York restaurant, where he was greeted with great deference by the head waiter. The latter returned in a flash with the head cook, resplendent in his white garments. He and Mr. H shook hands cordially, exchanged a few pleasantries in French, and then spent fully five minutes discussing the preparation of an omelet. An omelet? I'll never forget that dish. It was a work of art.

Hugo Gernsback was camera-shy. People who read his magazines for half a century had no idea of his appearance. This picture of him is a rarity, and I happen to have it because I took it myself in his office in 1931, when he was only 47 years old. It was one of those sneaky "candid" shots, and no one was more surprised then I was after I developed and printed it.—*Robert Hertzberg*

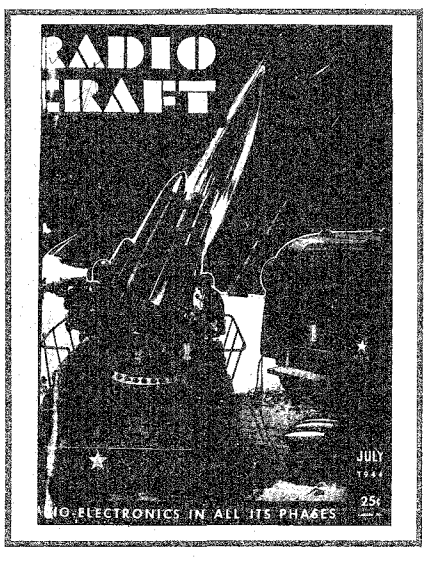
at 115 Nassau Street, New York City.

The effects of the war began to appear in the later issues of 1942. There was less material on servicing and more theory (some by authors who themselves appeared to be learning), and stories on wartime repairing and wartime limitations. (Lt. Cooke, inventor of a radio slide rule and author of a popular mathematics book for radiomen, reports that, because of "priorities," he can't get one of his own Cooke slide rules).

Nikola Tesla, the great electrical inventor-engineer who invented the induction motor and the multiphase AC power distribution system among other things, died on January 7, 1943, and the February issue was a special Tesla number. Hugo Gernsback (possibly Tesla's last friend) wrote of the great technologist's achievements from his own memory and from the patent files. A page of appreciative comments from prominent people in the field revealed that many of them still had a photographic memory of some of the pages in "The Inventions, Researches and Writings of Nikola Tesla" (published 1894).

The war cut off not only radio supplies, but news as well. "Post-War Planning" was the substitute feature and many an item on the news page described events in the postwar world instead of present news. Gernsback predicted that after the war we would have combination alarm clocks and radios that would wake you up with music. There would also be plastic radio tubes (the plastic actually waited for solid-state) and radios that would fit into a suit pocket and provide loudspeaker volume. Using industry as a source of material, the magazine printed articles on germicidal tubes, dust precipitators, and *Heatronic* molding machines.

The May 1942 cover had another notable feature. The magazine had been running items on careers for women in the military forces. *Radio-Craft* was approached by a publicity man for the U.S. Coast Guard, with a promise of a cover picture to run with an article on women "radiomen" in the Coast Guard. The picture was to be original, he said, and not offered to any other magazine. But the May issue of every magazine in the radio field had a different and "original" picture of the same Coast Guard "radiogirl." The editors were not pleased, and the clever publicity man found it impossible to place any of his publicity releases in their magazines for some years.



"Post-War Planning" extravaganzas went so far that Zenith Radio was impelled to protest, in a July 1943 cartoon showing their proposed after-the-war model. It *included* the kitchen sink, plus all imaginable forms of electronic entertainment, facsimile newspaper, and even a soft-drink dispenser. It did have one true prediction of things to come—a radio oven.

SENATOR BARRY GOLDWATER

Yes, I remember *Radio-Electronics*, I remember Hugo Gernsback, and, in fact, I started with amateur radio in 1922 or 1923, and the names you have mentioned bring back very fond memories.

I remember the eagerness that each of these publications was met with, and I particularly remember the interest in anything that Hugo had to say about what was becoming a great service and is today one of the greatest any group can offer its fellow citizens.—*Barry Goldwater*

Barry Goldwater, K7UGA, K3UIG, is the radioman in the United States Senate. While never an author for the magazine, his name has appeared in it frequently in news reports of legislation benefiting radio amateurs or technicians.

Radio-Craft reorganized on a wartime basis with the November 1943 issue. The covers—all on military subjects—were handpainted in flaming reds and yellows by science fiction artist Alex Schomburg. The influx of money to pay authors began to show up in improved articles, and headline type and captions spruced up. (Those bright wartime covers continued until 1945, when the magazine went back to peaceful subjects.)

The January 1944 editorial, "Shrinking Radio," points out that while locomotives, planes, and ships were getting larger, radio was bucking the trend. Tubes that were 4 inches high in the '20's were now the size of a flashlight bulb. A "set no larger than a dime is not an impossibility and . . . will be produced." Even record players would shrink, and possibly "future records will be made on plastic tape."

In a lighter vein

In the April 1944 issue, Gernsback reinstated the April Fool hoaxes, which had been abandoned after the repercussions of the "Westingmouse" portable of 1933. The "Radium Radio Receiver (Ra-Ra 4-1)" gave full loudspeaker output with only one tube—in fact it needed a throttle instead of a volume control. The set could be turned on at any time by a signal from the local station, to receive disaster warnings or important bulletins. In spite of plain clues in the story and the closing words, "APRIL FOOL?" Gernsback was deluged with orders and offers to invest. The April Fool stories were printed every year until the mid-1950's. Some of the ideas were pretty unbelievable—but one, at least, was patented within two years after it appeared as pure fiction.


PHOTOFACTS FOR SERVICEMEN

A New Organization Attacks Circuit Information Problems

WHEN *PHOTOFACTS* were announced, service data became readily available.

The June 1944 issue escaped suppression by a narrow margin. Its cover showed planes dragging wire nets as a "radar-defensive reflector" to confuse enemy radar. The idea was so close to the tinfoil "chaff" actually being used secretly that the censorship held up the magazine for a considerable time. (The readers didn't notice—so many issues were late during that period.)

Radio-Craft introduced a new type of fiction, the "Sally the Service Maid" series in the early 40's. They were the only love stories ever illustrated with schematic diagrams.

In the March 1945 issue, McMurdo Silver, high-fidelity pioneer, suggested that 8000 cycles-per-second should be a good top limit for audio, and that an amplifier should reproduce well down to about 50 cycles.

That year saw other events: Amateurs went back on the air in midsummer; a new soldering instrument "that draws no current when not in use and heats up in half a minute" was described, with photos courtesy of the Weller Company. An interesting item to viewers of today's news programs appeared in the October, 1945 issue: The president of the National Broadcasters Association opposed the new practice of inserting a commercial in the middle of a news broadcast. "No more reason why a news broadcast should

large cash influx. But the customer, not having to pay for the calls, called the service technician on the slightest pretext. The service shop of course, went broke. Some fairly large and reputable firms were destroyed before the unlimited service contract was abandoned. Strangely, the one-man shop that usually gets the worst of everything was not much affected. It had not been easy for the one-man operation to get in on the big contract boom.

The Citizens radio band—460-470 MHz—opened in the fall of 1949. Equipment prices were so high and tuning so difficult that this band was never fully occupied, and CB radio didn't become popular until the lower frequency band was opened. (Incidentally, 460-470 MHz CB is still in use, and the band is not crowded!)

The nuclear age was beginning to open, and the September 1949 issue had four articles on uranium prospecting, as well as an explanation of the Geiger counter.

22 Electronics

The Geiger Counter

How Does it Work?

Anyone with an understanding of radio circuits can grasp the fundamentals of counters

By ERIC LESLIE

The rival qualities of the FM discriminator vs. the ratio detector were being hotly debated. In the United States, commercial rivalry overpowered scientific detachment, and *Radio-Electronics* decided to run tests in a neutral area. In England, Radio-Electronics correspondent Ralph Hallows, assisted by engineer H.K. Milward, ran a series of tests. The discriminator with one limiter came out slightly ahead—and with two limiters far ahead—of the ratio detector.

The January 1950 issue was proclaimed the Annual Television issue, and started a seven-part series: "Build a de Luxe Televiser." The author supplied large schematics and templates for a fee, and several hundred were ordered by readers. An illustrated TV station list, with 77 station-identification patterns (out of a total list of 99 stations) filled six pages of the issue.

The most famous story?

The January 1950 issue also contained

one of *Radio-Electronics'* all-time outstanding articles. TV viewers often saw strange things on their screens and called on service technicians to whom TV was also strange. The technician would tell his customer: "outside interference," and both would usually agree that "it must be an amateur." The author of the story, William L. Kiser, was an FCC employee. A new resident in a Long Island, NY, village, he was known vaguely as a "radio man" to the neighbors. One night half a dozen husky men, one carrying an axe—presumably to chop down his radio mast—and another a rope (prospective purpose not disclosed) invaded his home and demanded to see the man who was blocking their reception.

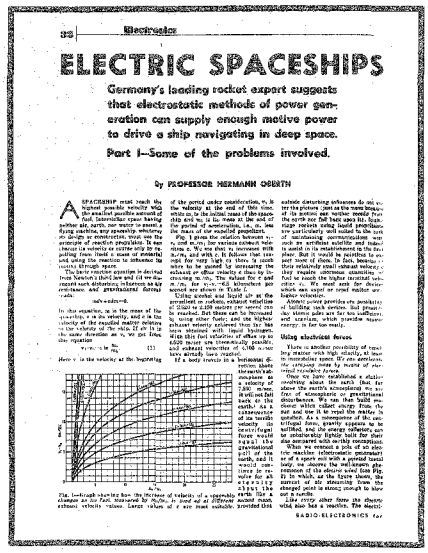
The group left somewhat discomfited, but not before giving Kiser a revealing view of what the radio amateur was up against. Kiser then wrote a story directed at the service technician, that placed the responsibility where it belonged. It showed various kinds of interference patterns and how to clear them up, often by placing a filter on a badly designed set. *Radio-Electronics* received so many inquiries that it was necessary to have hundreds of reprints of the article made. An amateur radio magazine, QST, which normally would not run a story already printed by another magazine, asked for and received permission to run the whole story in its pages.

CBS started experimental color broadcasting early in 1950. The viewer needed to be able to adjust his set to the 410-line scanning frequency of the system, and a "color wheel" was necessary to view the correct color at the correct instant. The picture could not be seen in black & white on a standard set. Some sets could be adjusted to 410 lines, others showed a mosaic of six images. Color wheels became available—some viewers made their own. The most ingenious wheel was mounted on an egg beater, and was powered and synchronized by hand. An article in the May 1950 issue mentioned a new development that might make the color wheel obsolete—the shadow-mask tube. "Should be available in a couple of years," said the article.

Radio-Electronics printed one of its most remarkable covers on the July 1950 issue. The photographer received a special award for "taking a picture of sound in a dark room." What was really photographed was a demonstration by Dr. Winston Kock and F.K. Harvey of the Bell Telephone Labs, of an acoustic lens, useful for Focusing UHF radio waves (or sound waves of the same length.) A microphone and neon lamp on the end of a rod that swung up and down was mounted on a carriage that moved slowly away from the lens. The mike was connected to the input of an amplifier, and the neon tube was connected to its output. Thus, a photograph could be taken of the standing-wave pattern of the sound as the mike-neon lamp backed slowly away from the lens. (The photographer and scientists went out for coffee during the 10-minute exposure.)

The space age

Often considered "far out," *Radio-Electronics* ventured into space with the December 1950 issue. The "Father of Space Navigation," Dr. Herman Oberth, found himself in the United States practically without funds. He communicated with Hugo Gernsback, whom he had known in the past. The result was two articles entitled "Electric Space Ships."



33 Electronics

ELECTRIC SPACESHIPS

Germany's leading rocket expert suggests that electrostatic methods of power generation can supply enough motive power to drive a ship navigating in deep space.

Part I—Some of the problems involved.

By PROFESSOR HERMANN OBERTH

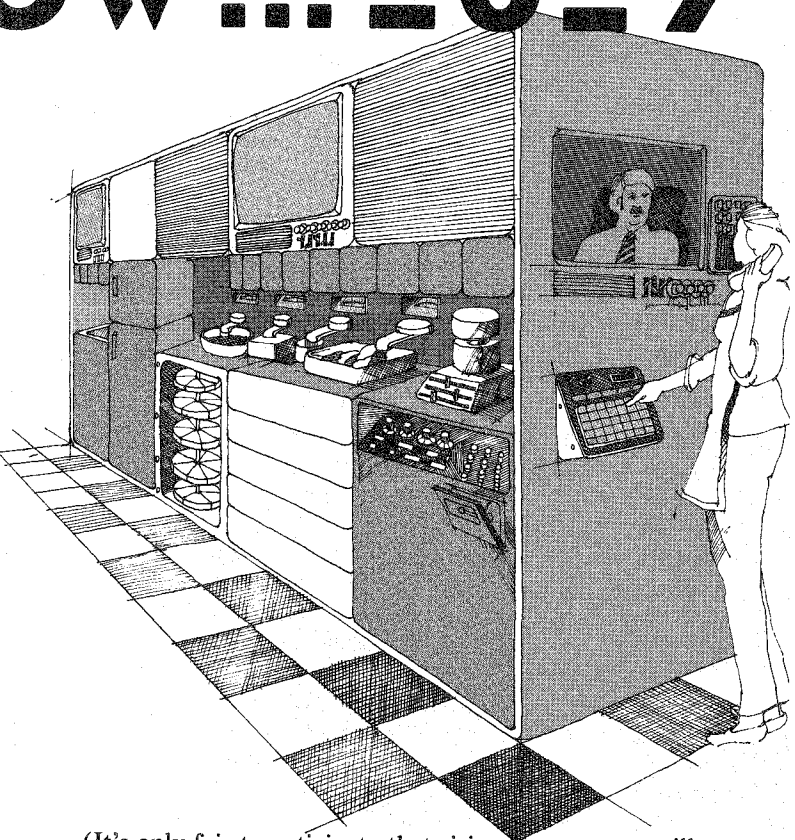
At the time, they were almost science fiction. The articles nevertheless attracted considerable attention, and *Radio-Electronics* was afterward able to boast that it was the first American technical magazine to print an article on space navigation.

The December 1950 issue also had an article on multiplex FM broadcasting. The purpose was to facilitate a second program—possibly for "storecasting" or facsimile broadcasts—no one was thinking of stereo at the time.

continued on page 64

ELECTRONICS TOMORROW...2029

MARTIN BRADLEY WEINSTEIN



AS I SIT HERE AT MY TYPEWRITER, IT IS A FEW DAYS BEfore August 1, 1979. My friends at **Radio-Electronics** have asked me to bring into focus what our todays will be like 50 years from now, especially in terms of how electronics (or its future forms) will be playing their part. And I'm wondering how possibly to predict anything without too much raw speculation, how to forecast without the flavorings of a lifelong gadget nut.

Well, I can't! So here—as our friends in broadcasting would say—is a big, fat disclaimer.

Don't count on anything. I have tried to apply more than technological trends to my predictions. For new technology and future inventions to have any impact on our lives, we're going to have to want, buy, and accept them. That means that they will have to offer us such benefits as convenience, savings, or versatility that outweigh their costs.

Alas, this is not the place for lessons in marketing, sociology, or economics. There is much business at hand and we'd best plug in our crystal balls now.

The computer evolution

There will be dozens of computers in the homes of the future . . . and there will be none . . . both by today's definitions.

Just as relays, timers, and rheostats gave way to transistor and IC controls in kitchen appliances, for example, semicustomized microprocessors are sure to become the most economical way for an appliance manufacturer to let his customers "talk" to his products, and vice versa.

Soon, manufacturers will respond to the pressures of the marketplace and develop ways of letting their appliances "talk" to each other. For example, a microwave oven can start the coffee even before you wake up using an input from a clock and an output to the coffeemaker. It will then start the toaster and your eggs when it "hears" the bathroom light turn off.

This will mean that manufacturers will have to incorporate a *kitchen bus* (similar to a microcomputer S-100 *bus*) as an input/output data port on appliances. To all the world, it will simply seem to be an extra plug on the back of the box; at least until it is incorporated into standard house wiring practices, at which point it will be known as the expanded *household bus*.

As soon as there's a bus, manufacturers are sure to exploit it with a controller—a new kitchen appliance that will coordinate all the others. That controller will probably have some smarts of its own, too. It will keep tabs on whatever food (and possibly utensils) you have on hand, scan the newspapers (which won't be newspapers, quite, but I'm getting ahead of myself) for the best prices, suggest a shopping list, and, subject to your approval, place your order with the "store."

(It's only fair to anticipate that rising energy costs will dictate the return of the delivery route and the near-disappearance of actual stores; in energy terms, it's cheaper to deliver goods on efficiently planned routes than to have shoppers drive to stores. Eventually, multiservice route delivery would replace both individually run store delivery services plus mail and package delivery services.)

The kitchen controller could also suggest meals and menus, count calories, balance diets, and teach you how to cook things you'd never cooked before.

The chances are also better than excellent that your kitchen controller will be able to both listen and talk in plain language (although in 50 years, the language used will not likely be at an adult level).

How will you pay for your food? This one's dangerous, but I think if we follow the trends of bank services we will see checking, saving, and credit functions merging. Properly, the complicated legislation controlling the banks in administering your money means that very complicated schemes must be devised and implemented by banks in order to make their services seem simple to you. In the end, it should mean that you will have a single account that will be good for whatever money you need (whether you have it or not) in line with good credit practices. How you access that money is a challenge for electronics that may never be fully met, but I foresee some combination of voiceprint, fingerprint, facial recognition, magnetic card, holographic card, secret code number, signature, and possibly central nervous system signal recognition.

"Memory Bank, Savings & Loan"

Today, home computer enthusiasts are discovering that bulk memory is the most expensive part of their hobby. While bulk memory prices may well come down, it is even more likely that software requirements for bulk memory will explode.

Think about that and you'll realize that the bigger the bulk memory, the smaller the probability that you will need access to any given part of it any one time. That means that the overhead costs of maintaining increasing amounts of memory will increase, even while the utilisation of each bit of memory is reducing.

Here enters the entrepreneur.

Let's take an example. Say you are the head of a family with several young school-age children. You've decided it would be wise to provide your family with some form of encyclopedia.

Encyclopedias in bound volumes are very expensive, and because most of the information they offer is never read, they are very inefficient learning tools. And since the information they provide is fixed, updating is out of the question. All of that makes the encyclopedia a natural for computer storage and access, given an inexpensive access to enough bulk memory to store it.

It's not hard to imagine a farsighted businessman investing his money into an enormous computer with enough bulk memory to store an encyclopedia, and then devising ways to make that data available to given customers on either a subscription or pay-as-you-go basis.

Fifty years from now, there may be hundreds or thousands of similar services available. Your home terminal (possibly available through the telephone company and tied to phone lines) will help you use them. You can shop for a used car, look up an old **Radio-Electronics** construction article, learn about the country of Zanzibar, see what's new in fashion, plus more.

Oh yes, stores will tie in to that service, too. Now you can select new furniture, or shop for presents (probably in full color) from your living room. And you can tap the library to have them transmit a chapter of *Jude The Obscure* to your printer or local "not-so-bulk" storage facilities for a little bedtime reading.

In addition, you'll be able to rent your own memory deposit blocks into which you can enter personal or financial data for your own access later.

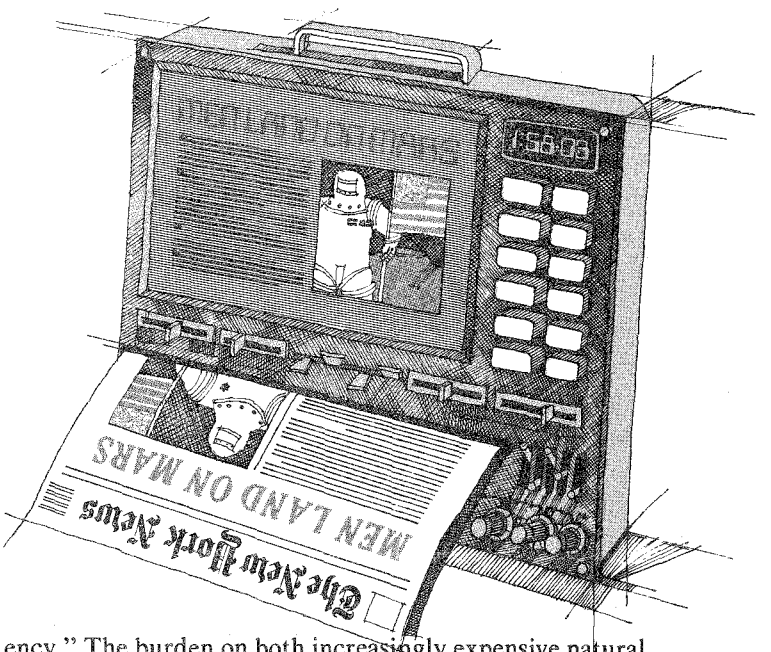
Morning magblox gazette

The cost of newsprint is rising, the cost of labor is rising, and the cost of publishing and distributing a daily newspaper is nearly prohibitive, even today. Fifty years from now, we'll probably let a terminal do it.

That terminal will tie into a fairly high-speed data-transmission network for a minute or so each afternoon, night or early morning, automatically recording the daily paper on magblox. In some homes, the terminal will then automatically produce a paper hard-copy output; in others, a magblox replay on the terminal will be enough.

The service just may be free. Since the bulk of a newspapers income comes from advertisers and not subscribers, and since magblox is a very inexpensive distribution method as compared with regular delivery, newspapers may use free subscriptions as an advertiser incentive.

Magazines are likely to arrive on a single holograph. Holography seems to offer both the data compression and fidelity required for delivering a magazine full of information on a single magazine-sized holographic "transparency." The burden on both increasingly expensive natural resources and delivery systems will be reduced, and back-issue storage will require virtually no space. Also, holozine "reader" hardware should be available in the $100 to $200 range.



What's on the screens?

Nobody expected the FCC actually to take TV stations off the air, but it worked out fine. After all, the developing nations had really been putting a squeeze on for more spectrum space. And what with all the new personal radio and telephone services demanding so much spectrum themselves—well, something had to give.

Cable TV was everywhere, too, and it was better than ever. There were hundreds of channels to choose from, for one thing, and even though most of them had only special interest material most people would never watch, there were still plenty of other good programs to choose from all the time. That was the strength, they said, of the new optical cable; still, some folks still suspect that skyrocketing aluminum and copper prices had a lot to do with the switch.

And now that the Interstate Master Cable had been completed, those tall towers with the ugly Yagis were finally disappearing. Most of them were converting to the microwave and infrared horns to pick up the additional satellite channels directly. Funny how most people preferred the old single-channel Weathercon so much, with its false-color video view of the clouds and temperature strata. As if folks could tell the weather better than the 30-day forecast from the bureau.

But they'd sit at their screens at home, poking their buttons or waving their wands or calling out the words that changed channels and perspectives. Normal people got funny where the screens were concerned. They'd buy screens built into mirrors and bathtubs and planters and walls and furniture and bracelets and every which thing.

Funny how TV sets with the preset perfect color never sold. Folks wanted to make their own adjustments. And there wasn't one out of a hundred who ever had the color adjusted correctly. Well, that's nostalgia for you.

All you ever heard at parties was the old argument about which was better . . . the do-everything screens or the special-purpose screens. Proponents of the former argued that since generally people only do one thing at a

time, who wanted to watch both news and an old "magblox" (magblox denotes some offspring of mechanically spooled magnetic-tape-storage media) movie and terminal up a catalog at the same time? The special-purpose side liked the idea of a big screen for prerecorded magblox programs, a handy workscreen in a little home office cubbyhole for the terminal, and the portable screen for watching the telly cable.

Thank goodness, at least, the screens were so thin and light. Can you imagine trying to watch one of the coarse pictures those old bulky tubes used to show? And the sound then was even monophonic! No wonder our grandparents never liked programs or commercials.

More household changes

As long as we've gone this far, let's take a look at a few other possible changes to familiar household things.

In the laundry room, for example, it's fair to anticipate motionless washing machines. Some combinations of infrareds and microwaves with ultrasonics will heat and agitate the water—perhaps a lesser grade than drinking water—to wash the clothes, then repel the water out of them. The driers will be using smaller motors to force-feed a small but intense stream of air while stirring rather than tumbling clothes.

In the bedrom, mattresses will be filled with a combination of air sacs and gel sacs that are selectively and indirectly heated with a planar infrared source. A nonelectronic wick-action humidifier will be part of the headboard.

Two new appliances will grace the kitchen: The first, a phased microwave oven, using high-power solid-state arrays and a microprocessor-controlled driver to cook separate dishes individually to different cooking times and temperatures. The other is a supercold snap-freezer, using techniques now being developed for commercial frozen-food preparation.

The house will be lighted throughout with soft, highly efficient tertiary emission lamps. (Don't look that one up yet! I'm counting on some technology transfer between materials and physical optoelectronics developments that are still just laboratory curiosities.)

By the way, your garbage disposal unit will probably feed the neighborhood catalytic waste-to-power conversion station. Those stations will store and reconvert power from many sources—much like state-of-the-art uninterruptible power supplies but on a larger scale.

The holobox

I'm going to go against the grain of other predictors of things to come and say—with some conviction—that there will not be a 3-D TV in 50 years. Instead there may be a home 3-D theater that uses lasers and film-recorded holography. Three-dimensional plays and movies will be available in stores and by subscription, but I believe the nature of holography and the data density it requires will prevent its transmission, even over ultra-wideband optical cable.

Three-dimensional home recording will be available, but most likely as a plaything for the wealthy.

The rest of us will have to settle for our "vidimatic" home VTR "movie" cameras. Snapshots will also be taken electronically, with high-resolution, scanned-array cameras that store pictures in memory. You will be able to transfer memory into other memory media, and eventually into hard copy if preferred. Do you suppose it'll be called a "RAMera"?

Is your terminal linked?

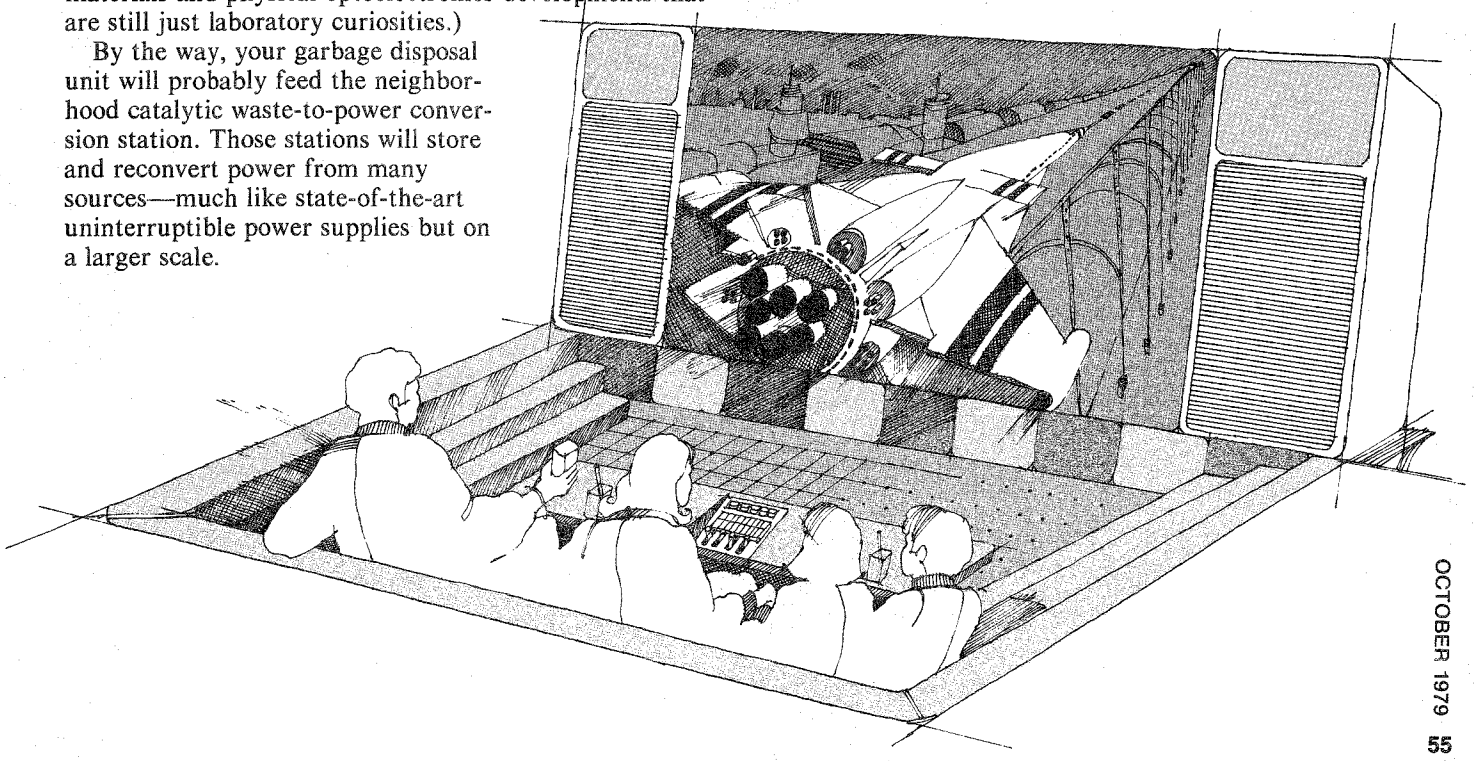
Trying to tell you about the terminal is like trying to explain a telephone to Thomas Jefferson: it's simple, it does a lot, there's a labyrinthic structure behind it, and where do you begin?

The terminal has a screen, like a TV screen, probably in color. It also has a box hooked to it that takes what appears on the screen and puts it onto a piece of paper—maybe in color, but probably not usually in color if we're just looking 50 years ahead.

What your terminal can do depends on how many of the options you've bought and had installed in it. So understand that not every terminal will be able to do everything I suggest.

The terminal has two modes of operation, Local and Link. We'd better start with some of what it does in the local mode.

For one thing, the terminal is a word processor, similar to a typewriter, but having a display that you can see



before the words hit paper. Here's how it works: Say you want to prepare a written report. First, you either type or dictate your report into the terminal. The terminal displays your report on the screen. You either correct or approve what you see, then the terminal prints it (this looks more like facsimile reproduction than printing, and more like dot-matrix printing than pen-plotting). If you prefer, the terminal could record it on a small magblox that you can put in your library, take with you, or transmit later.

The terminal screen can show you several kinds of displays: alphanumerics, graphics, and still photography. It switches automatically according to codes included in the transmission and operations protocol. In the local mode, it accepts inputs from a keyboard, speech, magblox, camera, camera stand, OCR (*O*ptical *C*haracter *R*ecognition) scanner, or a special auxiliary input. (That auxiliary input might be used, for example, to hook up your "MediScan"—a pulse/temperature/heartbeat/blood pressure/EKG/blood-oxygen/white-cell analyzer—when you are linked up with a doctor's office or the "*MediCenter*" computer).

The terminal screen can store information temporarily on magblox, print it, or display it. And every function it performs in the local mode it can perform when linked to remote terminals.

The family car

Yes, there will still be petrochemically fueled, wheeled vehicles 50 years from now. Many will be able to afford them, although not as haphazardly as today.

Electric vehicles will be fully developed and available as urban utility vehicles, and will be highly popular.

Mass transportation systems will offer more frequent service and more systematic routing. That will mean quicker overall trips, despite an abundance of available stops and transfer points.

What's the family car going to be like? It will be smaller because of the tremendous costs of labor and materials for larger cars, the incredibly high cost of fuel, and the resultant demands on fuel economy. And it will be a safer vehicle, thanks to electronics.

Collision avoidance will be a legislated mandatory feature. And many types of hardware will be available for the job: Microwave radar, infrared scanning lasers, ultrasonic SODAR, matrix-image analysis, implanted inductive pulse-code transponders, etc.

Maps will be stored on magblox and viewed on the car's screen. Many vehicles will have limited service terminals, others will have "radionav" and display both the map and its position, á la James Bond.

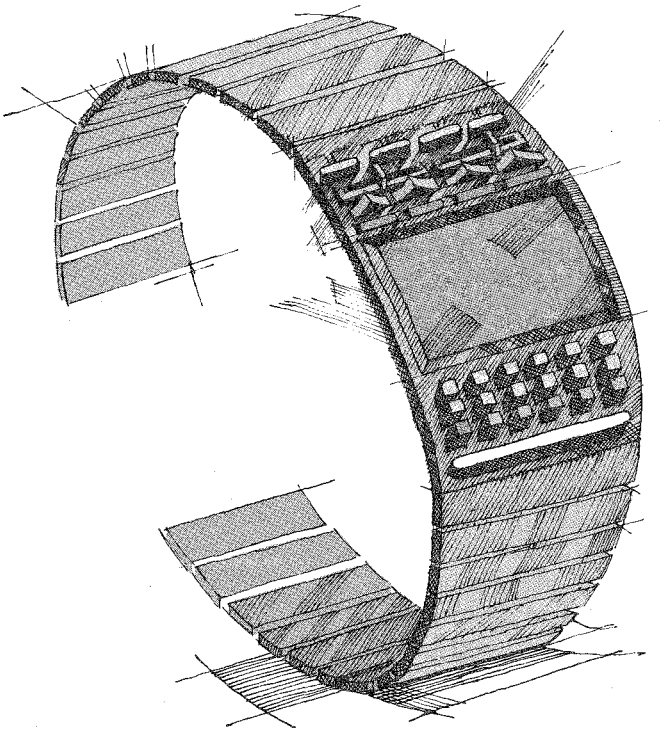
And when the police chase speeders, a Doppler laser device will be the "picture taker".

Speed, braking, steering and perhaps even routing will be out of your hands; electronics will most likely become the car's chauffeur.

The wristworks

In 1979, wristwatches were produced that display the time, the date, and short messages; they worked as stopwatches, sounded alarms, incorporated calculators, displayed a pulse, worked on solar power, and (no doubt), more.

What might you speculate we'll find in a future wristbox?



It seems the likely place for a "pocket" pager, for one thing. It's less bulky, won't rip pockets and won't be left behind.

It would also be simple to envision a personal modulated pulse code—in optical, infrared or microwave—as an electronic key to permit you access to your home, car, office, and so on.

Nor is it hard to include a readout of the ambient temperature. And it could keep an eye on your temperature, too, as well as your pulse and heartbeat, to warn you when your metabolism goes out of bounds.

And there will probably still be room enough left to engrave your initials.

The world won't change

In spite of all these predicted changes, life won't be too different. Any of us, suddenly thrust 50 years into the future, would quickly adapt.

However, just imagine over 50 years how competing manufacturers could escalate the features and benefits of their products in their struggles for a healthier share of the marketplace.

Imagine over 50 years how our mushrooming population will make demands on itself that require legislative control.

Imagine over 50 years how the changes in supply and cost of natural resources may change the way we order options and rank alternatives.

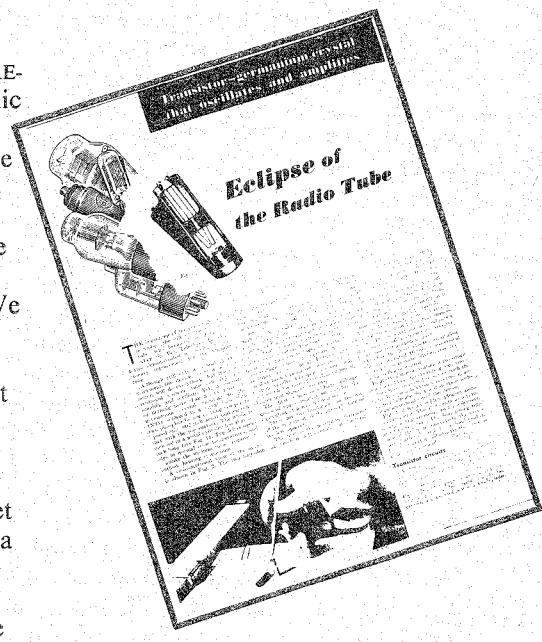
And remember that 50 years from now, it'll still be you and I, our kids and their kids trying to make a living and keep things comfortable.

On the other side of the crystal ball, the changes that occurred during the past 50 years seem a natural progression of perfectly reasonable developments. And so it is looking forward.

And 50 years from now, somebody will be asked to look into his future to predict high-fidelity speakers the size of a walnut, personal-fusion power vehicles, and blue LED's!

It's just a straw man we build. In a decade or so, he'll appear laughably naive. But for right now, he'll do just fine. **R-E**

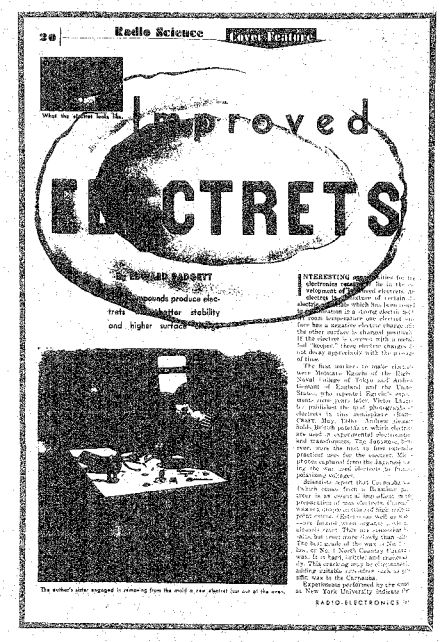
LIGHTS THAT FAILED



AT VARIOUS TIMES *RADIO-CRAFT/RADIO-ELECTRONICS* HAS ANNOUNCED REmarkable new discoveries, that might change the whole direction of electronic progress. In one or two cases the expectations were more than fulfilled. No one could have expected our whole solid-state age to develop from the simple transistor reported in the September, 1948 issue. And the multiple uses of the laser were not even suggested when Bell Laboratories revealed the discovery of coherent light. (Certainly no one ever dreamed it might even be used as a surgical tool or a precision drill.)

But the majority of those new discoveries simply dropped into oblivion. We were determined to find out why, and contacted a number of discoverers or developers. As might have been expected, we found that most of them had simply been made obsolete by newer and better devices or developments that did the work more efficiently.

The most important exception to the "drop into oblivion" rule was the electret, which was so little known when the magazine published the first electret article that many scientists would not believe it existed. (The electret is the electric counterpart of a permanent magnet—a piece of material with a permanent positive charge on one side and a permanent negative one on the other. Originally they were wax discs from two to eight inches across and about a quarter of an inch thick. Later, electrets or electret-like devices have been made of thin plastic film, and those are the type now in common use.) We heard of it from the "mad Austrian" scientist Ehrenhaft, and persuaded an author to make a few. Even after several articles and after exhibiting the electret at an IRE convention, it was largely ignored until the military began picking up a few mysterious microphones in captured Japanese equipment.



Today electret microphones are standard equipment. There were rumors of other uses, and we contacted James West of Bell Laboratories, one of the persons responsible for much of the development of modern electrets. From materials supplied by him, it appears that electrets are now widely used in such unrelated devices as gas filters and radiation dosimeters. The Bell Speakerphones are now using electret microphones, as are many operator's headsets, and electret transmitters (microphones) will replace other types in ordinary telephones as new models come out. Millions of electret microphones are in use all over the world. Electrets have also been used in headphones and phonograph cartridges, and are coming into use in photographic processes.

The Stenode Radiostat

About the time *Radio-Craft* came into being, a revolutionary new receiver, the Stenode Radiostat, was expected by some to make it possible to have

many more broadcast stations on the band, while cutting down interference tremendously. It was supposed to be able to operate on a bandwidth of about 60 Hz (as compared to the 10,000 Hz allowed at the time for each radio broadcast transmission), while maintaining the quality of an ordinary receiver.

Circuitwise, the Radiostat looked like an ordinary superhet with a crystal filter in one of the intermediate frequency stages. That made the IF bandwidth extremely narrow, and low notes were "disproportionally amplified" while the higher notes were cut down fantastically. To compensate for the sideband cutting, the highs were boosted tremendously in the audio stages.

The exact way the circuit worked was a matter of (sometimes heated) discussion, which actually gave a better idea of how little was known about modulation at the time than of the operation of the Radiostat. (Some explanations even denied the existence of sidebands, which of course couldn't be cut off by the sharp IF if they didn't exist.)

In the long run, it was generally admitted that what was happening was that the high frequencies were simply cut down in the IF, then boosted up again in the A.F. audio stages to restore something like normal reproduction. As Clyde Fitch, who wrote extensively on the subject at the time, said years later: "It was a delusion—not that the circuit wouldn't work, but that nothing would be gained if it did!"

The Eveready Air Cell

The April 1931 issue carried a story on a remarkable new battery that—together with a new series of tubes—was to be a boon to the millions of rural listeners who had been bypassed when manufacturers turned their main attention to "electric" receivers operating on alternating current. The new '30 series of tubes (including a screen-grid type) operated with filament currents of 60 mA (the '31 output tube used 130 mA). Those were used in receivers equal in sensitivity and quality to the line-operated sets then available.

The Air Cell was designed to power such sets. Its capacity was 600 ampere hours at a current drain of about half an ampere. That battery would power a 6-tube set using tubes of the '30 series, something that would have been expensive and impractical with dry cells.

The Eveready Air Cell was especially interesting because it used no chemical depolarizer. Instead of the manganese dioxide of the dry cell, it had a positive pole or anode of a special type of carbon, which projected through the top of the case. It absorbed oxygen from the air, which combined with the hydrogen bubbles that collected on it and tended to insulate the positive electrode, to form water. Incidentally, while always called an Air Cell, it was a two-cell battery, as the two projecting carbon anodes proclaimed.

After an initial surge, the battery sank into oblivion; it was no longer mentioned in the technical press nor advertised. The reason was unique—its application was fast dwindling to the vanishing point. Development in rural electrification paralleled that of rural radio receivers, and the radio families without electricity, originally about seven million, were rapidly reduced in number.

Thus the battery was not made obsolete by new developments. It continues quietly in use in more limited applications, according to Roswell Bennett of Union Carbide, who answered our inquiries on the subject. Among its present-day uses are railway signalling applications in remote areas where alternating current is not available, for buoy lighting, and for off-shore drilling rigs. It was used for much emergency lighting in World War II, and we may expect to see it soon in miniature form as a power supply for hearing aids and digital watches.

Discovery of the Age?

In March 1944, *Radio-Craft* published an article: "Magnetic Current—Discovery of the Age?" It described the work of refugee scientist Felix Ehrenhaft, Director of the Physics Institute, University of Vienna. Ehrenhaft believed that he had discovered particles with a one-pole magnetic charge (either N or S, but not both). Beaming light on the gap between the poles of a powerful electromagnet, on the lower polepiece of which powdered metal had been scattered, he found that when the magnet was activated, he

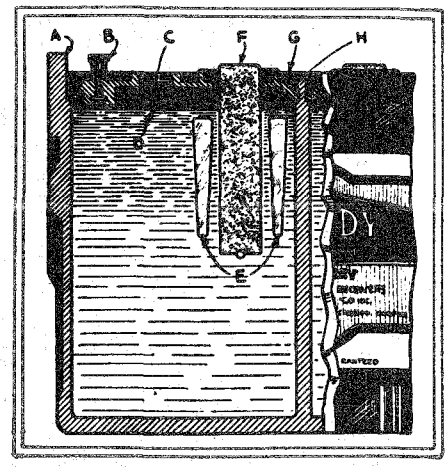


Fig. B

Cross-section of an "air-cell": A, case; B, terminal; C, filling vent; D, level of electrolyte; E, zinc electrode; F, carbon electrode; G, seal; H, partition.


Magnetic Current—
Discovery of the Age?

By FRED SHUNAMAN

Electrical science may well be on the verge of a new era; an age in which magnetism will duplicate or exceed the advances of current electricity. The action of magnetic particles in a strong field, movement of electrically-charged bubbles of gas spirally around a magnetic field set up in a liquid, and above all, the decomposition of water by magnetism, prove that some new thing has been discovered. How important such discoveries are, and what their effects may be, only the future can tell.

THE EHRENHAFT CONDENSER

Electrically-charged gas bubbles in a gap between the poles of a magnet, more or less similar to magnetic "lines of force"

Dr. Felix Ehrenhaft, looking over some photos of recent experiments with magnetic current.

RADIO-CRAFT for MARCH, 1944

could see some of the particles spring from the lower to the upper pole. Ehrenhaft believed that this indicated that they had a monopolar magnetic charge. (Others were not so sure.)

The work attracted a great deal of attention. (*Radio-Craft* devoted two articles and an editorial to it.) There is a gap in electromagnetic theory that would be filled neatly by monopole magnets and magnetic current, and students were extremely interested. Ehrenhaft made a number of other experiments that also supported his hypothesis. Unfortunately one of the most dramatic ones—indicating that water could be decomposed magnetically—went wrong. It was absolutely unrepeatable. The professor was tremendously embarrassed, and to some extent withdrew from public discussion, carrying on his experimental work in the semi-seclusion of Manhattan College.

He returned to his post in Vienna after the war, and some of his later work was published in French and other scientific journals. He died not so long after, and interest in magnetic monopoles seemed to have died with him, until about 1970. Then one H. R. Kolm reported finding a track produced by a particle that was strongly accelerated in a magnetic field, something that might indicate a monopole magnet. He never published a formal paper on the subject, and presumably did not feel that he had enough evidence that a magnetic monopole existed.

In 1975, scientists of the University of California and of the University of Houston (TX) reported the existence of a particle, far heavier than any yet discovered, that fitted the characteristics of a magnetic monopole as laid down theoretically by Dirac in 1931. For one thing Dirac had suggested that the particle—if it existed—should have a basic charge of 68.5 or a multiple of that number. The suspected particle had a charge of 137.

Three years later no further discoveries have been reported. An inquiry to Dr. Alfred Goldhaber, who commented with interest on the 1975 discovery, reveals that though he has been doing theoretical work on the subject since 1975, "neither I nor anyone else has any evidence of the existence of magnetic monopoles." The final conclusions of the 1975 experimenters, he said, were that the track was not compatible with the magnetic monopole.

So the subject is still open. Theoretically, there is a place in the universe for magnetic monopoles, but apparently so far nobody has ever "seen" one.

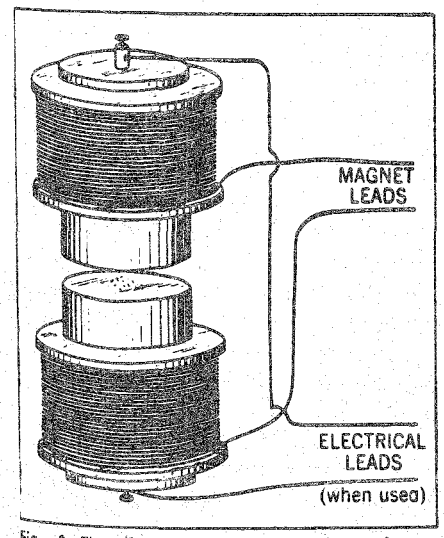


Fig. 2—The Ehrenhaft condenser. Magnetic or electric fields may exist between its faces.

RADIO-CRAFT for MARCH,

Magnetrons in TV sets?

The August 1951 cover and a feature article showed and described a new development—magnetron oscillators for UHF TV sets. It was not easy to get regular receiving tubes to oscillate reliably at the frequencies needed in UHF television. To a magnetron, such frequencies were low. The main problem seemed to be how to make a magnetron small enough to put in a receiver. General Electric solved that problem—the magnetron oscillators were the size of a standard miniature receiving tube.

But the little tubes were too good as oscillators—they radiated into all parts of the receiver; it was extremely difficult to shield them to the point where they didn't create interference in various circuits in the set. That, combined with the rapid improvement of more conventional tubes, made them impractical, and the miniature magnetron never did reach the general market.


32 Television Cover Feature

Miniature Magnetron

for V.H.F. TV Receivers

By FRED SHUHAMAN


44 New Design

IONOPHONE

By E. AISBERG* and M. BONHOMME**

Long the dream of engineers, the inertialess loudspeaker is now reality. It produces sound from electric current with ionized air molecules

The brilliant failure

One device did not fit the general definition: something with a great deal of intrinsic merit, but edged out by newer and better devices. Nothing has ever been found better than the Ionophone, a loudspeaker with no moving mechanical parts. Completely inertialess, it produced sound of a quality that could not be equalled by other speakers. The speaker was completely described in the issue of November 1951, and treated less fully in other issues. The active unit was a heated wire, specially treated to give off large quantities of ions. When heated by a radio-frequency field, the wire maintained a cloud of ions between it and a shield surrounding it. The field that heated the wire was modulated by the output of the audio-frequency amplifier, thus expanding and contracting the ion cloud in the space between the wire and the shield (which formed the small end of the speaker horn). That produced sound. The problem was that the ion-producing wire destroyed itself in an impractically short time. The idea was so good,

however, that it was hard to abandon it; one English company, Plessy, actually manufactured and sold units. But it finally disappeared—in the words of one consumer magazine: "A brilliant failure."

The January 1957 cover (and an accompanying article) showed and described a picture tube that Philco had been developing secretly under the code name "Apple." Instead of the phosphor dot pattern of all kinescopes of the time, the Apple had a pattern of stripes of red, blue and green. In addition to the beam carrying the color information, the Apple used another "pilot" beam that located the vertical stripes, so that the correct color information would fall on the right ones. There was more than a possibility that this tube would replace the conventional shadow-mask type—it was supposed to be cheaper to make and much simpler to adjust.

Attempts to learn the fate of the Apple have been made difficult by changes in the Philco organization, possibly also because Philco apparently ceded its interests in the tube to one of the engineers who developed it. But it would appear that, in view of the number of tubes now successfully using vertical stripes without the necessity of a pilot beam, the pilot beam technique of the Apple was found unnecessary. (However, a recent news item tells of a developmental kinescope that emits X-rays from the boundaries between the stripes. Could that be an attempt at guidance similar in intention to that of the Apple?)

Two "different" amplifiers

The cover of the November 1957 issue showed what was expected to be a revolutionary new solid-state device, the Spacistor. One of the disadvantages of transistors was their low input and output impedances and their high input capacitances. The input and output impedances of Spacistors were higher than those of vacuum tubes, and their input capacitances were low, also in the order of those of tubes. The transistor is a low-voltage device—the Spacistor operated at about 100 volts. The device seemed so potentially valuable it was surprising that nothing more was heard of it. An inquiry to Raytheon brought—after some searching for a person who remembered it—this information from Herman Statz of Raytheon's Research Department:

"Spacistors were made in the laboratory with FET-like characteristics in the middle '50's. The Spacistor employed a source and a gate contact in a high field space charge region of a junction. Because of the small dimensions of typical space charge regions (at most a few micrometers), the fabrication of these devices required photolithography with dimensions of the order of 1 μm. This technology was really not in hand for production in 1957. When regular FET devices came along with high input impedance characteristics, work on the Spacistor stopped.

However, in recent times, technical people have contacted the company as to whether a Spacistor-like device could yield high frequency operation beyond the capabilities of present GaAs microwave FET devices. The answer to this question is probably yes, because of the high fields that exist everywhere in the Spacistor. The concept may therefore be reexamined, since present-day technology would allow its fabrication in some form."

In the same article that described the Spacistor, another amplifier, the Solion, that didn't depend on electrons, was described. It was a flat cylindrical liquid cell about two inches across. It produced an electric current, the intensity of which depended on the agitation of the iodine electrolyte. Thus, with one side of the cell acting as a diaphragm, it became a sort of microphone, responding to low and subsonic frequencies from about 400 Hz down to less than one per second. A modification of the device was usable as a flow meter.

The Solion was developed by the Navy, and was expected to be useful in aerial navigation, among other things. An inquiry to the Navy brought back the information that, while the device worked well, it was outmoded by the development of modern transistors. At least one commercial company has investigated it for special applications, and it is still too early to state that it—or a modification of it—will never be used.

Earth's charge leaking off?

An unnerving phenomenon was revealed in November 1957. Professor Koenigsfeld of the University of Liege reported that the atmospheric potential had dropped significantly. Normally at least 100 volts at one meter

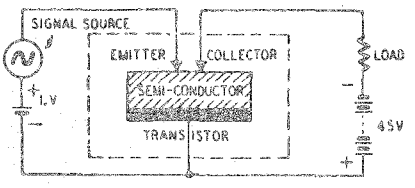


Fig. 4—This is basic transistor amplifier.

The "separated detector"

The Solion principle may be used in a variety of modified designs for special jobs. An example of a slightly different type of Solion is that in Fig. 5. It is adapted to the measurement of unidirectional flows and pressures. The hookup resembles that of Fig. 3, except that one of the outside electrodes is at the same voltage as the cathode, which in this cell is a piece of closely woven platinum gauze. (Its response is linear rather than logarithmic.) The ions tend to drift toward the left (positive)

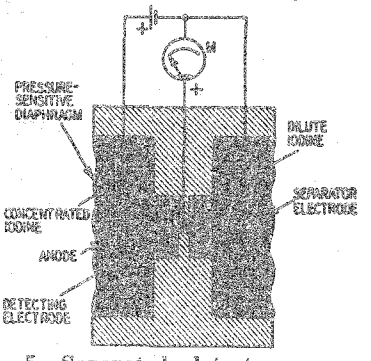


Fig. 5—Separated detector measures unidirectional liquid motion; acts as rectifier on back-and-forth flows.

electrode (anode) where they become iodine molecules. In time, practically all the iodine ions find themselves, under the attraction of the anode, on the left side of the cathode (separator electrode). Now, if there is a movement of liquid toward the right, due to pressure on the left diaphragm, new ions are brought into contact with the cathode, and increased current flow is indicated on the meter. If flow is from right to left, there is no action —there are practically no iodine ions in the liquid in the cell's right section.

above ground level, recent measurements at three points in Belgium showed an average of only 15 volts. It was speculated that such a condition, if it were widespread and permanent, could produce an ionized layer in the lower atmosphere, which could affect radio as the ionosphere does, and might have other and unforeseeable results. No reason was given for the sudden drop, though it was suggested that radioactivity could be a possible cause.

An inquiry to the University brought a reply from Professor Koenigsfeld, now in retirement. He remembers that it was later discovered that there had been an accident at "an English station" that had created strong radioactivity, and that later conditions had returned to normal.

However, between 1970 and 1975 there had again been a certain diminution. The professor enclosed some tables of observations he happened to have. They indicated that between 1970 and 1974, the voltages had dropped in the order of 30 per cent from a fairly high 1970 figure. The average for 1974 was still above 100 volts (above that figure in winter, in some cases somewhat below in summer. However, he had just received the results for May 1978, which showed 70 volts, indicating that the diminution was still continuing (or starting anew).

"Revolutionary" video recorder

The March 1960 issue announced "a revolutionary new system of video recording" demonstrated by General Electric. The new system's recording density was claimed to be about 100 times greater than that of magnetic tape. The video signals applied charges to a moving plastic tape, the surface of which was then softened by radio-frequency heating in a strong electric field. That deformed the tape in proportion to the charge on each surface element, making ridges and valleys in the surface—a sort of embossing. Most interesting, the embossed tape could be "played back" with optical equipment. One difficulty—the system operated in a vacuum.

Nothing further was heard, and it was felt that possibly the problems of recording in a vacuum had stymied the process. That was not quite correct. Ray Shanahan of the General Electric Research Center states that the plastic recording did, indeed, have a recording density about 100 times greater than corresponding areas of magnetic tape. But "information handling technology advanced so rapidly during the 1960's, especially in magnetic recording, that the technical and economic advantages of thermoplastic recording disappeared, and the technique never was transitioned to a commercial department."

The great discovery that wasn't

In late 1968, a remarkable story from Troy, MI, made the front pages of most of the newspapers. "The newest, the biggest, the most exciting discovery in solid-state physics," was how one staid journal put it. What had happened was that Energy Conversion Devices (ECD), a Michigan company, had held a press conference announcing that patents had been granted for the amorphous (non-crystalline) semiconductor switches they had been manufacturing. Since Troy is far from the head offices of technical magazines, or of newspapers with technical staffs, the conference was covered by reporters almost innocent of technological knowledge. Their stories on the revolutionary new "ovonic devices" were the basis for the sensational reports. *Radio-Electronics* covered the story in a more subdued way, in a January 1969 news report based on ECD's own press releases, and in an article in May 1969.

The immediate result was a fantastic jump in the price of ECD stock (and a nose-dive when it was learned that the devices were already known and were not likely to make the transistor obsolete in the immediate future). Sections of the financial press attacked ECD and its head, Stanford Ovshinsky, for the spurt and subsequent drop, even though it was caused inadequate reporting by the press itself and not by anything ECD had said or done. After the furor died down, the company continued to produce ovonic devices, without any tremendous benefit from the spurt of publicity.

Some of the "lights that failed" in the past 50 years may have been overlooked (and we may not have noted that some of today's successes were first mentioned as bare possibilities). If any reader is interested in other inventions, proposals or devices, please ask and we will discuss them in a future issue.

R-E

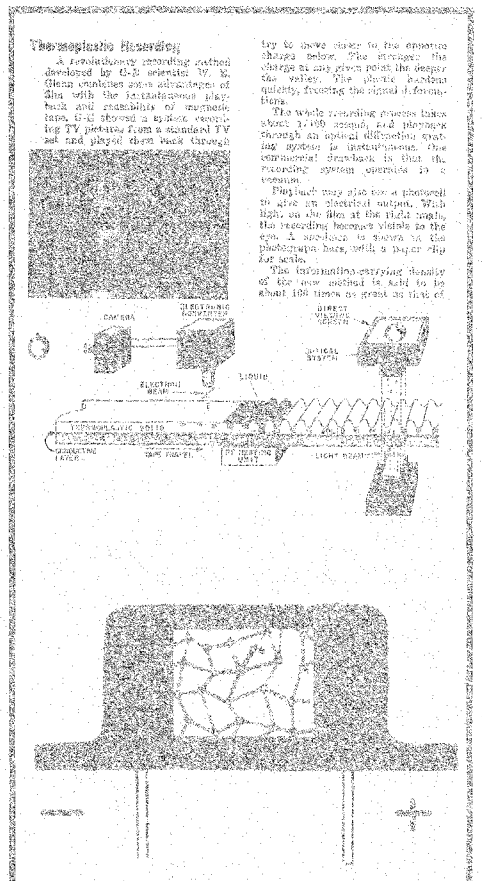


Fig. 1—If ovonic material is placed between two electrodes and a voltage is applied, the voltage exerts a pull on the trapped carriers, marked e in figure.

ALL ABOUT OVONICS

Glassy semiconductor switch! Is it new? Is it a breakthrough? Or is it nonsense?

by FRED SHUMAKAN

"THE NEWEST, THE BIGGEST, THE MOST exciting discovery in solid-state physics at the moment" was heralded in front-page articles in the daily press a few months ago. The transistor, the articles screamed, was about to be superseded by a new, smaller, lower-cost, and more reliable device; a device that would make it possible to have computers so small and so inexpensive that every two-car family could have one; a device that would finally make the picture-on-the-wall TV set a reality.

A self-educated inventor, Stanford R. Ovshinsky of Troy, Mich., had announced that he had obtained patents on a new type of semiconductor switch, one that did not have to use crystalline semiconductors, but was made of disordered (amorphous or formless) materials or glasses. These switches could be operated by any voltage from about 2.5 to 300 or more, would switch in picoseconds, and—unlike transistors—were bilateral (would work both ways).

Even more important, the new devices were insensitive to radiation and could be used in space equipment. Another possible use was on nuclear warheads. Most antimissile weapons depend on paralyzing the electronics of a warhead with radiation. Warheads equipped with Ovshinsky's devices would ride right through a strong radiation field without noticing it.

A few days later, the same papers came out with more subdued stories. Reporters sent out to interview large electronics companies found little enthusiasm. "Yeah," the manufacturers said in effect, "we know about them. They work—after a fashion." One large company reported using the devices experimentally; another had been a licensee of Ovshinsky's firm for a few years. One outfit even claimed to have invented the device—years ago!

So, what is the truth? What is this Ovshinsky device? Will it work? How? What can we expect from it? Is it new? Is it revolutionary? Is it even Ovshinsky's?

A true semiconductor device

First of all, it is a semiconductor. It is a two-terminal device, so it might be called a diode—except it is a two-way device, conducting equally well both ways. Physically, it has a very thin "glass" film. (One formula is 48% tellurium, 30% arsenic, 17% silicon and 19% germanium.) If a voltage is connected across this semiconductor, it acts like a high resistance (hundreds of megohms) until the voltage reaches a certain point. Then the resistance drops suddenly to as little as 6 ohms or less.

Depending on the thickness of the layer and its composition, the trigger or threshold voltage varies from about 2.5 to over 300 volts. Since the semiconductor is practically an open circuit until it is triggered, almost no power is needed to turn it on, even at the 300-volt threshold. And since the resistance can drop to a few ohms once triggered, it can handle large amounts of current—in the order of amperes.

Why does it work that way?

This is one of those "good" questions. Strangely enough, less is known about noncrystalline (amorphous) solids than crystals. This is largely because the orderly and symmetrical arrangement of the crystal structure lends itself to mathematical treatment. A few theoretical physicists have devoted themselves to the more rugged and less popular task of studying amorphous solids. The ovonic device is one of the first fruits of their efforts.

One of the things researchers at "disordered structures" found out is that (in the words of Jan Tauc of the Czechoslovak Academy of Sciences): "In an amorphous body or in a liquid the atomic arrangement is not totally chaotic. The chemical forces between the atoms tend to bind the atoms in the same way they are bound in a crystal. The consequence of these forces is that *the arrangement of the nearest and next-nearest neighbors of a given atom is not very different from that in a crystal.*" This finding has added some order to an otherwise disordered subject.

Mr. Ovshinsky looked for materials that would trap many carriers of electric charge and yet, upon application of an electric field, release the carriers so that the material can be reversibly and selectively transformed from a nonconductor to a conductor.

In other words, if ovonic material is placed between two electrodes and a voltage is applied, as in Fig. 1, the voltage exerts a "pull" on the trapped carriers (shown as electrons, marked "e" in the figure). At a certain (threshold voltage) many carriers are pulled out of the traps and give the previously insulating material a metal-like quality—it has many free carriers. This permits easy movement of carriers from one electrode, into the semiconductor material and out into the other electrode.

Once a path is established, an avalanche of carriers starts, and the resistance of the semiconductor drops to a few ohms. The whole process may take only about 150 picoseconds (0.000000000150 second). The conducting state is maintained until the current drops below a given level (10.5 mA), then the material switches back to the high-resistance condition. If the voltage is alternating, current starts in the opposite direction as soon as threshold voltage has been reached on the opposite alternation.

Note that when the switch goes

Fig. 1—If ovonic material is placed between two electrodes and a voltage is applied, the voltage exerts a pull on the trapped carriers, marked e in figure.

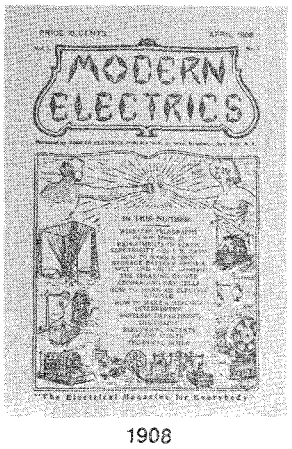
Hugo Gernsback—Founder

HUGO GERNSBACK, WHOSE FAME RESTS ON HIS WRITING, publishing, and predicting not only future events, but the whole course of an industry, thought of himself originally as an inventor and engineer. Graduating from one of the best technical institutes in Europe, the Technicum at Bingen. he came to the United States as a young man of 19, with a patent on a layer-built battery he intended to exploit.

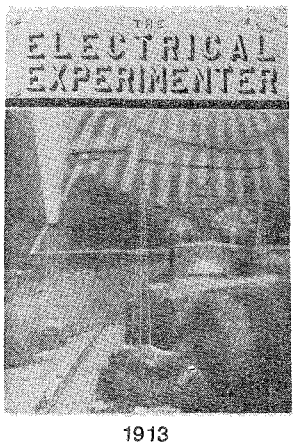
The young Hugo sought work with a battery company while trying to sell his invention. (It never did sell. While the idea was good—and was used many years afterward in heavy-duty "B" batteries—it cost nearly twice as much to make as the batteries it was designed to replace.) With the importance of cost now in mind, he designed a new, lighter, and cheaper steel battery case for his new employer. But here a typical Gernsback characteristic—one that was very valuable to him in his future career—came into play. His was not the plodding, painstaking approach of an engineer—he wanted to cut through to the final results without fussing too much with details along the way. Shipped to customers before being carefully tested for corrosion, the new batteries started to leak, customers began to return them, and his employer nearly went bankrupt before he could fire the brilliant young engineer.

Hugo and a friend were carrying on radio experiments, for which they had to import most of the necessary components from Europe. The two decided to start a small business and sell radio parts to fellow hobbyists. Thus the Electro Importing Co., the world's first company to specialize in radio materials, was born. From importing, it was only a step to manufacturing many of the components.

In 1906, the company sold the first radio ever offered to the public, advertising it in *Scientific American*. The *Telimco* Wireless Outfit (the name came from ELectro IMporting CO) was a spark transmitter and receiver with a range of about a mile, completely powered by three dry cells (two for the transmitter and one for the receiver). These and other company products were described in a small mail-order catalogue. (Early editions of that catalog are worth their weight in gold.) Because little was known of radio, lengthy explanations accompanied the description of any new item, and the explanations formed a considerable part of the catalogue. Hugo decided to start a magazine and put the technical information in it. So, in 1908, his first magazine, *Modern Electrics*, was born. In spite of the name, it was primarily a wireless magazine.



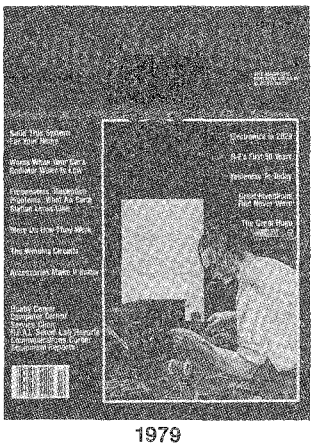
1908



1913

Later (in the early 'teens) he started the *Electrical Experimenter*, then *Radio News*, in 1918, and finally *Radio-Craft*, in 1929. (*Modern Electrics* was combined with a number of other magazines which finally became *Popular Science*; *Radio News*, after a few name and ownership changes is still published as *Popular Electronics*.)

1929

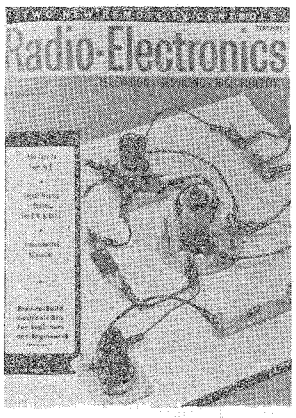

1979

Gernsback began his career as a prophet soon after starting his magazine. One of his first predictions was of the inevitability and necessity of television, and one of the articles in an early issue of *Modern Electrics* was entitled "Television and the Telephot." He was widely credited with inventing the word "television" but disclaimed the honor, saying that it had been used in France. (However, he was probably the first person to introduce the word to English.) In his book *Ralph 124C 41+* (serialized in *Modern Electrics* in 1911) he describes a televised opera in color, projected life-size on a wall made up of a mosaic of Telephots. The other predictions in that book read like a description of scientific progress through the first half of the 20th Century, and range from radar (his most famous prediction) through tape recording to night baseball.

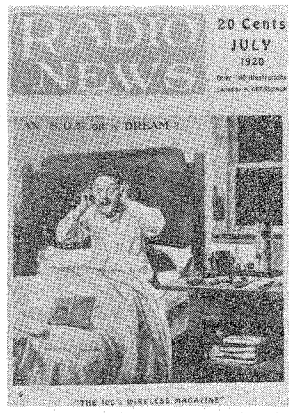
The *Electrical Experimenter*, Gernsback's chief magazine of the 'teens, was not so well adapted to scientific prediction, but *Radio News* (which reached its peak in the '20's) carried full-length articles—by Gernsback and other authors—describing the wonders (and often the absurdities) of the future. Two of the most important predictions in that magazine were the one-dial radio receiver (written when the better broadcast receivers had anywhere up to eleven controls) and the article, "Can We Radio the Planets?" in 1927. (When the results of the first Venus contact were announced by the Massachusetts Institute of Technology, the speaker began his report: "This was first proposed by Gernsback in 1927.")

Gernsback continued to press television, among other things as a useful instrument in war. An illustration for one of his articles shows a wall display of six large television screens, each looking at the same combat scene, from six different aerial viewpoints.

In *Radio-Craft*, Gernsback used his editorials to forecast the future. In November 1930 he assured his readers: "Television is coming to the home." The editorial listed 27 experimental stations broadcasting TV (almost all of them by the Jenkins scanning method). In 1933 he says again: "The radio of 1953 . . . will have a television faceplate." (Most people at the time thought of TV as merely an adjunct to the radio, with the TV sound of course going through the radio's audio amplifier—some receivers of the '30's had an input jack marked "TV.") Another prediction about the set of 1950 was not as fortunate: "The present broadcast band will probably be abandoned and stations will move to the higher frequencies."



1957



1920

In 1935 he predicted CB: "A two-way radio in tomorrow's car," and pointed out its value in accident cases. "A special frequency will be needed," he says, and it must be above 50 MHz.

Gernsback did not let his career as a publisher get in his way as a radio inventor and experimenter. He patented some 80 inventions in his career, none of which, he said, made him any money. (It is credibly reported, though, that Crosley paid him royalties for the "book condenser" used in one of the early Crosley sets. The patent was on compression-type variable capacitors, and ran out before the trimmer capacitor became common.) He described a bone-conduction hearing aid in at least three issues of his magazines, but when one was patented several years after his last article, he made no protest. "I never intended to manufacture it," he said. "Why should I bother someone else?"

Some of his circuits, notably the Interflex and the Peridyne, were published in *Radio News*. The Peridyne was the first circuit to use non-magnetic metal in the field of a coil, to trim it by reducing its inductance.

His last invention, which he did not patent, was a device for detecting the charge on an electret. The electret was placed on a sheet of metal, which was connected to one terminal of a small neon tube. The tube's other terminal was attached by a wire to a disc of sheet copper about the size of the electret. Moving the disc toward the electret produced a high voltage that caused the tube to flash.

But Gernsback's predictions remained the most important facet of his career. In later years they appeared in two forms: editorials in which he proposed, demanded, or showed how to achieve improvements in present equipment or practice, and in April Fool hoaxes, which described things a little too far out to be the subject of serious prediction. Those were realized, in fact, possibly as often as his more serious proposals. Automatic equipment testing, electronic sleep, and sound cancellation have all been patented, one within two years after it appeared as a hoax.

One of his most serious proposals, a computerized National Facts Center, on the other hand, may never be realized, because many fear invasion of privacy. And his most often reiterated prediction (or demand): television as a major means of education, is making slow progress, in spite of the obvious need for some better means of education than the traditional ones. Yet that was what Gernsback pushed most insistently, in numerous editorials, and even mailings to public officials, members of legislative bodies, and prominent individuals, from the President down. His multiple television receiver, which would permit a viewer to enjoy one program while keeping an eye on several others on small screens around the edge of the main one, is being manufactured in Belgium, but does not appear to be readily available.

So Hugo Gernsback may go down in history as a publisher—a science fiction and electronics publisher—rather than as a prophet. (Although, whenever a new development comes into being, there may always be someone to remember "Hugo Gernsback described this in 19—.") Founder of the first serious magazines for the radio hobbyist and professional technician, an editor who was more interested in explaining new things in language his readers could understand, than in promoting the latest models of his advertisers or in maintaining a "scholarly" publication, his magazines have been the stepping stones by which countless intelligent youngsters have made their way to careers in radio and other branches of electronics.

In science fiction he is the acknowledged master—so much so that the Oscar-type awards the science fiction associations give the year's leading science fiction author are called Hugos. Known in that field as the Father of Modern Science Fiction, he could equally well be called by electronics enthusiasts: the Father of Radio-Television publication. R-E

Hugo Gernsback was a true genius. Not only did he have the ability to cut through a mass of details to come to a conclusion, but showed up equally well when forced to handle difficulties of detail when they appeared. His ingenuity was fantastic. I picked up a little puzzle at a press conference by Pyramid Electronics—three or four small pieces that formed a pyramid when properly fitted together. It took me just three minutes to solve it. Then I took it to a person I considered about the smartest man on the staff. He worked with it for two minutes, then showed his intelligence by refusing to fool with it any longer. When I next took some editorial material to Hugo, I showed him the widget. Gernsback's time—40 seconds. *Fred Shunaman*

50 YEARS

continued from page 52

The January 1951 (Annual Television) cover shows CBS color television in action. The FCC had made a tentative decision favoring the system, but announced that other systems were being studied. That January issue also told of an FCC crackdown on an illegal TV repeater at Emporium, PA, a town ringed by high hills. The culprit was a large television and tube manufacturer. The term "TV" for television was used in the magazine for the first time in that news item.

Blind inventor and engineer Bob Gunderson was featured on the March 1951 cover, with one of the pieces of test equipment he designed for the blind.

Remarkable records were made in TV dx. Reception of more than 1000 miles was common. London's sound channel was received regularly in South Africa, and the picture seen occasionally. Station KPRC in Texas was heard all over the United States and abroad; the most fantastic report was from Manchester, England, *two years after the station had ceased transmitting!*

Radio astrology?

One midsummer 1951 article created some controversy. John Nelson, RCA Communications' propagation predictor, advised on the best routes for long-distance radio hops for a given contact. (Depending on weather, magnetic conditions, etc., the best transmission to distant stations might be around the world in one direction one week—the opposite direction the next week.) Working with various factors, he discovered that the angular position of the planets with respect to Earth had a strong effect on long-distance propagation, and used that factor in his predictions. Asked by reporters if this was not using astrology, he indignantly denied any connection. But later on—possibly after reading up on the astrologers' claims—he was heard to remark: "One thing you have to say for those old astrologers—they sure had the angles figured out right!"

A country is only as good as its schools," wrote Hugo Gernsback in the September 1951 issue, in one of his many editorials on education. Television, he felt, was the answer to upgrading teaching.

Radio-Electronics' only article on a CBS-type commercial color receiver was printed in the November 1951 issue. By the time the article appeared, the Korean situation had brought on a national emergency, and all color broadcasting was shut down. When the freeze lifted, the present NTSC color TV system had been approved, and CBS receivers were obsolete.

Fips, the master inventor, had been slowing down. His "Hypnotron" (electronic sleep inducer) was almost immedi-

ately announced by the Russians as a serious discovery. The "Electronic Brain Servicing," which appeared in the editorial for April 1950, was put on the market by Lavoie Labs a few years after that article appeared; and the masterful "Noise Neutralizer," in which he picked up office noise, reversed its phase, amplified it and retransmitted it into the office to produce quiet, was patented by Harry Olson of RCA within two years! (It would not be long before Hugo Gernsback submitted his official resignation as a prophet, saying "Two years ago I would not have dared predict that a hearing aid, complete with microphone, amplifier, and loudspeaking telephone, could within the next five years be made small enough to fit in the human ear. Yet today there are several on the market!")

In another editorial, Hugo stated that the public had never taken kindly to the term "transistor," and suggested the word "Crystron" instead. (He could not have predicted what the youth of the 1970's would call a small portable radio!)

An improved audio amplifier, called the Williamson, described in a construction article by M. Harvey Gernsback in 1949, made news in 1952. For a few years, no audiophile would dream of using another circuit.

Flyback squeal was another technical discovery of 1952. A letter from a service technician complaining about the 15,750-Hz whistle was printed—with some reservations: the man might have been a crackpot. The response left no doubt that the squeal existed and bothered many people. A complete article was compiled from letters received from those who suffered from this problem.

At this point, transistors were working up to 250 MHz. A new type of audio amplifier—an NPN and PNP transistor in-series for push-pull output—was announced. Television distribution systems were inaugurated with a two-set coupler.

Radio-Electronics began to serialize an internationally famous book on television, under the title: "Television, It's a Cinch!" The FCC adopted the NTSC television standards that gave us compatible television. RCA was already transmitting a few broadcasts using the new standards. Both RCA and Sylvania announced mass-production methods for printed circuits. Radios were really becoming smaller; Emerson had one measuring 6 x 3.5 x 1.25 inches.

Volume 24 of *Radio-Electronics* contained 15 issues. *Radio-Craft* had started in July 1929, and the volumes ran from July to June. War emergency shortages and consequent financial problems forced the elimination of a few issues, so that new volumes started with the October issue. To round off the year, the volume running in 1953 was extended to December, and the January 1954 issue was Volume 25, No. 1.

"The Most Useful (TV) Circuits of 1953" (was this an apology for dropping the data sheets?) appeared in that January issue. Five of the circuits were on two-page schematics. Four more appeared in the July 1954 issue.

The hi-fi boom

While high-fidelity sound started to become a new household word in the late 1940's, Joseph Marshall's "Golden Ear" department began, with Joe writing under the name of Monitor. He also contributed an occasional article under his own name. Associate Editor Dick Dorf, an organist, now the owner of Schober Organs, started a series on high-fidelity music.

Progress in 1955 was marked by the development of a hearing aid incorporated in a set of eyeglasses. Industrial electronics was making progress, a manufacturer of plastics was sentenced to a 30-day jail term for interfering on a military channel. The world's largest transmitter was installed at Jim Creek, WA. It provided power of more than a million watts with a frequency from 14 to 35 kHz. Its purpose was to communicate with submarines under water, among other things.

During the summer of 1955 we first heard of transistor radios being installed in Chrysler cars, with resultant great savings of current. Tropo-scatter, a new form of radio propagation, was the subject of the August cover and feature article. In the September issue, the article entitled "Making Printed Circuits is Easy" showed the hobbyist that he, too, could become a printed-circuit manufacturer.

The September cover represented a scene dating back to an April 1 story that outdid Ulysses Fips. April 1, 1955, two *Radio-Electronics* staff members made the classic journey to visit Dr. Fish at the Aquarium with the idea of getting a story on "fish talk" and an accompanying cover. The expedition was a success, and Dr. (Marie Poland) Fish, probably the world

authority on fish noises, supplied plenty of material for an informative story.

Color television took a sharp upturn in 1956, with a rapid increase in programming that made owning a color set worthwhile. Up to October 1955, there were no daytime color programs and few in the evenings. About 50,000 color sets had been manufactured by the end of the year. Prices were high—around $700 for the types that were readily available. Sets were becoming simpler—only 26 tubes now as against 37 in 1954.

Sylvania pioneered in industrial computer use. A large data center was constructed in Camillus, NY, to handle all data for the company's 10 divisions throughout the country, and even to write the paychecks for all its employees. The equipment was still very large—room-high rows of plug-in units to hold the computer's 58,000 tubes.

The 110-degree B-W picture tube—only 14 inches long instead of 21 inches long, was mentioned in the December 1956 issue, as was an improved light amplifier devised by RCA.

The "re-wash" tube racket made news in early 1957. *Radio-Electronics* had made a quiet study of the "surplus-tube" situation, buying and testing its advertisers' products, and adopted a policy of refusing to place ads for anyone who would not guarantee that all tubes were unused.

Information on a new amplifier—a maser operated at extremely low temperatures—appeared in the April 1957 issue. The signal-to-noise ratio was said to be 100 times greater than could be obtained by any other receiver.

Fifty years of consumer radio were celebrated in the June issue with a news item and a photograph of Hugo Gernsback presenting the Ford Museum one of the first radio sets sold to the public (in 1906-1907). A spark transmitter and receiver with a range of about a mile, the set received code signals with a coherer, and used an ordinary doorbell as its output device. The total price was $7.50.

A new associate editor, Larry Steckler, joined the magazine in the summer of 1957.

Stereo phonograph records were demonstrated at the Audio Engineering Society convention in the fall of 1957. London demonstrated the vertical-lateral technique, and Westrex presented the 45-45-degree technique.

Articles on transistors and transistor equipment outnumber stories on tubes and their related apparatus in the latter part of 1957. Tubes are still running neck-and-neck with solid-state devices in the construction articles.

FM comes into its own

FM started to come out of the cellar in 1958. Starting optimistically, FM broadcasting had increased its stations from about 150 in 1946 to 750 in 1949; then, because of the forced shift to the 88-108 MHz band, and the popularity of TV, it started a skid that bottomed out only in 1956, with about 525 stations still on the air. The receiving-set slump was more dramatic: 1.6 million sets were manufactured in 1948 and only about 200,000 in 1954. Production started climbing in 1955, and about a half-million sets were manufactured in 1957. An avalanche of applications for new station permits poured in to the FCC; and FM started to climb to its present favorable situation.

The first stereo disc was marketed late in 1957. (It was terrible!)

In 1958, St. Clare of Assisi became the patron saint of television, by proclamation of the Vatican. The designation was based upon St. Clare's vision, in Christmas 1252, of Midnight Mass being celebrated in the basilica of St. Francis, two miles away.

It was also in 1958 that Dr. Land of Polaroid pulled the props from under conventional color theory. Using only red and white light, he produced sensations of color that could not be explained by the three-primary approach.

Stereo came to the forefront in the March 1959 issue, with 15 articles on the subject. Several new stereo pickups had

already been described in the February issue, and even the annual April 1 hoax was about stereo . . . with a promise of four-dimensional stereo next year!

The October 1959 issue contained the first mention of electronic behavior modification. Dr. Delgado of Yale University reported that very weak electrical charges applied to selected parts of an ape's brain could elicit reactions of pain, rage, or pleasure.

Marked advances in electronic physics were described in the 1959 issues. The tunnel diode (invented by Esaki in 1958) was first described; so was the avalanche diode, as well as the nuvistor tube, then believed to be a revolutionary device. The fuel cell was first publicized, and magnetohydrodynamics was invented or discovered toward the end of the year. In the latter, a stream of gas is heated to create a conductor and then is passed between the poles of a magnet, producing electricity as any other conductor would.

Three-million-mile transmission

A new duplex record was set at the opening of the 1960 IRE convention in the New York Coliseum. A signal from New York was transmitted to the Jodrell Bank radiotelescope in England, which retransmitted it to the satellite Pioneer V (then 1.7 million miles away). Pioneer V then sent it back to New York, where it was amplified to produce the signal that opened the convention. Unfortunately, there was a snafu at the Coliseum itself. A worker accidentally kicked a plug out of a 120-volt socket, darkening the TV screens that were to show an oscillogram of the signal. The sound, which was carried on another circuit, was OK.

The June 1960 issue reported the opening of the world's most accurate time and frequency station, WWVL, at Boulder, CO, with a frequency of 20 kHz and a 20-kW power capability. The signals were 20 times as accurate as those of station WWV on a 20-MHz frequency.

The optical maser, or laser, was demonstrated by Bell Labs in October, 1959. Practical applications for this "coherent light" were then unknown. It was called "a wonderful solution for a problem not yet discovered."

In February 1960, Manfred von Ardenne, German pioneer in cathode-ray television and video amplifiers, proposed a new safety measure for automobile traffic. Citing the example of an aviator who fell half a mile into a haystack and suffered no more than a broken leg, he suggested a car in which occupants would ride facing backward in heavily padded seats mounted on sliders (similar to those used on some field guns) that would back into "braking material" in a crash or sudden stop. Three TV screens "ahead" of the driver would give him a 270-degree field of vision. The rear-view mirror would be a simple opening to the road behind.

Two more electronic advances—the Giaever two-way tunneling device and electric anesthesia—were revealed early in 1961, as well as a less-inspiring innovation; the use of hand-held portables in burglaries.

The September 1961 cover was possibly the most striking the magazine had ever printed. Showing only one side of the face of a young girl wearing a single earphone that contains a complete superheterodyne receiver, it attracted widespread attention and kept cropping up in ads until a much later date.

Lesser news items of 1961: Philco's Lansdale, PA plant and the CBS plants at Danvers and Newbury, CT stopped manufacturing vacuum tubes. And the man who started them in business, Dr. de

Forest, died on June 30. German electronic engineer Marlene Schmidt became Miss Universe. The first use of pulse-code modulation on subscriber telephone circuits was reported in the Newark-Passaic area of New Jersey. OSCAR—Orbiting Satellite Carrying Amateur Radio—the ham satellite, was launched in December.

In the February 1962 issue, Hugo Gernsback echoed the words of FCC Commissioner Minnow: ("Television is a Wasteland.") Television programs, he said, have "shrunk to an incredible low," turning off viewers and their sets. His remedy—canned TV Recordings, either in tape or disc format, already in experimental form, must be commercialized. Then, the viewer can buy his own programs and run them when he wants, seeing "worthwhile, adult television fare." (In 1962 "adult" and "pornographic" were not synonyms.)

The United States is brain-draining from Asia as well as Europe, the March 1962 issue stated. Dr. Esaki, inventor of the tunnel diode, was working in this country for IBM.

Dr. Fips (emulating the "tough guy" who "shaves with a blow-torch") invented for readers of the April issue a new cathode-ray shaver that burns the user's whiskers off.

Women are getting into electronics, stated the *Wall Street Journal*. Raytheon, the newspaper reported, has tripled its female staff. (Quantitatively, the breakthrough was not impressive—an increase from 3 to 10.) The Graeco-Schenectady vocabulary now exceeded 500 terms, from Accutron to Zyklotron. (Some terms like Shucktron—a device for removing oyster shells—were not electronic.)

Telstar, the first active communications satellite, was launched on July 10, 1962, and the September issue had a Telstar article. Voiceprinting was discovered.

Bell Labs developed an electret microphone (in telephone language—(transmitter) and earphone (receiver) early in 1963. Light-emitting diodes were on sale for $130 each from General Electric, according to the February 1963 issue, and Tappan started marketing a microwave oven range for home kitchens. Radar ranges had already been sold to restaurants, hotels, and similar institutions for some years.

A record for remote radio repair was set in 1963: Telstar, which had been out of order for six weeks, was repaired from the earth—a distance of 300 miles (average). The first weather satellite, TIROS, was launched. MOSFET (Metal-Oxide-Semiconductor-Field-Effect Transistor) technology was announced in the April issue.

The August 1963 editorial was written by Arthur Clarke, the scientist and science fiction author who was the first to predict satellite radio (in 1945). Expansion of satellite communications may lead to the day when anyone on earth may call anyone else by dialing a number; when businesses may abandon central offices (files will be replaced by "memory banks beneath the Arizona desert, the Mongolian steppes, the Labrador muskeg.") Earth's languages may drop to one or two, with present languages becoming local dialects.

Technicians were beginning to show great interest in color TV troubleshooting. There were eight articles on the subject and one on color-TV test equipment in the December 1963 issue.

In the January 1964 issue, Hugo Gernsback predicted a voice-operated typewriter, citing the pre-electronic work of Flowers, of RCA's Harry Olson, and of Count Dreyfus-Graf, who had progressed to the point where he could dictate readable Christmas cards.

"Biggest Telescope *in* the Earth" is the title of a February 1964 article. Scooped out of a natural hollow in the hills south of Arecibo, Puerto Rico, this spherical radio telescope, still in operation today, covered more than 18 acres, had a diameter of a thousand feet, and was 10,000 times as sensitive as the radio telescope in Millstone Hill, MA, that detected the first reflected signals from Venus. Radio astronomy scored another victory when Channel 37, important to radio astronomers, was withdrawn from television use and set aside for radio astronomy.

Joe Marshall, one of *Radio-Electronics'* most important audio authors, died on February 23, 1964. Aircraft designer Igor Seversky demonstrated an ion-powered craft that could lift itself off the ground—he claimed it could rise to 60 miles above sea level. Bell started commercial *Picturephone* service between New York, Chicago, and Washington, DC. The cost: $16 for three minutes. The first pictures of the moon, taken by the Ranger satellite from a thousand feet up, were shown. Pan-American Airways adopted inertial guidance for its entire fleet.

John Reinartz, the world's greatest ham operator, died on October 6.

New approach to editorials

Most of the 1965 editorials were written by guest writers. Struggling against his failing powers, Hugo Gernsback wanted only to write enough editorials to supply material for his last Christmas booklet, *Forecast—1966*. This he accomplished; and he wrote only one more editorial, "Fuel Cells", after finishing the booklet. The February 1965 editorial was written by John Pierce of Bell Labs, who suggested that the future might see a telephone in everyone's pocket.

Bob Middleton, in September, 1965, points out that fame often descends on the famous rather than the deserving. As examples, he cited the Wheatstone bridge, invented by Christie; the d'Arsonval galvanometer, invented by Pouillet, and Coulomb's Law, discovered by Cavendish.

The guest editor in January 1966 was David Lachenbruch, once associate editor of the magazine. In one more year or two, he said, probably all TV programs will be in color; all programs, but not all sets. As long as black-and-white sets are considerably cheaper, they will continue to be produced and sold in heavy volume.

The February editorial (written by managing editor Fred Shunaman) demonstrated a strange contradiction in U.S. law: This is the only civilized country in the world that cannot prevent a manufacturer from making and selling dangerous equipment, though the *buyer* can be put in jail for using it. And much harm can result before the user goes to jail! Interference expert Rexford Daniels tells of an electroencephalograph that sent people to mental institutions on the strength of signals picked up from a freight elevator in a hospital. A taxi dispatcher's message to a driver blew up a missile on the launching platform.

With the March issue, Fred Shunaman, who had edited the magazine for 23

years, left the publication. The April editorial "To Know an Editor" was written by Forest Belt, former editor of *Electronic Servicing*, a Sams publication.

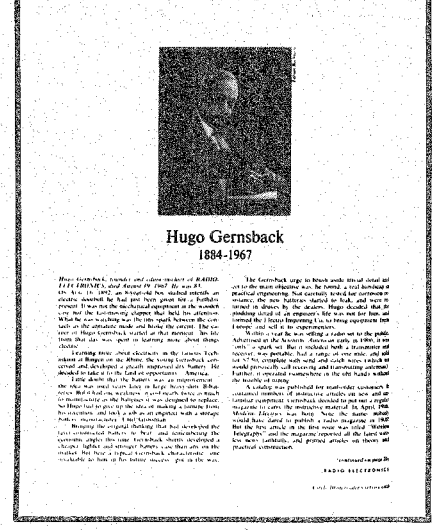
The July 1966 issue featured the new Marantz tuner—the world's most expensive, costing $750.

A European conference to decide on a common color TV system for Europe disbanded. Political instead of technical considerations dominated. Countries oriented toward France or Russia selected the line-sequential SECAM; the Germanic-oriented countries plumped for PAL, an improved NTSC. Several European countries planned to have color TV in 1967.

The use of fluid (nonelectronic) amplifiers in several industrial applications was reported in 1966. There was an explosion of automobile tape decks, with Bill Lear's 8-track tape gaining over the 4-track type. The first direct-dialed U.S.-Europe telephone call was reported; nine digits were needed for the transatlantic call.

January 1967 saw the first Pacific satellite go into action; it provided service between the United States and Hawaii, and the Orient. The vehicle was called "Lani," which is Hawaiian for "bird."

Construction stories became more sophisticated: in the August issue, one story showed you how to build a directional antenna with three towers, another was on an audio phase-shifter-rejector to eliminate whistles or other interference. (The unwanted signal is duplicated in opposite phase and nulled.)



Hugo Gernsback
1884-1967

The death of Hugo Gernsback, August 19, 1967, at age 83, was announced in the October issue.

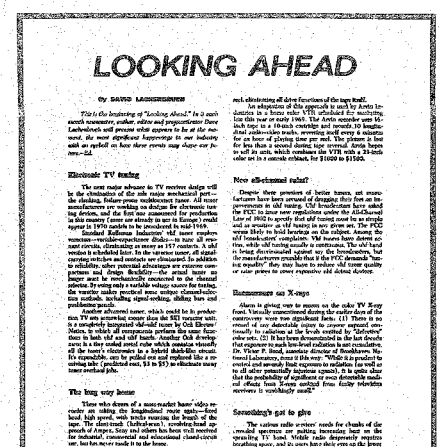
Stereo approaches 100%

During 1967, record companies stopped producing monophonic discs. British EMI led the way, and three U.S. companies announced that stereo and mono records would henceforth sell for the same price.

At the end of the year, Bob Cornell, formerly of *Radio and Television News*, was listed as the editor of *Radio-Electronics*.

The electret microphone (transmitter) was being used by Northern Electric in Canada's telephones, announced the March 1968 issue. (Only 20 years before, scientists had greeted the first story on electrets with skepticism and most considered it a hoax.)

A new department, "Looking Ahead," appeared in May. Not as futuristically minded as Gernsback, former associate editor Dave Lachenbruch, talked now



LOOKING AHEAD

about things on the horizon, which we might (or might not) be able to buy in the next year or two.

The summer of 1968 saw two changes in the *Radio-Electronics* organization. William Lyon MacLaughlin, staff artist from 1944, who created the distinctive *Radio-Electronics* schematic, died during the summer. Larry Steckler, who had been associate editor during the '50's, rejoined as editor, to conduct the magazine into the age of the computer.

Electrocution in hospitals was the subject of an April 1969 story. People were discovering that an MD degree does not make a person competent to handle the electric and electronic apparatus now becoming important in medical work. With electrodes placed on moistened skin (or even under it), fantastically small voltages became dangerous or lethal.

The ovonic bust

A press conference on ovonic devices triggered a sensation in early 1969. Held to announce the granting of patents in Troy, MI, far from the head offices of technical magazines and of dailies employing technical reporters, the press conference was attended by technically innocent journalists. Although ovonic devices had been manufactured in limited quantities for special applications for some years, the reporters hailed these amorphous semiconductor switches as something new and revolutionary that would probably replace the transistor at much lower cost. Prices of the stock jumped astronomically, and the manufacturer was (unjustly) blamed. (After the furor died down, the factory continued producing ovonic devices without any tremendous benefit from the spurt of publicity.)

A new reader section, "Technical Topics," conducted by technical editor Bob Scott, began in the June 1969 issue.

In October 1969, two Fairchild engineers made a unique suggestion: Since the TV tube is a display device, why not let it show the channel number as the station is tuned in? Furthermore, why not tune digitally, with varactor diodes in the tuner to bring in the desired channel without running through all the intermediate channels?

The November 1969 "New & Timely" (news) page was devoted to an article, "Automatic Tint Control" written by Bob Scott. Evidently, tint control was the big news of the season.

"Looking Ahead" in the January 1970 issue reported on television manufacturers' efforts to control X-rays. Their efforts were directed entirely toward the viewer's safety; nothing was said about that of the service technician, though at least one manufacturer's employees wore radiation badges. Yet a technicians' national conference at Waterbury, CT, had some sobering exhibits: Two technicians had suffered permanent eye damage during convergence tests; another had developed skin cancer on his left forearm, a result of habitually laying his arm down on top of the set while making adjustments.

Fires in TV receivers began to attract attention. The National Commission on Product Safety reported there were over 10,000 such fires annually.

A 1911 Gernsback prediction, the "magnetic tunnel," was being studied by Stanford University research scientists. A car levitated by magnetism could travel between New York and Washington in about an hour, they believed. But another Gernsback prediction was shown to be in error: In the early 1960's, Hugo was asked by reporters: "When will man reach the Moon, and would you like to go along?" His reply: "Before 1970, and I shall not be there." Now Hugo Gernsback *is* on the moon—a mountain on its dark side has been named "Mount Gernsback."

Four-channel stereo was demonstrated for the first time at the Audio Engineering Society convention in October, 1970. The listener's first impression: "Four-channel is very loud!"

Service technicians, according to the April 1971 issue, were beginning to strike back in protest against "one-way justice." Example: Customers had access to the Small Claims Court—the service organizations did not. They also protested police harassment when parked on a job. Unfair

warranty practices were the most grievous problem. (For example, one manufacturer who charged a walk-in customer $19.95 for a repair allowed a service shop only $7.50 for the same job.) RCA was the shining exception—warranty payments were identical to RCA's published rates for the same work.

"Which Way Does Current Flow?" was the subject of a discussion in the June 1971 issue, decades after everyone (well, almost everyone) thought it had been laid to rest. Audio author Mannie Horowitz held that today there is some justification for the "current flow" (positive to negative) approach, since the hole current in transistor circuits can be better expressed as current flow from positive to negative.

By December 1971, 37 percent of the TV sets, 63 percent of the phonographs, 92 percent of the radios, and 96 percent of the tape recorders purchased in the U.S. were foreign imports.

In 1972, projection TV began to be mentioned in connection with such names as Sony and Advent. Telegames were also mentioned for the first time; electronic captions on the TV screen for deaf viewers were proposed. RCA came up with its new 3-in-line, slotted-mask tube, which gets rid of most convergence problems. The transistor celebrated its 25th birthday. Calculators that sold for $200 just two years ago could be bought for half that price. Next year, according to the November 1972 issue, the little calculators would be available for less than $50.

Japanese taking first place?

"Looking Ahead" in the January 1973 issue stated that the Japanese were now technically ahead of us. One reason, said contributing editor Lachenbruch, may be that consumer electronics is the lifeblood of the Japanese electronics industry—in the United States, military and industrial electronics come first.

Bob Gerson took over Gernsback's old job for predicting the TV of the future. Ten years hence, he predicted the picture will be on the wall—with projection. The screen may be of liquid crystal, adjustable for use as a window at one end of the "opacity control" range—as a mirror at the other. The only other controls will be a station selector and a volume control. All other controls will be automatic. Satellites will transmit programs from all countries; CATV will provide a wide range of services—the TV set may become a home message center, and even receive and record calls when you are away from home.

Four-channel audio reached the point where an issue (March 1973) devoted six articles to the subject. School students, the May issue warned, were being exposed to dangerous radiation from lasers in the school science labs.

The August 1973 issue tells about the phase-locked loop for stereo detection. That appears to have been the first mention of the PLL, which became so much more prominent in the next few years.

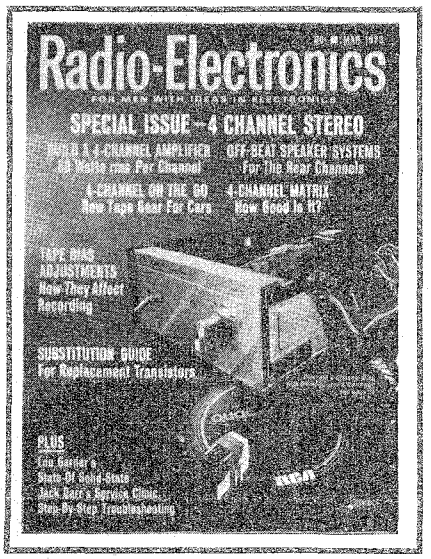
Harry Secor died at the age of 85. He had worked as an editor in the Gernsback organization—with two brief interruptions—for 54 years, retiring at age 80.

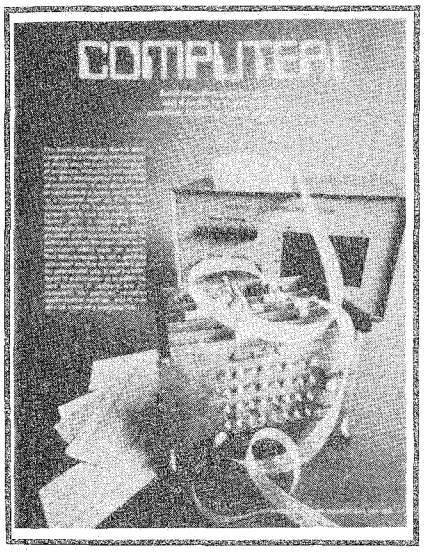
In the September 1973 issue, *Radio-Electronics* entered the space (and mark) age with the famous TV typewriter, which prompted such a flood of inquiries that the magazine had to publish a special reprint, with additional details and information. Thousands of these were mailed to readers, at $2 each. This was followed, in 1974 by the first computer article to be published anywhere. Again the demand was staggering at a $5 price.

A gift of 8 million dollars by audio manufacturer Avery Fisher to improve the acoustics of New York's Philharmonic Hall made news in the January 1974 issue. (The building became Avery Fisher Hall over Fisher's objections.)

Latest CB designs now showed a Channel 9 monitor to operate while the user is working on another channel; SSB receiver and transmitter; and automatic level control. The first electronic supermarket checkout-counter computer system was put into action in Cleveland. Bell researchers raised the temperature of niobium to 23.2 degrees Kelvin without losing its superconductivity.

Two important figures in the early electronics field died in 1975: William D. Coolidge, of ductile tungsten and high-voltage X-ray fame, died on February 3, at age 101; and E.F.W. Alexanderson, developer of the high-frequency alternator that was the most important high-power transmitter in the early years, died on May 14 at age 97.





If you haven't thrown out that old radio in the attic, don't, the October 1975 issue warned. An early-breadboard Atwater-Kent may sell for $200; some others may fetch nearly the same price. A new FM tuner (the *Sequerra*) was described by Len Feldman as worth every cent of its purchase price of $2500.

Citizens band rules were relaxed somewhat in 1975. The FCC began to recognize that CB is a hobby, and legalized the already universal practice of contact between different stations. It had previously tried to confine communication to a base and its auxiliaries. The first report of

cooperation between police and truckers via CB appeared in late 1975. Still bitterly at odds over speed limits and radar traps, both groups began to realize that they had a strong common interest in traffic safety. Police chiefs started to suggest that all police cars be equipped with CB radios.

The monopole magnet—a magnet with only an N or an S pole—in hibernation since the days of Ehrenhaft (1944-1945) surfaced again in the work scientists were conducting at the University of Houston, TX, and the University of California. The magnet would fit into electromagnetic theory so neatly that scientists were willing to believe that it existed with much less proof than might be required for some less-convenient discovery. The new particles the scientists hoped they had discovered fit in very well with the characteristics predicted by Dirac in 1931 for such a monopole, should it exist.

The impossibility of total recall in relation to defective equipment was demonstrated in the January 1976 issue, when Panasonic attempted to bring back some 240,000 TV sets from its customers' hands. The sets were to be inspected and modified to avert possible X-ray dangers. Of the 240,000 units, Panasonic was able to locate and modify only about 80,000; most of those were still in dealers' hands.

Increased efficiency does not always lead to profit. "TV is in a slump—the industry cannot supply the fantastic demand for CB equipment. So why not use idle TV factories to turn out CB?" The E.F. Johnson Company, for one, ordered 100,000 units to be produced at the Magnavox TV plant in Morristown, TN. The cumulative result was a general dumping of CB equipment in late 1977, as even the ever-increasing demand could not keep up with the vast oversupply.

Dangerous interference from TV games was reported from several areas. One game arcade blocked out the city's police communications system. There were 364 million TV sets in the world—more than 100 million of those in color. The U.S. had 58 million color sets and 63 million black-and-white sets. Brazil adopted a color system that would be compatible with both NTSC and its close relative, PAL. There were 196,000 service technicians in the country and 66,000 service shops. The National Bureau of Standards was looking for a definition of the word "portable" (some warranties specified that portable sets must be carried to the shop for servicing). The traditional definition, "anything with a handle" wouldn't do. RCA put out a TV receiver—in the XL-100 line—with no controls on the set; the unit was operated completely by remote control.

The Hugo Gernsback scholarship award (given to correspondence school students) presented to two women, Sally Knight and Mazine Anderson, indicated that the home-study schools were at last beginning to wake up to the vast potential market that this half of the country's population had to offer.

RCA's great Harrison (N.J.) receiving tube plant closed on July 30, 1976. Only 80 million tubes were manufactured in the U.S. in 1975—10 years ago the output was half a billion.

CB takes its great leap

The October 1976 issue revealed that CB channels had expanded to 40, effective January 1. The FCC stated that 23-channel CB sets would in no way be made obsolete by the expanded band. The long-proposed temporary licenses were authorized. A CB buyer could obtain his license at the store where he bought his set and could use his initials as call letters while waiting for his license to come through. The FCC reported that 85 percent of the 100,000 annual interference complaints they received were due to CB. More than 90 percent of all state police agencies are now cooperating with the CB-ers, and 36 states have installed CB radios in about half of all police vehicles.

Projection color TV finally arrived. Over four dozen models, made by 26 manufacturers, were on the market by the end of 1976. Only a half-dozen were definitely 3-tube projection-type sets. Cable TV viewers in Hastings, England, were receiving TV programs via optical cables, possibly the first use of optical cable in entertainment electronics. The British were also using optical cables in experimental telephone lines. Bell Telephone was now using bubble memories in subscriber message equipment. ("That number has been . . ." etc.)

The January 1978 issue told of a Belgian manufacturer who produced a set long predicted by Hugo Gernsback: At the press of a button, a small image of any desired channel appears in the upper left-hand corner of the screen. Thus, the viewer can see what's happening on the other channels without interrupting the program he is watching.

A Main Frame Round-Up replaced the Television Characteristics Charts that appeared regularly in *Radio-Electronics* not so many years ago. It ran through two 1978 issues and described 46 main frames. (Meanwhile, "Looking Ahead" listed the seven remaining U.S. TV manufacturers.)

The oscilloscope—taken for granted but receiving little space in the magazines—received due attention in a special 12-page section in the May 1978 issue. Triggered, delayed-sweep, dual-trace scopes were described and other scope features discussed in this section.

A portable tape player that speeds speech up to 2 and ½ times for playback—or that slows it down to 60 percent of the recording time if desired—was developed by the Variable Speech Control Company of San Francisco. This may help the problem of tape correspondence by bringing the time required to listen to a letter nearer to that in which it can be read. And the slowed-down transcriptions can be useful in following difficult technical descriptions or learning a language.

Television may be on the threshold of another period of transformation and advancement as the 1980's begin. Experts are beginning to say that our present standards are outmoded. Don Fink, who was a member of the NTSC committee that set up the present standards, so informed an IEEE luncheon, stating that a 1,000-line system, with a wide-screen aspect radio, would give TV viewers the equivalent of a 35-mm moving picture.

VCR's, Videodisc, and who knows what else are in their early days now. On the drawing boards are many other unique electronic devices. There is no question that electronics will become steadily more important to our everyday life and there is no question that Radio-Electronics will continue to keep its readers up to date. For a look at 2029, you'll want to read about the future of electronics, elsewhere in this issue. **R-E**

Author... Author!

In the long run, a magazine's value depends on the quality of its contents. And the contents, in turn, depend on the authors. Many of *Radio-Craft's* authors were developed by the magazine itself. Because of its specialized readership, that was a necessity. Neither the writer for the popular journals, nor for the engineering magazines, spoke the language of the technician-hobbyists who make up the bulk of *Radio-Craft*/**Radio-Electronics** readership.

So the magazine's authors have been to some extent a special breed. They have ranged from at least one semi-illiterate writer (whose only qualification was that he knew what he was talking about and could express it only in simple language) to heads of college physics departments.

The near-illiterate writer described the replacement of a part in series of short sentences, each beginning "I . . ." (i.e., I unsoldered the three wires to the part. I removed the nut holding it to the panel . . . etc.). We printed the item in more conventional form, and should have saved the original as an example in the use of simple English. But nobody thought it was possible to forget it—and so we did!

When a person submitted even a short technical hint that showed compatibility with the *Radio-Craft* style and seemed able to put his thoughts in writing, he was encouraged. He would then sometimes come back with a longer article, which was often returned to him with suggestions that he rewrite it. Even outright rejections were regularly returned with detailed suggestions. (One author and, later, teacher of technical writing, Allan Lytel, told his class: "*Radio-Craft* is the only magazine whose rejections are sometimes longer than the article.")

It was through a rejection that Jack Darr came to the magazine. His first contribution was returned with the comment; "It is worth about $35 to us, but if we accept it at that price you will probably never send another one." Correspondence continued to the point of planning a coherent series on television servicing, and his contributions increased until he became the Service Editor.

One of the steps in developing authors is to encourage reader-correspondents to think for themselves. That sometimes fails. (One correspondent wrote: "This is a new low in reader service!") On one occasion it paid off beautifully. Otto Wooley, who had occasionally supplied short hints and "kinks," asked a question that went something like: "The circuit calls for a 70-mA choke. I have a 75-mA choke, can I use it?" Especially jolted because the reader had been a semi-author, we reprimanded him mildly and called his attention to a few of the electronic facts of life.

We got no reply from Wooley, and were about to consider him another case where we'd been too "helpful," when a manuscript arrived—his first full-length story. He went right through the circuit of a small receiver, showing what parts values were critical and in what locations large variations could be tolerated. ("The RF screen bypass could be any value from .02 to 2.0 μF without making any noticeable difference.")

The story was just what we needed, and we printed it under the title "Circuitry and Common Sense." Apparently, other editors also needed such a story because it was reprinted in almost every country in the world! We saw it first in the magazines with which we exchanged publications. Then, magazines we had never known existed mailed us copies with the article, including the only radio magazine in Turkish that we had ever seen.

Once he learned that he could write, Wooley contributed several other articles until his early death (related to injuries received in World War II).

Another unexpectedly developed author was a young German, Otto von Gericke, who sent in a hint that was interesting but not as interesting as his name. When we printed his suggestion, we used the ancient spelling of his name—Otto von Guericke. He came right back and admitted he was a descendent of the man who—because of his early work in producing a vacuum—he called the father of electronics. Later, he contributed a number of useful articles.

There are other ways of obtaining good material. The television issue of 1965 carried an article entitled "World Television," written by E. Aisberg (the world's foremost radio-television author, whose book *Television—It's a Cinch*, has been translated into 22 languages). Aisberg suggested that some Europeans translate the initials of the American system, NTSC, as "Never Twice the Same Color." RCA indignantly demanded equal time and was mildly surprised that **Radio-Electronics** seemed so willing to open its pages for a rebuttal (by one of their top scientists, who otherwise would never have "had the time" to prepare an article for the magazine).

Unexpected talent sometimes lurks under our very noses. The Question Box editor, Schendel, wrote a "Letter to the Editor" that concerned service technician licensing. We needed a story on licensing, so sent him all the notes we had been gathering on the subject and asked him to write an article. He responded with a reasonably good story. Then, some months later he sent in two excellent articles on iron-cored components—magnetic circuits, a subject on which few are competent to write but on which he was an expert. We immediately sent a talent-scouting questionnaire to all our authors!

Once in a while, one author breeds another. An article from a young woman started out: "Whenever I need a little extra money, my husband asks, 'Why don't you write an article, like I do?' " So she wrote a story on the special problems of radiomen's wives, whose husbands work hard in the radio shop all day and experiment with new circuits or talk to Timbuctoo all night, and sent it to the magazine her husband wrote for. The story was not particularly complimentary to the craft, and even went so far as to suggest that radiomen's families tend to be smaller than the national average. Next time our author appeared in the office, we complimented him on his wife's work, but his replies were in monosyllables. We wondered just what was the cumulative effect of his well-meant suggestion on his family life! **R-E**