WISDOM

V. F
Electronics

THE MAGAZINE OF KNOWLEDGE AND EDUCATION

SPECIAL EDITION

THE UNIVERSE OF DAVID SARNOFF

radio • television • communications • electronics • research

BRIG. GENERAL DAVID SARNOFF
Portrait by Karsh of Ottawa

TWENTY-SECOND ISSUE
TWO DOLLARS

We need another fifty years of David Sarnoff's service and great contributions to science, industry and our country as a whole.

HERBERT HOOVER

I congratulate David Sarnoff personally for splendid leadership. His organization throughout the years has created new wonders and brought into being new services in all phases of radio activity for the benefit of the American people and for people everywhere.

I wish David Sarnoff continued success in pioneering. With television as a new postwar industry of great promise in the fields of employment, entertainment and education, I know that under his guidance and vision RCA will continue to contribute to the economic and cultural values created by radio.

FRANKLIN D. ROOSEVELT

For exceptionally meritorious conduct in the performance of outstanding services to the United States, Mr. Sarnoff placed the full resources of his company at the disposal of the Army whenever needed, regardless of the additional burden imposed upon his organization. He encouraged key personnel to enter the service, and at his direction engineers and technicians rendered special assistance on numerous complex communications problems. He fostered electronic advances which were adapted to military needs with highly beneficial results. The wholehearted spirit of cooperation which Mr. Sarnoff inculcated in his subordinates was of inestimable value to the war effort.

Through his leadership in American industrial life and in science, he has contributed immensely to the growth of America and its pre-eminence in communication.

HARRY S. TRUMAN

The Golden Anniversary, marking General David Sarnoff's fifty years in the field of radio, television and electronics, is made brilliant by his leadership and great contributions in the science, art and industry of communications. He has established an outstanding record of service to the American people and to the Nation. He has helped greatly to bulwark the pre-eminence of the United States in electronics and world-wide communications.

With all who know him I join in congratulations on his splendid record of achievements made possible by hard work and steady adherence to high ideals and American traditions.

DWIGHT D. EISENHOWER

WISDOM

THE MAGAZINE OF KNOWLEDGE AND EDUCATION

WISDOM PAYS TRIBUTE

TO AN AMERICAN GENIUS

The WISDOM MAGAZINE AWARD OF HONOR *is bestowed upon* BRIG. GENERAL DAVID SARNOFF *by* LEON GUTTERMAN, *Editor and Publisher, for "Significant Contributions to Knowledge and Distinguished Service to Mankind."*

THIS issue of WISDOM honors the great mind and extraordinary achievements of a courageous American pioneer whose explorations into the vast worlds of time and space have immeasurably enriched our civilization. To the miracles of modern communications, radio, television, electronics, and scientific research, no single individual the world over has contributed more brilliantly or with greater foresight than David Sarnoff.

For what name is more eminent in the communication arts and sciences? Industrialist, scientist, researcher, philosopher, soldier, public-spirited citizen, philanthropist, prophet of scientific progress, and benefactor of mankind, he has mastered the art of harnessing the mysteries of science for the betterment of man's destiny. A rare combination—a dreamer and a doer—his wise and courageous leadership and vision have inspired scientists, inventors, engineers, and research men to extend their knowledge in many fields.

Always a pioneer, always looking ahead, and blessed with the spirit of adventure, David Sarnoff has blazed a path of progress across half a century to help mankind. Blessed with ideas of incalculable magnitude, his tremendous mind has ranged the universe, seeking new conquests, new truth, opening new worlds to civilization and humanity. Continually scanning the vast frontiers from wireless to electronics, from radio to television, he has electronically extended the worlds of sound across the hemispheres, thus illuminating this century and our culture.

David Sarnoff exemplifies the highest tradition of our country. He has proved valiant in defense of our country and its ideals. His inventive genius and industrial leadership, fired by his glowing patriotism, were of inestimable value to the nation's security, as indeed they still are. His devotion to America in peace and war has served as an outstanding example to all Americans. He has been unstinting in his effort to bring to the American people a realization of the urgent need for the universal tolerance of human freedoms.

His life of service to the nation and his contributions to the world have been wide in scope, outstanding in quality, and enduring in significance. Through example and precept, and measured by the highest standard of intellectual integrity, he has furnished an inspiring example of notable leadership for his fellow Americans and especially for the youth of our country. His accomplishments, his extraordinary thinking, and contributions to the 20th century wonders of science have won the admiration, esteem, and gratitude of all America and untold millions the world over.

WISDOM now adds its own tribute to this great humanitarian of our time from whose wisdom, knowledge, and achievements all mankind will benefit forever.

Leon Gutterman

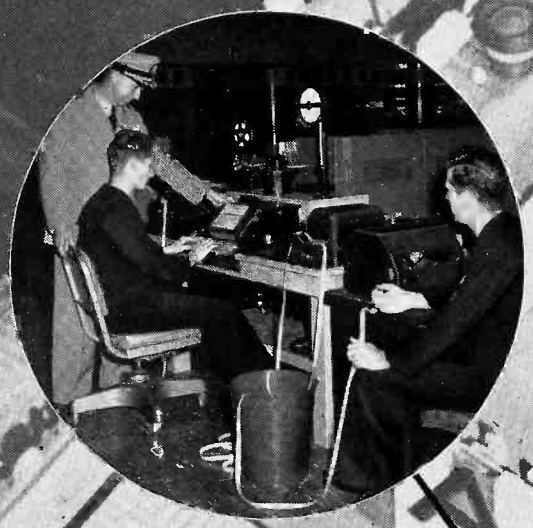
EDITOR AND PUBLISHER

EXECUTIVE AND EDITORIAL OFFICES—8800 WILSHIRE BOULEVARD, BEVERLY HILLS, CALIFORNIA

WISDOM MAGAZINE is published by The Wisdom Society For The Advancement Of Knowledge, Learning And Research In Education. Second-Class mail privileges authorized at Beverly Hills, California, Post Office. Additional entry Chicago, Illinois, Post Office.

WISDOM is available only by membership in The Wisdom Society. **MEMBERSHIP:** 1 year, $15—includes WISDOM MAGAZINE (United States, Possessions and Canada). Other Countries—$25. Single copies $2—direct from The Society. Membership payable in advance by check or money order. **CHANGE OF ADDRESS:** At least one month before a change is to take effect, please send us your name and new address (including your zone number) together with your complete old address and serial number from a mailing label. Duplicate copies cannot be sent. **POSTMASTER:** Send notification regarding undeliverable magazines to WISDOM MAGAZINE, Beverly Hills, California. **CONTRIBUTIONS:** WISDOM assumes no responsibility for unsolicited manuscripts and photographs.

THE UNIVERSE OF DAVID SARNOFF



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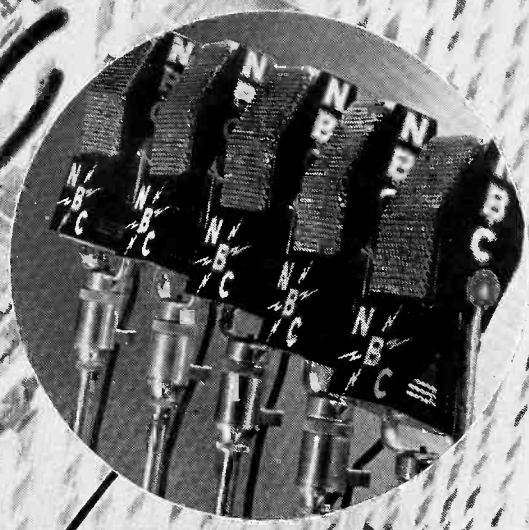

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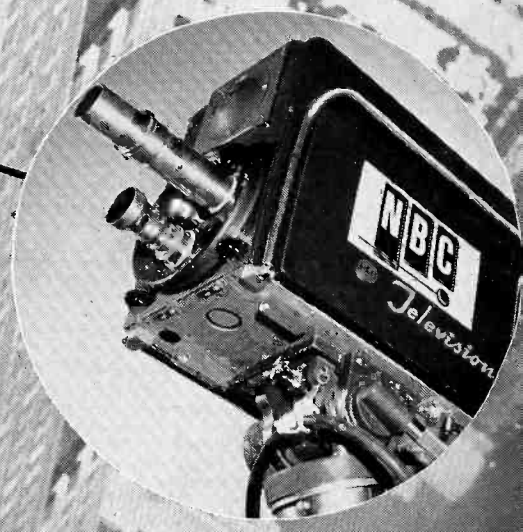

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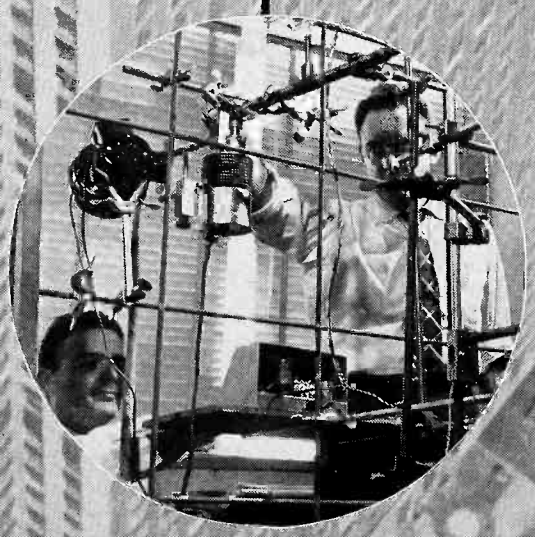


SCIENTIFIC RESEARCH

"I must confess to a feeling of profound humility in the presence of a universe which transcends us at almost every point. I feel like a child who while playing by the seashore has found a few bright colored shells and a few pebbles while the whole vast ocean of truth stretches out almost untouched and unruffled before my eager fingers."

ISAAC NEWTON

AS ONE REVIEWS THE PAGES OF RECORDED HISTORY, he finds that each century has produced a few individuals who, because providence seems to have lavished upon them extraordinary qualities of heart and mind, appear from the beginning to be destined to lead their fellow men, to be the nucleus about which the progress of their eras revolve, and to plan and to build unselfishly for a world of tomorrows that they themselves may never see except in their own courageous and teeming imaginations. These have been called *the great* of their time.

The great men of history, those who have planned and built and lighted the way for mankind's progress, have generally been distinguished by at least three essential qualities. They have had an awareness of and an appreciation for the past; they have held a bold and imaginative vision of the future; and they have had the aggressiveness and stamina to work tirelessly and selflessly in the present, molding and transforming *past* and *present* into *future*.

They are the ones for whom time and place do not exist in the same sense that they do for their contemporaries; and without their visions, their foresight, their willingness to persevere and sacrifice, little practical progress could have been made.

In our own century, such a man is Brigadier General David Sarnoff. His career in the worlds of radio, communications, television and electronics has, even in his own lifetime, been described as legendary. The description is more accurate than not, however, for legend is generally the product of imagination, and Sarnoff's career represents the results of the boldest type of imaginative thinking. Never content to be described "a man ahead of his time," General Sarnoff has planned and worked consistently, using his vast intellectual and material resources, to help bring the times abreast of the dreams he knew could be brought to reality.

In order to accomplish the realization of his dreams, one must act with courage where others fear to act at all; he must see cities and men and progress where others see nothing; he must contend against a myriad of obstacles, not the least of which is the suspicion and opposition of those who mistrust *innovations*, *impossible ideas* and *change*. Yet General Sarnoff's accomplishments have all tended to be in the very forefront of what at the time was considered *the impossible* and which today is taken as a matter of course.

In the year 1915, he conceived radio receiver sets for the home; in the late twenties and early thirties, he was working on television and his creative imagination envisioned sets for the home. As each of his dreams was realized and took its place in everyday life, Sarnoff, not content with accomplishments of the past, was looking ahead. Today he is as far ahead of his time in the world of the atom and electron as he was with radio in 1915 and television in the 20s and 30s. Though his thoughts and ideas sound as if they belong in a science-fiction world, Sarnoff is able to speak of seeming impossibilities with the confident assurance and absolute conviction of a man who has made many science *fictions* become *facts*, and who firmly believes that anything man can think man can do.

Thinking and *doing* are old companions of Sarnoff's. His grasp and understanding of complex systems in the field of electronics is a constant source of amazement to his associates. And in view of the fact that Sarnoff has had little or no formal training in the intricate world of the electron, his ability to not only understand and work with difficult electronic problems, but to teach and explain them to others, borders on genius. The General's particular talent is to see an area, an activity or a problem where the electron might be of service, to imagine the electronic device or system that might fill the need, and then to explain it to his associates who carry out its execution. Nor are such projects merely unfeasible chimeras or demands on Sarnoff's part. They are the result of a thorough understanding of the principles governing electronics and a realization, as a result of this knowledge, of the tremendous work potential of the electron. For the electron has always been the General's "guiding star" and his particular working medium.

Normally, General Sarnoff speaks in low, scholarly tones and with the reserve of a British peer; however, on the subject of the electron, his voice becomes more intense and his manner more animated as his thoughts roam through a world he loves and knows well and that is peopled with a thousand possibilities which, as yet, only he and a few others regard as actualities in fact. He speaks of the electron and the atom almost with the same affection that an ardent sportsman might speak of a favorite horse or dog. Towards the electron he feels a particular affinity.

"I had nothing to do with discovering the electron," he says almost regretfully, "But it so happens that the electron and I grew up together. It was discovered by a British physicist about 1895 and I was born in 1891." Sarnoff likes to point out that the electron is the smallest particle of nature known to man, an interesting thought in view of the fact that, utilizing this infinitesimal particle, he has been instrumental in bringing about the most striking and dramatic changes in the daily living habits of mankind; he has enabled his contemporaries to revaluate completely their concepts of time and space and communication. His early appreciation of the power and importance of the electron has enabled him to harness one of the basic forces of the universe and use it with prophetic understanding.

From his offices on the 53rd floor of the RCA building in New York, David Sarnoff looks over a vast city he first came to as a boy of 9 years from a small village in the Russian province of Minsk. Many wonder what this ruler of an extensive business empire, this genius of the electron is really like. Those who know the General and have worked with him know that he is frankly impatient with the stereotyped picture of the "great tycoon." His routine is calm and efficient, his offices — equipped with the latest electronic devices in all the fields of communications — are deceptively quiet, his desk is uncluttered and a sense of dignity and decorum prevails.

Sarnoff regards himself as a man with a job. Never one for the ostentatious, or even quiet flamboyancy, usually indigenous to "position", he works with the determination of a man whose constructive imagination has revealed to him a multitude of challenges and outlined vast projects to be accomplished, more perhaps than any one person could hope to effect in one lifetime. Living in his own mental universe which knows neither time nor space, he is totally unconcerned with trivia. But this does not really explain the man. To understand him, it is necessary first to realize the milieu, the forces and influences that produced him.

The lot of the immigrant from the comparative quiet of a small European village to a new, bustling, highly competitive land is never easy. It is particularly difficult if the immigrant is a young boy, like David Sarnoff, fresh from the idealism of Talmudic studies, unable to speak the language of his new environment, hampered by poverty and forced to compete for a livelihood in an often merciless man's world. The mantle of responsibility, one which David Sarnoff has worn — even cherished — throughout his life was settled upon him at an age when other young boys are still preoccupied with the happy vagaries of childhood. At the age of 10, young David, because of the illness of his father, became the head and sole support of his family, which, in addition to his mother and father, included three younger brothers and a sister.

The young immigrant boy arose early in his East Side tenement home, sold newspapers, managed to attend school, worked after school and studied late into the night. Certainly, Sarnoff's early days are not unique by any means; one might even say that they are proverbial in the lore of early 20th century America. Yet, there is an important difference in the case of David Sarnoff.

The source of this difference is in the character of the man himself. If amazement is expressed to General Sarnoff that he was able to accomplish so much, so young and under great handicaps, he is genuinely unable to understand. "Difficult," explained one of Sarnoff's associates, "is a word that does not exist in the General's vocabulary. After all, his work and his accomplishments have all been in the realm of the 'difficult' and the 'impossible'. He knows no other type of endeavor. As far as the General is concerned, 'easy things' are done by other people."

What might have staggered a lesser character at this stage in life, young Sarnoff took with a precocious philosophical insight, to be the struggle of life itself. What to others appeared to be insurmountable difficulties, served only to harden and temper the mettle of his character and to set in motion the dynamic *thinking* and *doing* powers which characterize him today. Even if the circumstances of his early days in America had been different, it is not likely that Sarnoff would have been content to rest more and do less. The essential character of the man would have expressed itself regardless of his circumstances, for as he has remarked, "I do not think that a man, any man, begins to reach for the stars or the moon simply because he makes up his mind to do so; he cannot do otherwise. In a real sense, he cannot help himself."

The obstacles and pressures that Sarnoff experienced in his early youth acted as a catalyst for the process, already at work within him, that enabled the boy to begin his "reach for the stars." A persistent, obstinate consciousness of the vastness of the unexplored worlds of human endeavor, still vague and unclear in his mind, began to insinuate itself to him. He would do he knew not what; he would explore worlds the existence of which he as yet only suspected; he would build and plan things which he did not yet know. Young David could not have named it then, but his restlessness, his visions, his yearnings, his need to be actively engaged in productive work was the beginning of the creative ferment characteristic of the poet, the philosopher, the painter, the builder — the men whose genius leaves an impress on history.

The General quite clearly dislikes the "Horatio Alger" appellation as it is applied to the individual successes of prominent men; he particularly does not like it applied to his own career. When one is able to see clearly into the true nature of human endeavor, to understand the processes and the qualities through which men accomplish noteworthy things, the less he is willing to admit to the necessity of a particular background, a particular set of circumstances or to luck. "Rags to riches," in the sense that it implies a spectacular rise from poverty to princely wealth, has no meaning in the General's understanding. A man such as Sarnoff, rich always in qualities of mind, in natural insight and in faith in himself and his ability to reach and realize the selfless magnitude of his visions does not consider himself in the presence of poverty when he lacks material comforts. And Sarnoff, by the standards usually applied to such an industrial titan, and in view of his accomplishments and the vastness of the company he controls, is not a wealthy man. To term him an "Horatio Alger" is to misunderstand facts and to misinterpret the forces that impel and spur a gifted individual on to accomplishment. Success and reward for effort have entirely different meanings in the General's frame of reference than is usually applied to them.

"Success," the General has said, "results when a man has the opportunity to express unimpeded the forces within him, whatever they may be; to be able to develop and enjoy these forces is the greatest measure of success. And wealth is not an evidence of success, contrary to popular opinion, nor is its possession an evidence of achievement." Sarnoff has always believed that the pursuit of success could more accurately be called the pursuit of achievement, for, properly understood, only achievement is happiness or success. The General makes it quite clear that whether one captured *happiness* in the popular sense of the word in such a pursuit is quite beside the point. Neither has the mere acquisition of wealth ever been one of the General's goals, and he is heartily contemptuous of this as a *motive* for anything. He is just as eloquent, however, that "the labourer is worthy of his hire."

Sarnoff views all human endeavor in the same way; he will argue that the philosopher's thoughts roam the world of the abstract unknown because they *must* and because a love of truth spurs him on; that the poet builds his poem because his sensitivities and emotions force him to do so, and because he wishes to share his intuitive awareness with his fellow men; that the musician creates or plays great music because he *must*, and also because of a desire to express and share such beauty and inspiration.

One should not, Sarnoff feels, distinguish between the motives, purposes and methods of any creative activity — in essence it is all one. Thus the inventor, the scientist, the builder share with the poet, the philosopher and the musician or painter the divine impulse to create. These things exist because they must, and not because anyone expects material gain from them primarily or whether they will necessarily benefit mankind. This has been the view which General Sarnoff has always taken of his own achievements. It explains in part his modesty and lack of undue pride in the things which he has done. Yet, underlying all this is perhaps one of the most pronounced and dominant of the General's characteristics — a deep and almost philosophical altruism. He has sought always to use his great powers of mind, the gifts that have been so generously bestowed upon him, for the betterment of humanity.

When asked to describe what he felt would be the best advice to a young man just beginning a career, the General replied thoughtfully, "Well, I would say to him to work and live in such a manner as to be able to serve others, to plan so as to be able to advance something, to achieve so as to leave the world a little better than he found it, and, finally, to garner for himself as much peace of mind, which is happiness, as he possibly can." This has,

in effect, been the General's formula throughout his own life.

Sarnoff began his now illustrious career in the world of radio and electronics in 1906 when, at the age of 15, he applied for a job as an operator with the Marconi Wireless Telegraph Company of America and was offered, and accepted, a position as office boy instead. In two years, through perseverance and practice with the telegraph key and the Morse code, Sarnoff managed at last to become a wireless operator. The rest is history. On the night of April 14, 1912, David Sarnoff was on duty at the Marconi station atop Wanamaker's Department Store in New York and was the first to receive the news of the sinking of the ill-fated liner *S. S. TITANIC*, with a loss of over 1500 lives. Sarnoff remained at his telegraph key for 72 consecutive hours receiving names of survivors as they were taken aboard rescue vessels, and he did not leave his post until the last name was recorded, promptly making the information available to an anxious world. During that time, President Taft personally ordered all other wireless stations to stop transmitting in order to prevent interference.

As a result of the *TITANIC* disaster, the role of radio communication could no longer be minimized, and the growth of the Marconi company was phenomenal. Sarnoff's position in the company from that moment on took on importance. The expansion of the radio industry in the periods immediately preceding and succeeding World War I was stormy, turbulent and confused, but grow it did and Sarnoff grew with it. In 1917, he became commercial manager for the Marconi company, and when his firm was absorbed in 1919 by the newly formed Radio Corporation of America, he became commercial manager for that corporation.

This new situation offered him opportunity that he had not had with the Marconi Company. Although individual pioneers in wireless had been working with the idea of commercial broadcasting, and some had in fact succeeded in transmitting radio programs as early as 1910, it remained for General Sarnoff to visualize and set in motion the factors which were to result in a commercially feasible radio industry. Working with what he already knew of wireless transmitting, the telephone and electronic amplification, he conceived of an instrument he called the *radio music box*. The idea had been in his mind for some time before. In 1916, he had proposed the idea to his superiors at the Marconi company. His now-famous memo, which outlined in detail radio broadcasting as we know it today, read in part:

> "I have in mind a plan of development which would make radio a 'household utility' in the same sense as the piano or phonograph. The idea is to bring music into the house by wireless. The receiver can be designed in the form of a simple *radio music box* and arranged for several different wavelengths, which should be changeable with the throwing of a single switch or pressing of a single button.
>
> The *radio music box* can be supplied with amplifying tubes and a loudspeaker telephone, all of which can be neatly mounted in one box. The box can be placed on a table in the parlor or living room, the switch set accordingly and the transmitted music received."

To a generation used only to the inadequate, manually operated *talking-machine* phonograph, the idea of an electrically operated *music box* was fantastic. Although Sarnoff knew the radio to be feasible, the officers of the Marconi company did not. They dismissed the idea as a wild scheme. When he joined RCA, he continued to cherish the idea, and in 1920, he resubmitted it, this time to the Chairman of the Board of the new company. His answer came in the form of an allowance of $2,000.00 for the development of a commercially workable home radio receiver.

One of the General's characteristics is to see a project such as this in all its aspects and ramifications. He not only detailed answers to technical problems involved in producing the radio, but he explored the sales possibilities as well, estimating that the initial demand, over a three year period, for the new *radio music boxes* would necessitate the production of approximately 1,000,000 sets. He informed his superiors that the sets could be built and sold at a price of $75.00 and, consequently, that a volume of $75,000,000 could be expected within that period. When the set was actually marketed, the sales for the three year period amounted to $83,000,000 — the General's original estimate as to the public acceptance of his first great technological discovery proving amazingly accurate. That he was able to predict at all the commercial value of an instrument so radically new, so completely beyond the conception of most people indicates Sarnoff's great talent for keeping a mental finger on the pulse of possibility. His urging and promoting of radio at that time seemed to many of his business associates intrepid and not worth the gamble involved. But the General and RCA, once having conceived the idea and transformed it into actuality, never considered that *the time was not right.* The combination of Sarnoff's knowledge of the practicability of his idea and RCA's faith in his vision initiated then a working relationship that has never flagged, and one which has remained as a high standard to all American industry.

Shortly after the *radio music box* idea was submitted, Sarnoff was promoted to General Manager of RCA in 1921 and in 1923 he became Vice-President and General Manager. His rapid rise through the ranks at RCA is still one of the most spectacular and talked about achievements in industrial history.

At the age of 39, David Sarnoff became President of RCA, but his youth was more than compensated by a reputation for probity and sagacity, and by a saving talent for eliciting trust and affection from his associates, most of whom were usually much older than he.

Prior to the mass distribution of home radio sets, the broadcasting industry had been confined to technical and business uses. What little broadcasting for entertainment there was, had been done strictly on a local level. Sarnoff saw the possibility of placing radio entertainment in homes all across the country. If radio was to progress, if the new blessing was to continue its growth, a complete revaluation of broadcasting was necessary. In a letter dated June 17, 1922 to E. W. Rice, Jr., Chairman of the Board of General Electric, which then controlled RCA, Sarnoff proposed a bold new plan:

> ". . . it seems to me that in seeking a solution to the broadcasting problem, we must recognize that the answer must be along national rather than local lines for the problem is distinctly a national one . . . I think that the principal elements of broadcasting service are entertainment, information and education, with emphasis on the first feature — entertainment; although not underestimating the importance of the other two elements . . . The service to be rendered distinctly calls for a specialized organization with a competent staff capable of meeting the necessities of the situation. Let us organize a separate and distinct company, to be known as the Public Service Broadcasting Company, or American Radio Broadcasting Company, or some similar name."

Four years later, largely as a result of Sarnoff's efforts, the National Broadcasting Company — NBC — was organized as a service of RCA *to provide the best programs available for broadcasting in the United States.*

General Sarnoff had lived with the idea of radio as a reality in his mind for so long prior to its actual production that, by the time it was beginning to come into use and while the public was still fascinated by the new marvel, it had become, one could say, "old hat" to him. Although he could not be free of the tasks that remained in building the radio and broadcasting industry to the point where it was delivering the potential of which he knew it was capable, Sarnoff was thinking ahead. There were new and bigger

and more spectacular things taking form in his thoughts. He visualized radio communications over long distances and was already thinking in terms of the short-wave radio, long before scientists were fully aware of the great possibilities involved. Sarnoff knew that professional engineers disagreed with him and did not share his enthusiasm or belief that such communication was possible as he had outlined it. But Sarnoff, once he has become convinced of the feasibility of one of his ideas — and this is no mere intuitive process — does not capitulate to objections. To the skepticism of the engineers, his assured reply was, "I doubt whether a careful and exhaustive research has been made on this point."

The period during the 20s and 30s was one of tremendous activity and import. Old conceptions were being overthrown and new and bold ideas were beginning to take their places. The new communications industry and the public in general were beginning to listen to ideas which had sounded chimerical and impractical with a growing respect; the advances in radio and broadcasting had taught them much. Sarnoff continued unperturbed to prophesy and deliver fascinating innovations.

The advent of radio heralded, in the view of many observers, the end of the recorded music industry. Sarnoff replied "not so," and instead talked of a radio-phonograph combination, seeing in the two mediums a unique compatibility of purpose. In 1929, RCA, at the General's urging, bought the Victor Talking Machine Company, and Sarnoff scored another first. During this period Sarnoff foresaw many technological marvels which are just now coming to the fore. The portable radio, the walkie-talkie, the robot, the remote control vehicle; all of these things were to him actualities merely awaiting the passage of the proper amount of time.

At the time Sarnoff assumed the Presidency of RCA, the entire business and industrial world was beginning to rock in the throes of depression. To the existing difficulties, primarily a result of the fact that RCA's earnings dropped from $182,000,000 in 1929 to $62,000,000 during the depression, the Federal Department of Justice imposed further difficulty by insisting that General Electric and Westinghouse dispose of their stock holdings in RCA. The result was that, although RCA became independent, it was saddled with an additional burden of $18,000,000 worth of debt.

But Sarnoff was, as always, thinking ahead. Depression was not a normal economic condition; normalcy would be restored, and the more comfortable business future would belong to those who could muster the courage to prepare for it now. Sarnoff was prepared to stake his reputation, his career and perhaps his company on what was to be his largest project to date — television.

As early as 1923, Sarnoff wrote:

> "I believe that television, which is the technical name for *seeing* instead of *hearing* by radio, will come to pass in due course. Already, pictures have been sent across the Atlantic by radio. Experimental, of course, but it points the way to future possibilities. It is not too much to expect that in the near future when news is telegraphed by radio — say to the United States, of important events in Europe, South America or the Orient — that a picture of the events will likewise be sent over by radio and both arrive here simultaneously. I also believe that transmission and reception of motion pictures by radio will be worked out within the next decade."

The General felt that television was inevitable, and, as with the radio, he foresaw its tremendous importance and the impact it would have on society. In order to prepare the way and to hasten its coming, Sarnoff began what his associates deemed a prodigious folly. At a time when others were employing the most drastic and far-reaching economies in their firms merely to stay alive, Sarnoff began to pour millions into one of his favorite activities — research. Again there were doubts and objections from associates and experts. They said that the undertaking was too large for one company, that the risk involved did not justify the expenditure of such large sums. Millions were being poured out with no guarantee that anything would be returned, and few believed that anything would. It was, all in all, a trying period for everyone except Sarnoff; he was as certain of the ultimate success of television as he had been of radio.

Sarnoff knew that television could be made workable in 1923 after Dr. Vladimir Zworykin had patented an electronic picture scanning device called the iconoscope. Previous experiments along these lines had been undertaken with mechanical scanning apparatus and the results had not been sufficiently encouraging to warrant full scale research. Zworykin's invention opened the door, and Sarnoff persuaded him to join the RCA laboratories research staff. This started a process of research calling for an initial cash outlay of $100,000 — the sum which Zworykin felt he would need to carry out his plans — and culminated in an expenditure of $50,000,000 before black and white television was finally perfected to the point where it could be offered to the public for sale.

Sarnoff's moment of triumph with the television project came in 1939 at the New York World's Fair where he displayed television receiving sets and demonstrated to the world that television had arrived as a new industry. Standing before a television camera and appearing on a screen, the General declared:

> ". . . . And now we add radio sight to sound. It is with a feeling of humbleness that I come to this moment of announcing the birth in this country of a new art so important in its implications that it is bound to affect all society. It is an art which shines like a torch of hope in a troubled world. It is a creative force which we must learn to utilize for the benefit of all mankind."

In 1944, the Television Broadcasters Association paid tribute to Sarnoff's pioneering efforts in bringing the dream of *sight and sound* to fruition; they conferred upon him the title of *Father of American Television*, one of many conferred upon him, but one of which the General is exceptionally and justly proud. And RCA, with the first large scale sale of television sets for the home — a highly successful 10-inch screen model — earned back with interest, from sales alone, the millions General Sarnoff had with great prescience devoted to research and development in the dark days when men with less faith and vision were holding back.

With the coming of World War II, RCA found itself unable to proceed with plans for mass production of television receivers. Instead, the extensive research and manufacturing resources of the corporation were turned over to the government for the development and manufacture of instruments vital to the successful prosecution of the war. Instead of television sets for the home, radar — a direct outgrowth of Sarnoff's television research, shoran, loran, and navigation and accessory instruments of all types were produced from 8 RCA plants. RCA's leadership in peacetime research projects, directly attributable to Sarnoff, enabled them not only to actually produce the very latest in electronic equipment, but to furnish their own plans and blueprints to companies around the country engaged in similar work.

After the RCA organization had been converted to war production, Sarnoff, a Colonel in the United States Army Reserve since 1924, went on leave of absence and entered active service with the Army Signal Corps. He served on the staff of the Chief Signal Officer in Washington and later went overseas to join General Eisenhower's SHAEF staff as a special communications consultant. On December 6, 1944, Sarnoff received another honor of which he is particularly proud; he was elevated to the rank of Brigadier General.

During his service in Europe, the General, never able to confine his planning for long to just one thing at a time, began to conceive the idea of a radio program which later became the *Voice of*

America. He proposed it to President Roosevelt at the time, but nothing was done about it until after the war. The success and efficacy of the *Voice of America* broadcasts is a matter of record and another example of David Sarnoff's constant search for ways and means by which the cause of humanity might better be served. He is today still one of the staunchest of advocates for the *Voice of America* broadcasts, for the whole purpose of his life's work has actually been to facilitate better communication between men.

On the whole, the General has taken in his stride the many honors which a grateful world has bestowed upon him. A few, however, always please Sarnoff because their sources and their implications are particularly close to his heart. For his services to his adopted country in the time of war, he was awarded the Army's Legion of Merit and President Harry S. Truman presented him with the Medal for Merit for services, according to the accompanying citation, of "inestimable value to the war effort." In addition, the government of France awarded him the Cross of Commander of the French Legion of Honor for his services in wartime communications in their country.

Much honored and eager to return to civilian life and the helm of RCA after his services were no longer required by the military, Sarnoff found the public full of anticipation for the long-promised television set. RCA was in the position of leading the industry in manufacture and sales of black and white receiver sets. In 1947, General Sarnoff announced:

> "In speaking of television for the past twenty-five years or so, we have been accustomed to say that 'television is around the corner.' I should like to bury that phrase. Television is no longer around the corner. It is beyond the doorstep; it has pushed its way through the door into the home!"

Just as the General had always thought of sight — *television* — in connection with his early pioneering efforts with the radio, so he had always considered color in connection with television. In neither case, however, did he believe it wise nor necessary to hold up presentation of the radio to the world because television was not yet ready, nor to hold up black and white television because color was not ready. But he never considered really that television was complete without color anymore than radio was complete without sight. The problem of producing an adequate color system was perhaps the one instance where Sarnoff's desire for perfection, his desire for completing each step of a project as perfectly and, what is even more important, as *permanently* as possible — he does not like to return to a project once it is pronounced finished — caused him difficulty.

In an effort to overtake RCA's postwar lead in the television industry, a rival company introduced in 1950 a mechanical color scanning device which necessitated the installation of a group of whirling color filters on each set. Sarnoff had, of course, visualized a completely electronic system of color television incorporating only a tube. He had further ordered, in his characteristic manner, his researchers and engineers to make this tube capable of receiving not only color telecasts, but black and white as well, a thing which no mechanical system known was capable of doing. It was a large order and the system that Sarnoff had visualized, and was waiting for his laboratories to deliver, had not as yet been perfected. To the dismay of everyone at RCA, the Federal Communications Commission in 1950 approved the rival system because Sarnoff's electronic tube was not as yet capable of reproducing true color with the same clarity and definition.

Sarnoff and his associates had previously experimented with a similar mechanical system, but had discarded it as a mere stopgap and not really desirable because black and white pictures could not be received on such a color set. Plainly and simply, Sarnoff saw the electronic tube as a better possibility, and he had authorized the expenditure of substantial sums of money required to perfect a compatible system of color television. In addition to the $50,000,000 that had already been spent in order to produce black and white television, it took $100,000,000 more to establish color television as a service to the public.

To a lesser man, the decision of the F. C. C. could have spelled disaster. It merely hardened Sarnoff's determination not to allow anything but the best possible color television to be offered to the public, and he knew that, in time his system would be the best possible. In a moment of crisis, the General is never ruffled; as he left the F. C. C. hearing at which the RCA color process was defeated, he said: "We have lost only a battle; we will win the war."

On his return to the RCA research laboratories at Princeton, New Jersey, Sarnoff presented the situation to his scientists. There would not be much rest around the laboratories until such a color tube as the General had visualized and knew to be possible was perfected. It is said that his staff immediately began a schedule calling for an 18 hour work day, seven days per week. By mid 1951, the tube was ready but testing and improvements continued until December 1953 when the RCA *Compatible Color* all-electronic system, was demonstrated to the public with such dramatic results that the F. C. C. was forced to reconsider its earlier decision. The result was that the F. C. C. stipulated industry-wide standards for color television based almost entirely on the principles that Sarnoff and RCA had prescribed when the matter first arose. It was another clear victory for Sarnoff, one which pleased him not so much because it proved that he was right, but because a higher standard, a firmer stepping stone on the road to progress had been established in an industry which he had, in effect, built.

The success of his color tube, like the success of the radio music box, the realization of the short wave radio, the development of portable radios, the practicability and achievement of remote radio control, the actuality of television itself, did not diminish Sarnoff's imaginative quest for those things in the universe that need only, in Shakespeare's words, "a habitation and a name." The General continues even today the practice he established long ago of asking for, and receiving new and startling developments from the scientists and engineers at the RCA laboratories. On the occasion, for example, of his 45th anniversary in the radio industry a testimonial dinner was held for him at the laboratories in Princeton. The laboratory staff members were at that time asked by the General to prepare for his 50th anniversary, five years hence, three gifts which he proceeded to outline for them.

The first gift he requested was an electronic amplifier of light. This he called *Magnalux*. Just as there were amplifiers, in use in radio, that would magnify, as it were, the intensity of sound waves, so there could be an amplifier that would intensify and make stronger light waves. The application in television, in X-Ray and in other fields would be almost limitless.

The second gift he requested was a magnetic tape recorder for both black-and-white and color television. This would be a device that would enable one to record sound and pictures at the same time and to replay them whenever one wished.

The third gift was an electronically air-conditioned room employing a system that had no moving parts.

Five years later on the occasion of his 50th anniversary celebration, these gifts were presented to General Sarnoff and he replied:

> "A few of the scientists and research men who heard me make these specific challenges to their ingenuity wondered if I quite grasped the toughness of the problems involved. If I did, they said, I might not have had the gall to set a five-year time limit for their solution. But I have often had more faith in these men than they have had in themselves. I had no doubts that they could solve these problems, and I even thanked them

in advance for the presents I confidently expected to receive tonight. Of course, I realize that in part they are still in what engineers call the developmental stage. But the fact remains that in five short years they have succeeded in turning what were bold dreams and hopes into proud realities."

Far from being anything like tired or worked-out after 50 years of the most strenuous and intensive type of work, the General is still in the process of discovering — he distinguishes between *discovery* and *invention* and regards himself as a *discoverer* — new marvels which he and RCA plan to give to the world. In the field of atomic science and electronics, the General has already transmitted radio messages using a tiny atom-powered battery as a source of electricity. He talks convincingly also of utilizing atomic waste-products, sealed and buried under the house, as a source of all the power needs of the average household for a period of 20 years.

Sarnoff continues to see the future in terms of the vast progress and achievements of the past. Within the next 20 years, he expects atomic fuel extracted from relatively inexpensive materials and used in industry, in planes, in ships, trains and automobiles; the energy of the sun and the static electricity in the atmosphere will be harnessed and put to work; television in full colors will be global in scope, and individuals using telephones will be able to see as well as hear each other; jet-propelled rockets, using nuclear fuels, will travel carrying passengers at speeds of 5,000 miles per hour and guided missiles will transport mail and freight over great distances; and the prediction even of weather for months and years will be perfected, and major steps will have been taken to make and control weather as desired. These are some of the things that the General sees for the future and that make him feel that modern youth, more than ever, has myriads of "new worlds to conquer."

Sarnoff is, as a rule, most often thought of as a wise scientific genius able to visualize and utilize to the fullest the essential possibilities of the electron and things electrical; as a shrewd financial genius who built his organization into one of the soundest, most progressive and efficient companies of its kind in the world — a model to be emulated in industry. But the General is in no sense only a scientist and a business man. He is also a man of wide learning and active interests in cultural and educational activities. He is actually the ideal of the *Renaissance man.*

Sarnoff himself has always enjoyed the music of the great classical composers, and good music is one of his favorite avocations. His love of music led him to another first in his long succession of firsts. One of the acts for which music lovers and the culturally minded citizens of America will be forever grateful to the General is his creation in 1937 of the NBC Symphony Orchestra, the first symphony orchestra intended primarily for radio broadcasting. Sarnoff assembled the very finest musicians available, at no heed to cost, and persuaded none other than the great Maestro Arturo Toscanini to direct it. Needless to say, under the aegis of Toscanini's genius, the NBC Symphony became one of the finest symphony orchestras in the world. And to music lovers on both continents the NBC symphony meant a hallmark of brilliant musicianship and inspired performance.

Always a willing patron for musical activities, Sarnoff numbered and numbers among his friends some of the finest musical minds that have lived. Toscanini and Sarnoff, for example, became close personal friends. Also among his friends was the late Dr. Serge Koussevitzky, the illustrious conductor of the Boston Symphony Orchestra. Sarnoff felt that great music and the personalities of the great musicians should be available to all people. This had been in his mind since his early days in radio and he saw it as one of the purposes for which radio had been created. At Sarnoff's insistence, NBC for years broadcast, under the direction of the late Dr. Walter Damrosch, the very popular and educational *Music Appreciation Hour*. Not only was symphonic music to be broadcast over the radio, but Sarnoff determined to bring the world of opera to radio listeners as well. He made arrangements to broadcast directly from live performances on the stage of the Metropolitan Opera House. His symphonic and operatic broadcasts were later put on television also, which, in conjunction with RCA Victor's ever growing production of fine recorded music fulfilled the General's desire that everyone could have the pleasure of good music.

In looking back over the years of enterprise, work and achievement that have made up his life — and this he does rarely since he is still looking forward to new worlds to conquer — David Sarnoff seems to be overcome by deep feelings of humility and gratitude. He will pause and say: "What I have done, I have not, of course, done alone. There have been a great many people — fine, brilliant men and women — who have worked with me. Were I to begin to name names, I could not finish because there have been too many." The General's associates, nevertheless agree readily that it has been his ideas, his clarity of thought and purpose, his inspiration that have held many doing difficult work as one.

Perhaps the greatest single contribution that the General has made to the practical progress of the field of electronics and to RCA has been his faith in and utter reliance upon thorough and exhaustive research. Sarnoff has spent countless millions in facilitating and implementing research and he has constantly urged its necessity and desirability upon young scientists. There is an almost philosophical conviction in his attitude on the search for new knowledge. Sarnoff believes that:

> "The sum total of our knowledge and everything we know is infinitesimal compared to the size of our ignorance. Every advance in the frontier of knowledge opens up a great vista of the unknown. The scientist is not happy except when he is searching or when he finds something. But science is an incomplete task just as life is incomplete. Fulfillment can never be there so long as knowledge is imperfect, and I might add that consequently the search for truth is not a peaceful occupation."

In recognition of the many things that Sarnoff has done and is doing to further the outer reaches of man's imperfect knowledge, his associates in 1951 named the RCA laboratories at Princeton, New Jersey, THE DAVID SARNOFF RESEARCH CENTER.

There is, finally, none of the pessimism in the General's make-up which sometimes afflicts men who have worked with the stern practicalities of science for a lifetime. Sarnoff, on the contrary, feels that the more a scientist is able to perceive of the order and remarkable harmony in natural and scientific phenomena, the more he will be brought to the necessity of realizing the presence of a Supreme Intelligence because the physical processes and laws of the universe, he feels, are logical, all-embracing and wholly dependable. To contemplate them, Sarnoff finds is to be inspired with reverence.

Sarnoff will turn easily from the discussion of physical phenomena, absolute scientific principles to a discussion of man. Underlying the General's preoccupation with the physical world and its laws, which is where he works, is a very genuine philosophical bent which, it is obvious from his conversation, Sarnoff has fed with reading and thinking. He is convinced of the ultimate perfectibility of mankind, but he feels also that man's perfectibility is up to man, not God. Man is given "a seed of moral perfection" Sarnoff says, but it is up to him to nurture it and make it grow. A part of this nurturing process may or may not include prayer. That, the General feels, depends upon the particular needs and disposition of the individual. "I think that prayer," Sarnoff says, "is not something we ought to do for the benefit of God but for ourselves. . . . If it benefits the individual in some way to pray, then by all means he should do so." ◆

LIVING IN A FAST MOVING WORLD

by David Sarnoff

WE LIVE IN A WORLD in which the speed of change is so swift that it is greater than at any other period in its history. Most of our problems arise primarily from this fact—the speed of change. So many changes have taken place in so many departments of our life that we have not been able to digest them at the rate of speed they were introduced. That, I believe to be the root cause of the present disequilibrium between technology and society.

A great challenge and a great opportunity face our generation and the rising generation. At no period in the history of the world have forces been released with such potentialities as they have been during the present century.

Just think of what has happened to all of us in the short span of the past half century. During this period there have been major changes in governments: kings have been deposed; royalty has been displaced; dictators have risen; and new forms of government have been established throughout the world.

In the field of politics the changes we have experienced include Labor Governments; New Deals; and Fair Deals.

In the field of economics, the battle between Communism and Capitalism still rages. That was only a theory in the past, but in the present century it is a fact—and we are not through with it.

In the field of society, we now have pensions, social security, and unemployment insurance. Those are all new "inventions" of the present century.

In the field of finance, we have personal taxes and business taxes—unknown at the beginning of this century. We have hard money, soft money, inflation and deflation—all these are spectacles of the 20th Century.

In the field of technology, methods of transportation have been revolutionized. We have learned to travel in the air and we have a whole new industry of aviation. In communications, wireless, radio and television are products of the present century.

Not many years ago few would have thought that there was anything of value between the heavens and the earth—just a lot of space. Nevertheless we discovered wealth and potentialities in space which one day may rival the wealth that lies deep within the earth. Much of our wealth in the past has come from sub-soil; minerals, metals, coal and oil. We had to dig deep in order to find the materials which could be converted to man's use.

Now in our own lifetime, we find that we have new systems of transportation and new systems of communication through the air. We talk and sing and play and send pictures through space.

Today we hear about solar energy and what the sun can do for us in providing a new source of power. Think of it—all of these things have come to us in less than a half-century. And all of them have made an enormous impact upon governments, politics, economics, industry and business, and our ways of life.

Perhaps it is too much to expect the world to adjust to all these revolutions with the speed with which they imposed themselves. These circumstances call for philosophy, patience and tolerance—above all, for hope and faith in the future.

But the basic values, the moral principles, remain unchanged no matter the number and extent of these technical revolutions and changes. We must, therefore, hold fast to these moral moorings or else we will be swept into a sea of complete confusion.

It is a curious but significant fact that in our own lifetime two little children of nature—the atom and the electron—have come to us and we have adopted them. We cannot see, touch, feel, or smell them, but they are here in a big way.

Geologists recently reached agreement that this universe is at least five billion years old. I am not going to quarrel with a billion, one way or the other. However old the universe may be, the atom and the electron were here when the world began for they are the building blocks of the universe. And they are convertible from energy into matter, and from matter into energy. The atom and the electron were *not* invented by man. They were *discovered* by man.

For some billions of years their existence was kept from the knowledge of man. The Einstein Theory of Relativity put us on the track of atomic energy. The development of the atomic bomb, which was exploded only thirteen years ago, gave proof of its potentialities. The world realized what could happen when the energy within the nucleus of the atom was released. A new world was born! For this reason, I think of the world we live in as thirteen years *young*, rather than five billion years old. The influence of atoms and electrons is revolutionizing many phases of our life and activities.

The change has come so fast that few have adjusted themselves psychologically to its implications. We have been like travelers on a train rushing at such headlong speed that the passing landscape is blurred. To appreciate it we must go back and examine that landscape at leisure.

We have to pause for contemplation and understanding, or we shall be overwhelmed by the forces we have unleashed. Unless we learn to use the new powers at our disposal for beneficent purposes, we shall find ourselves trapped by our own genius. That is the fundamental challenge to man today if he is to survive, not merely in the physical but in the spiritual sense.

Science offers us wonderful tools for helping to create the Brotherhood of Man on earth. But the mortar of Brotherhood does not come from any laboratory. It must come from the heart and mind. Precisely because the forces in our hands are so great, we dare not fumble. Our capacity for monumental mischief is so vast that moral values have ceased to be merely desirable. They have become *imperative*—their conscious cultivation has become indispensable to the very *survival* of the race.

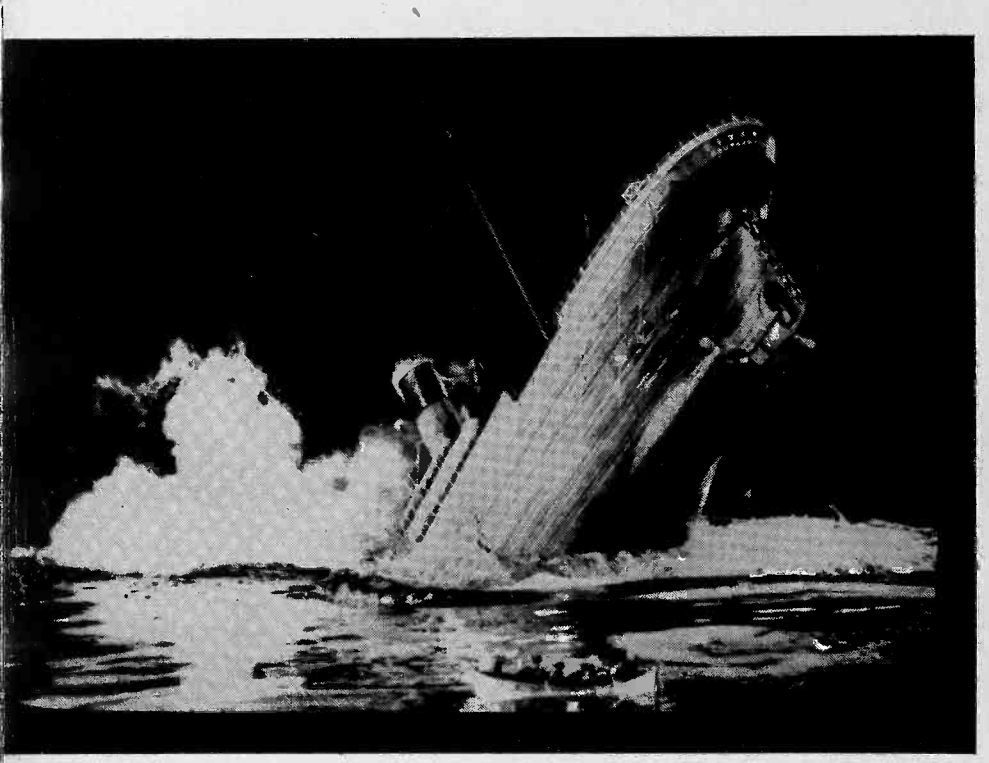
As we wrest more and more secrets from Nature and transmute them into services for mankind, the logic and rhythm of life take on more meaning. The myriad suns of which our own is as a single grain of sand in the Sahara, the majestic cycles of the celestial movements, the precise operations of natural laws—these could not be regarded as mere accidents.

Their harmonious relationship and their effects upon life on this planet cannot be comprehended by our limited mortal mentality. But an intuition beyond mere reason informs us that they are manifestations of a Divine Intelligence and Supreme Architect of the Universe. Science provides no substitutes for the lessons of universal harmony, embodied for mankind in religious teachings and moral precepts. It makes clear that material progress is a delusion unless it is put at the service of eternal spiritual value. ◆

Brigadier General David Sarnoff tapping out the inaugural message from the U.S. Navy's 1,200,000 watt transmitter at Jim Creek, Washington, on November 18, 1953. The message, from Admiral Robert B. Carney, Chief of Naval Operations (standing), was directed to all ships and Navy outposts throughout the world.

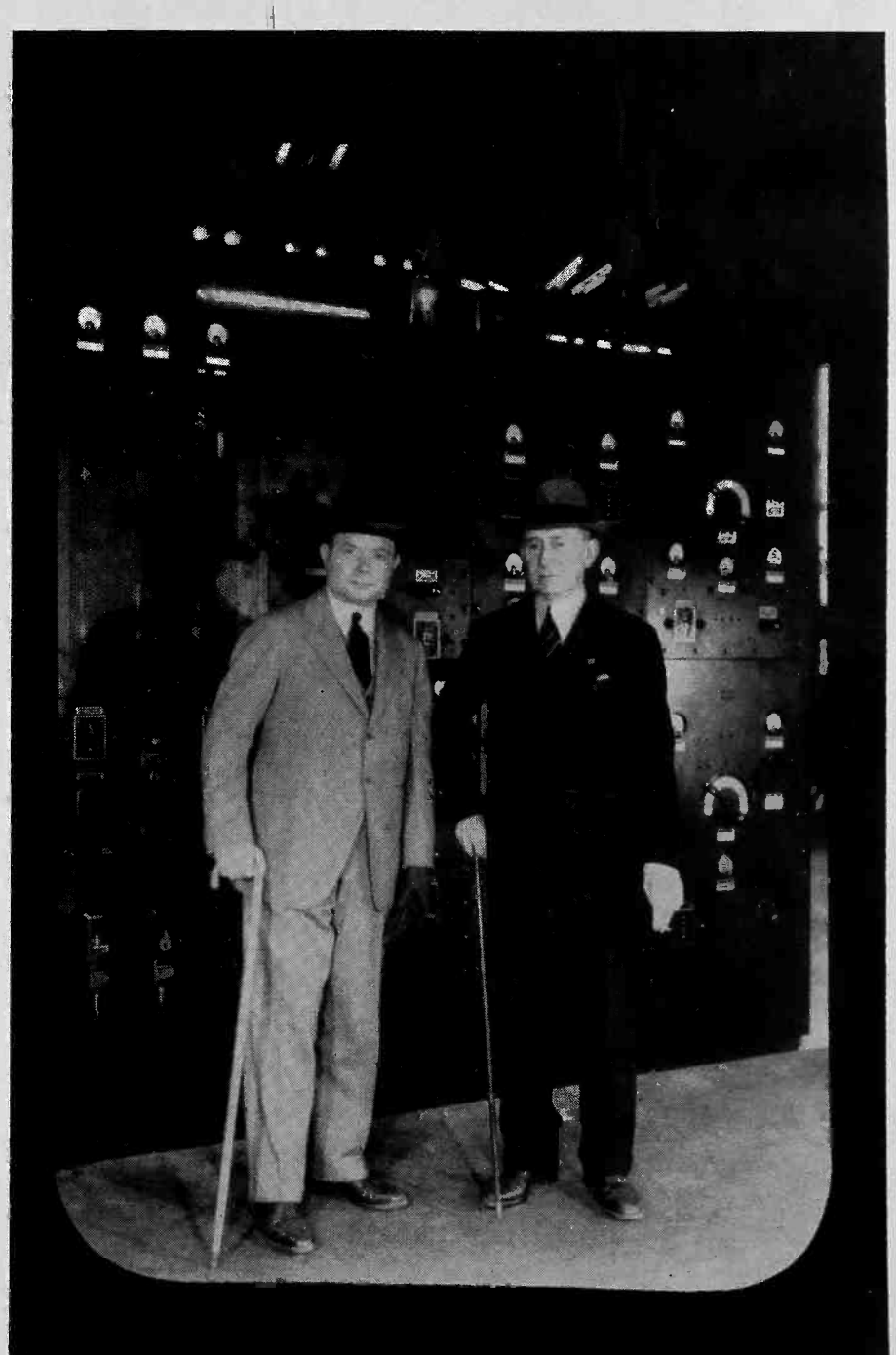
BELOW: *In 1908 the Marconi Company needed a wireless operator for their station at Siasconset on Nantucket Island. Sarnoff, who had taught himself the Morse Code and learned as much as possible in Marconi's experimental shop at Front Street in New York, was given the job.*

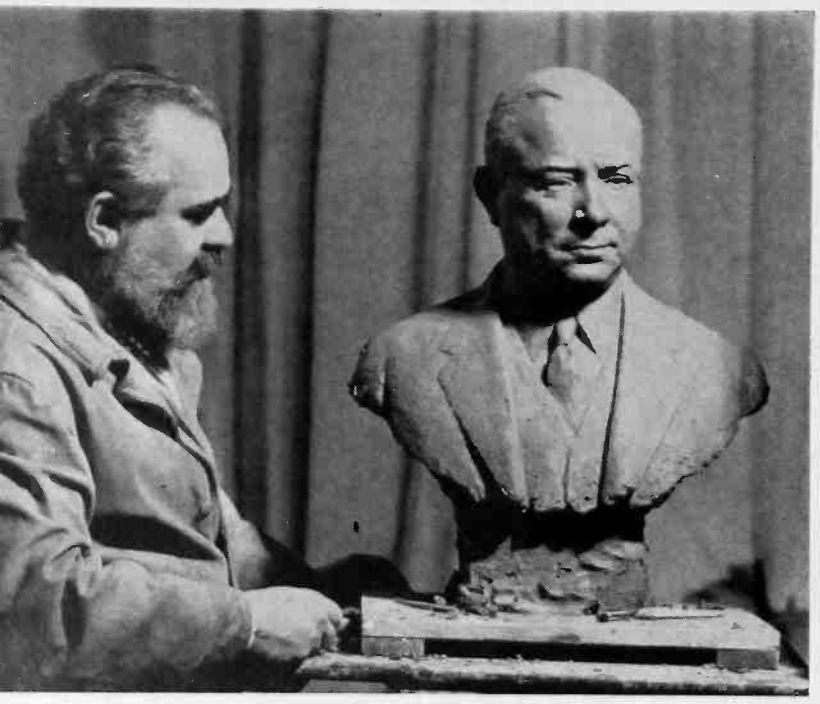
When General James G. Harbord (left) retired from the Presidency of RCA in 1930 to become Chairman of its Board, David Sarnoff was elected President.



ABOVE: *Overnight fame came to the Marconi Company—and David Sarnoff—with the disastrous sinking of the "S.S. Titanic" in 1912. Sarnoff remained on continuous duty in New York for 72 hours, until all survivors had been identified.*

Sarnoff became the close friend and co-worker of wireless pioneer Guglielmo Marconi (right). In 1933 they inspected the RCA Communications Transmitting Center at Rocky Point on Long Island.





In 1937 noted sculptor Jo Davidson created a bust of David Sarnoff, which was later cast in bronze.

During World War II Sarnoff was called upon to act as Special Consultant on Communications at SHAEF headquarters in Europe. For his achievements he was awarded the Legion of Merit.

President Roosevelt appointed Sarnoff a Brigadier General in 1944. He received the star of his new rank from Major General H. C. Ingles, then Chief Signal Officer of the U.S. Army.

Treasured personal photographs emphasize the magnificent record of the Sarnoff family during World War II. Here, Brig. General Sarnoff heads uniformed family, comprising. . . .

Mrs. David Sarnoff, Chairman of Nurses Aide Volunteer Section of the Red Cross. . . .

Son Robert William Sarnoff, Lieutenant, U. S. Navy. . . .

Son Edward Sarnoff, Capt., U.S. Army. . . .

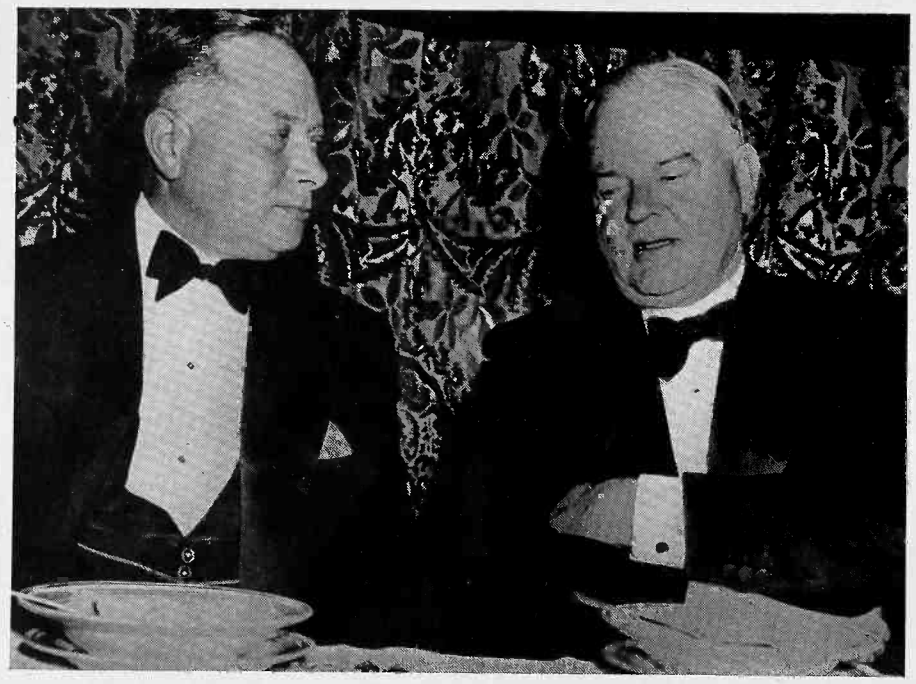
Son Thomas Warren Sarnoff, Sergeant, U.S. Army.

Although a very busy man, David Sarnoff has always found time to share activities with his three sons. In 1952 he was designated Father of the Year. This happy group shows David Sarnoff with sons Tom (seated), Robert (left), and Edward.

Coveted international honors have been earned by members of the Sarnoff family. The French representative to the United Nations, Roger Garreau, decorated Mrs. Sarnoff for wartime Red Cross work, the General for services to France in radio communications during the occupation and liberation.

Time for welcome relaxation in the crowded life of David Sarnoff is spent with Mrs. Sarnoff, at their New York home.

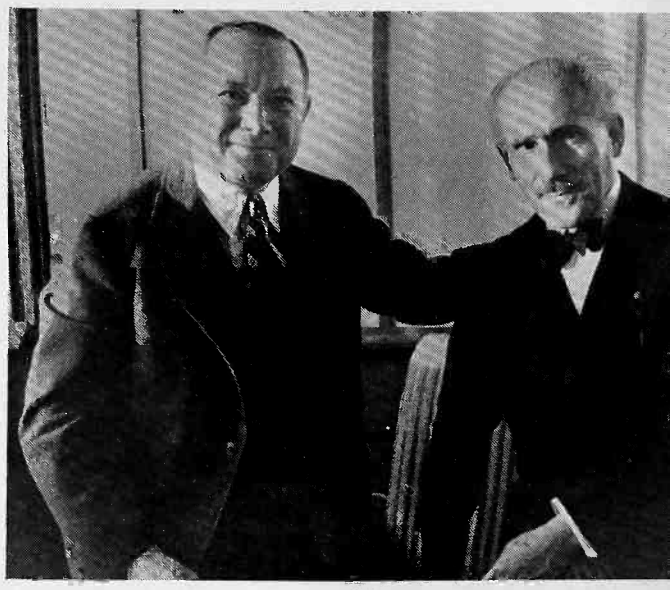
David Sarnoff was appointed by President Roosevelt as one of the original members of the Fair Employment Practices Committee.

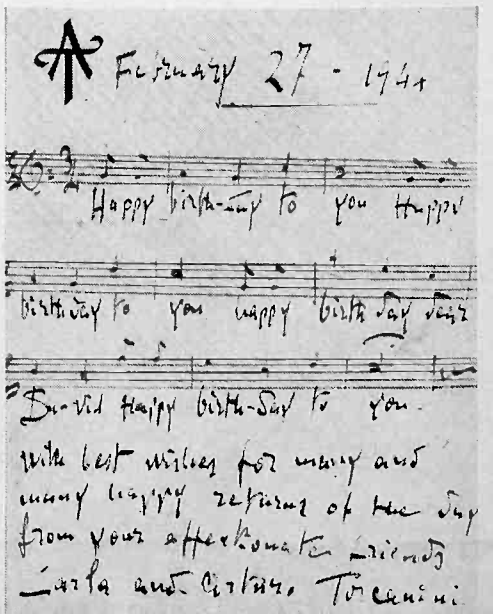


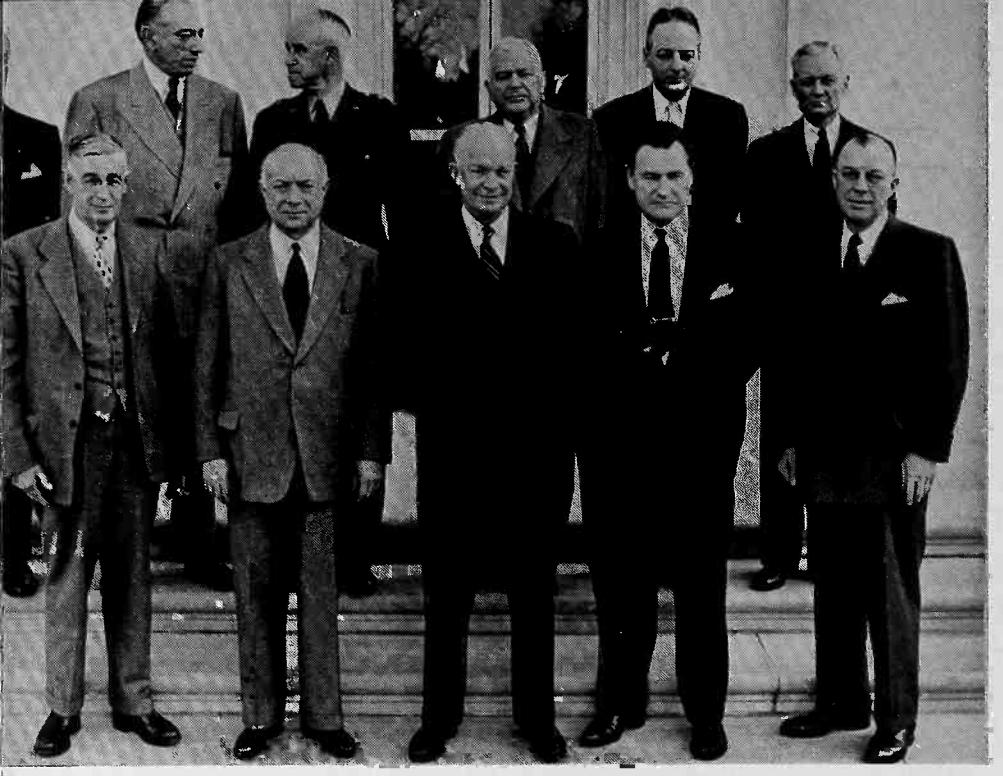
Sarnoff's youthful outlook is frequently reflected in his public engagements. On May 18, 1939, he was principal speaker at the Boys' Club of America banquet at the Hotel Commodore, New York. He is seen in conversation with former President Herbert Hoover.

The tenth anniversary of NBC's Catholic Hour, on March 3, 1940, was a milestone in the history of religious broadcasting. L. to r: Louis Kenedy, Most Rev. John F. O'Hara, Lenox R. Lohr, Archbishop Francis J. Spellman, David Sarnoff, Monsignor Sheen, the late Alfred J. Smith, and Bishop Walsh.

Arturo Toscanini and Sarnoff were close personal friends. In 1948 Toscanini conducted the NBC Symphony Orchestra on the occasion of the orchestra's first nationwide telecast. Among Sarnoff's prized mementos of their friendship is the late maestro's "musical birthday card."

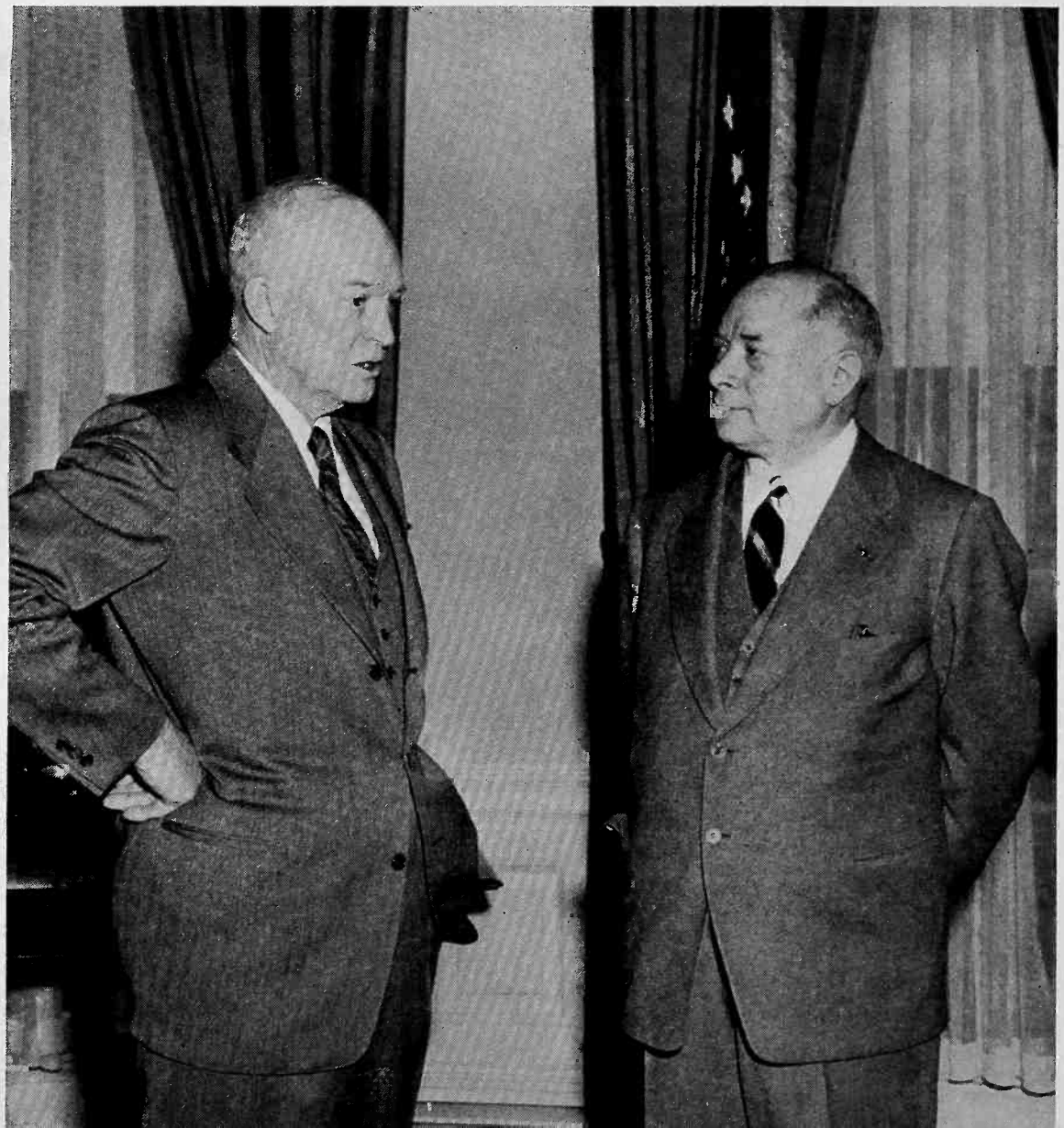






Sarnoff's contributions to the nation's welfare include membership on the "Committee On The Department Of Defense Organization." Pictured at a White House luncheon on March 20, 1953, are: Lower row, l. to r: Dr. Vannevar Bush, David Sarnoff, President Eisenhower, Nelson A. Rockefeller, Dr. Milton Eisenhower. Upper row, l. to r: Robert A. Lovett, Roger M. Kyes, General Omar Bradley, Charles E. Wilson, Dr. Arthur S. Fleming, Governor Sherman Adams.

A unique use of television, to transmit combat scenes from the battlefield, was first proposed to the Armed Services by Sarnoff. Combat television permits the regimental commander, at his command post in the field, to use the eyes of television to direct the action. The television camera may be carried by a combat soldier or mounted in a reconnaissance plane. Trying out an RCA combat camera is General Matthew B. Ridgway, Army Chief of Staff, and looking on are Brigadier General David Sarnoff and Major General George I. Black, Chief Signal Officer.



A memorable occasion for Sarnoff was his visit to the White House on February 6, 1954. He is seen in conversation with President Eisenhower.

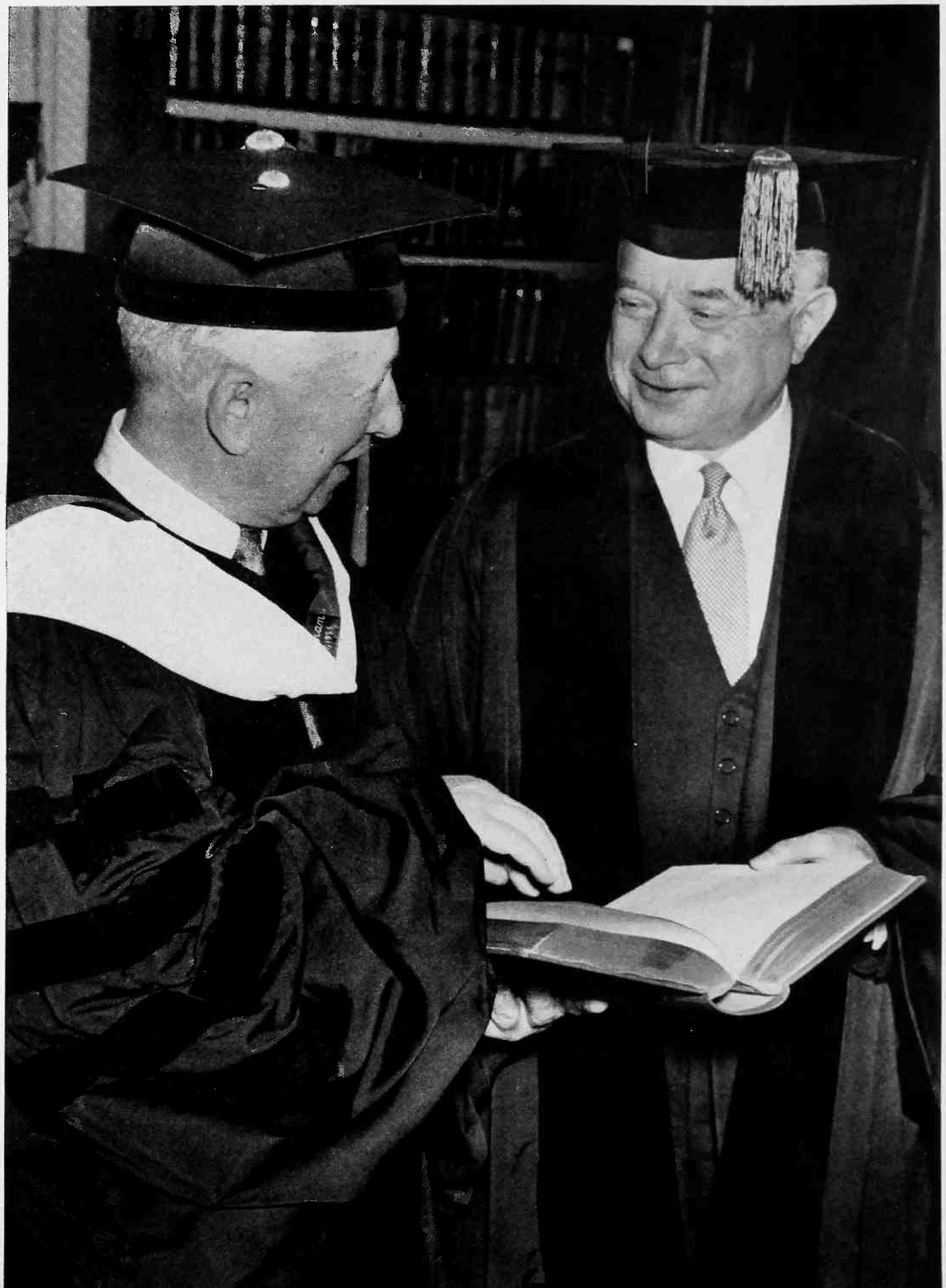
Sharing a story with David Sarnoff at an RCA annual meeting are the corporation's youngest shareholders, from Fox Meadow School, Scarsdale, New York.

Sarnoff's personal touch is much appreciated by stockholders, whose questions he answers at an annual meeting of RCA.

For his outstanding contributions towards international understanding, Sarnoff received the American Nobel Center's "One World" award on February 18, 1945. Making the presentation is Rev. Robert I. Gannon, President of Fordham University.

On behalf of RCA, Sarnoff receives the American Heritage Foundation's 1956 award from Charles E. Wilson, trustee of the foundation. RCA won the award for "outstanding public service in the national non-partisan 'Register, Inform Yourself and Vote' program of 1956."

The irresistible Sarnoff smile breaks through, even on formal occasions. On May 22, 1957, he received an honorary degree of Doctor of Laws from Dr. Abraham A. Neuman, President of Dropsie College, Philadelphia.



THE WORLD OF RECORDING

TODAY'S ALL-TIME POPULARITY of recorded music and the *Victrola* phonograph comes at a fitting time in the life of this great art and industry—a period immediately following the Diamond Jubilee of Edison's invention of the phonograph and the Golden Anniversary of the Caruso era.

The evolution of recording, from Edison's famous 1877 tinfoil model of the *talking machine* and the first notable operatic disks of 1902 to the present-day high fidelity reproduction of the world's finest music in all its tonal grandeur, provides eloquent testimony to America's quest for musical progress.

Recorded music is a unique combination of scientific and artistic achievements. An outstanding musical performance in either the popular or classical field must go hand-in-hand with outstanding technical performance in order to attain outstanding recording and reproduction.

The degree of success in reaching this goal is measured best by public acceptance. One out of every three families in the nation now has a record player, and total records sold by RCA Victor alone is approaching the two billion mark.

More and more record players are going into American homes each day. Millions of new disks of all sizes, speeds and classifications keep them spinning, playing music old and new.

Records have become the mainspring for the entire music business. In addition to their growing importance in home entertainment, they are an essential factor in many radio programs, some of the most successful of which derive exclusively from disk playing. They are a prime necessity of musical education in schools, and the principal impetus to the increasing sales of sheet music.

Many of the artists now featured on radio and television owe their start in show business to early recordings. Countless newcomers who have become favorites in entertainment depend on records to extend their popularity.

Recordings today encompass all types of music—the best in symphonies, operas, chamber music, popular and jazz music, as well as folk songs, hill-billy renditions, children's classics and foreign-language favorites.

Almost every avenue of musical progress has been traveled by the record-makers. In addition, they have transcribed for all time the towering messages of men and moments of contemporary history, literary and theatrical masterpieces, instruction in languages and the elusive sounds of nature.

Only the written word can today match the recording art in making accessible to everyone the variety and scope of material marking our cultural achievements.

The phonograph has come a long way in fifty years. In its association with radio and electronics, it has been imbued with a modern spirit and vitality far beyond the fondest hopes of the recording pioneers.

The introduction of the new record speeds after World War II, together with longer playing characteristics and vastly improved tonal quality, has stimulated the whole field of recording. Far from confusing and frightening the public, as many prophesied, the new speeds have supplied technical advances sparking unprecedented interest in records.

These speeds of 45-and 33⅓-rpm represent a radical departure from the conventional 78-rpm records and establish a new standard of musical enjoyment.

Today, nine years after its introduction by RCA Victor, the 45-rpm system has won universal acclaim for its distortion-free music of remarkable brilliance and clarity of tone. Consisting of the first phonograph record and player ever to be especially made for each other, the system is regarded as the greatest advance in 50 years of recorded music. ◆

the famous TRADE-MARK

A LITTLE DOG listening to a phonograph has been a sign of our musical times for half a century, and continues today to be an increasingly popular symbol of progress in the recording art.

The story of its origin and fabulous rise to fame has been told in many languages, with varying degrees of romanticism.

An undisputed fact is that the little dog was as real as the success that followed his appearance. His name was Nipper, an alert black-and-white fox terrier. He belonged to a London artist named Francis Barraud.

One day Barraud caught sight of Nipper sitting attentively in front of his old talking machine and was inspired to paint what he saw. He called the painting *His Master's Voice*.

This painting, as the trade-mark of the Victor Talking Machine Company and later of RCA Victor, has immortalized Nipper as the mascot of the world's greatest musical artists and symbolized quality and leadership in the field of home entertainment.

Victrola phonographs and records bearing this trade-mark have extended the best and the most captivating musical performances from the concert stage and amusement hall to households nearly everywhere.

From a virtually unknown painter, Barraud became renowned. Printed reproductions of his work were distributed throughout the world. Demands for painted copies put him to work for the rest of his life.

Today, you might call Nipper a fifty-million-dollar dog. That is approximately the sum that has been spent to bring this beloved terrier and the legend of *His Master's Voice* to the attention of the world. It has been more than justified by the enthusiastic response of the men, women and children, in America and elsewhere, whose enlightened support has inspired the outstanding advances in recorded music. ◆

the wonderland of MUSIC

by David Sarnoff

SCIENCE HAS A NATURAL AFFINITY WITH MUSIC. The phonograph is a perfect illustration of the strong relationship that exists between the arts and science. Music is a wonderland of the arts in which scientists find new challenges for invention.

The advances in scientific techniques and the development of new instruments have given tonal perfection to recordings of the masterpieces, presenting the creations as the composers intended. Music long challenged man to record and reproduce it with fidelity —a goal not easily accomplished.

Heifetz, Horowitz, Rubinstein and all the other great artists of this age now can record their songs and music and have them played back immediately. They have the opportunity to study the performance and decide whether their renditions are true to their talents and performed in the manner that the composer would want them played or sung.

Beethoven, Chopin, Wagner, Mozart and Bach had no such facilities of science at their command. They could only write the music for posterity and hope that it would be interpreted and rendered in the spirit of their creation.

The masters probably never gave thought to the fact that science might some day play such an important role in music. Yet it was electricity that first gave the phonograph new stature as a musical instrument by replacing its hand-wound spring with an electric motor.

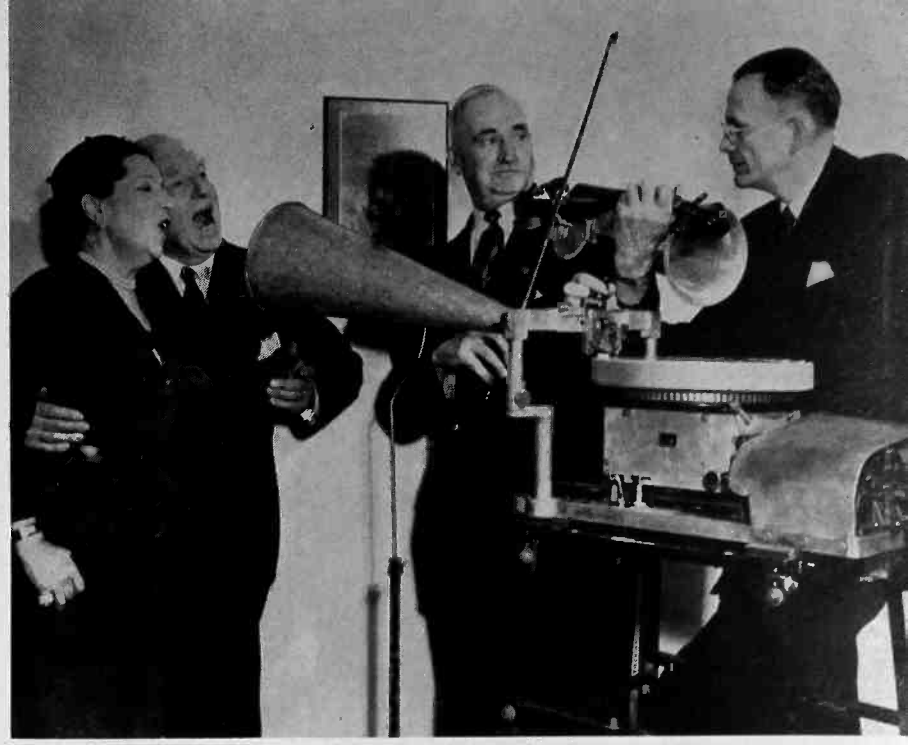
Surely the influence of radio and electronics never entered the minds of the phonograph pioneers, for wireless was not invented until 1895, and the electron waited until 1896 for discovery. Many years passed before those two new forces developed to a point where their relationship to the phonograph was realized. ◆

The reproduction of the early Victrola "talking machines" had to meet the critical demands of great performers. Intently listening to a recording of one of their duets are tenor Enrico Caruso (standing) and bass Antonio Scotti, both renowned for many thrilling performances at New York's Metropolitan Opera House. RIGHT: *In 1909 Caruso drew up his own contract with the Victor Talking Machine Co., and added the powerful self-portrait.*

New York 15th Nov. 1909

I have renewed the agreement now existing between the Victor Talking Machine Company and myself for a further period of twentyfive years giving to this company the exclusive rights to make and sell records of my voice for the entire world.

Enrico Caruso



Soprano Lucrezia Bori and tenor Giovanni Martinelli making a recording on the acoustical recording machine, vintage 1915–20. The violinist, George Peyre, is using an Ethro violin fitted with a horn to throw the sound in one direction.

In contrast with the picture above is this scene of a present-day RCA Victor recording session. The recording is being made on tape, and the proper balance of sound is maintained by the controlling engineer.

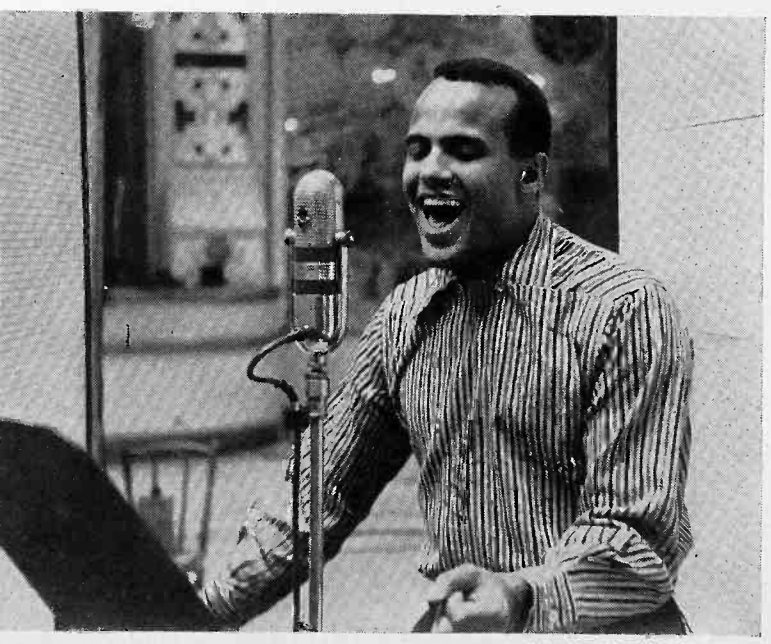
Top recording artists such as Lena Horne are helping to build an ever-increasing demand for disks.

The popularity of recordings by vocal groups, such as the De Castro sisters, has always been high.

Tony Martin and Kathryn Grayson present a study in musical coordination when recording "The Desert Song." The orchestra is under the experienced baton of Arthur Fiedler.

The magnificent sound reproduction of high-fidelity recordings calls for artistic and technical perfection. At the hi-fi mike are singers Perry Como and Jaye P. Morgan.

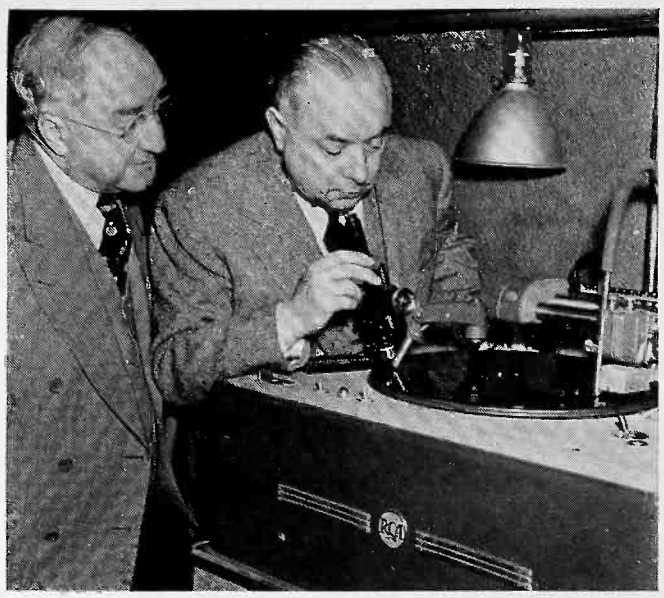
Confronted by the recording mike, Harry Belafonte exudes confidence and personality.



RIGHT: *All eyes are on the score as Frank Black conducts his String Symphony Orchestra in a recording session.*

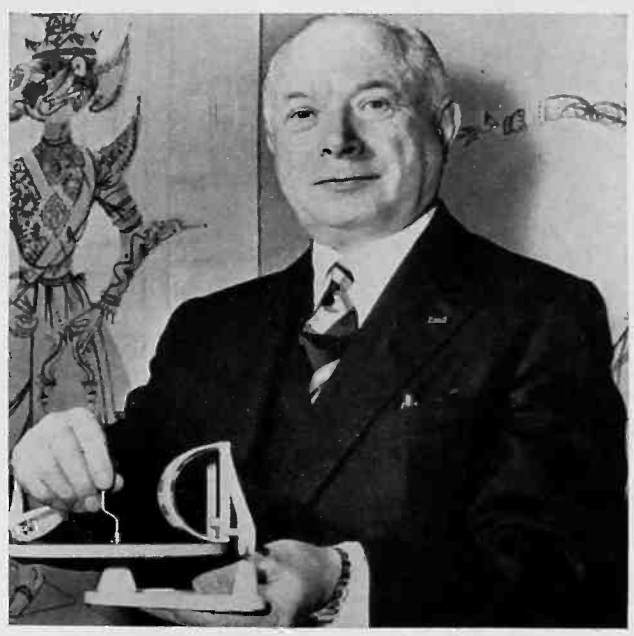
Enormous quantities of long-playing records are processed at the RCA Indianapolis plant.

General Sarnoff examines the first disk to be cut after signing of the contract between the American Federation of Musicians and the recording industry. Looking on is James C. Petrillo, President, A.F. of M.



RCA 45 rpm record players move down a conveyor line. They are assembled on the left and tested and inspected on the right.

Because of its many uses the magnetic tape recorder has come rapidly to the fore.

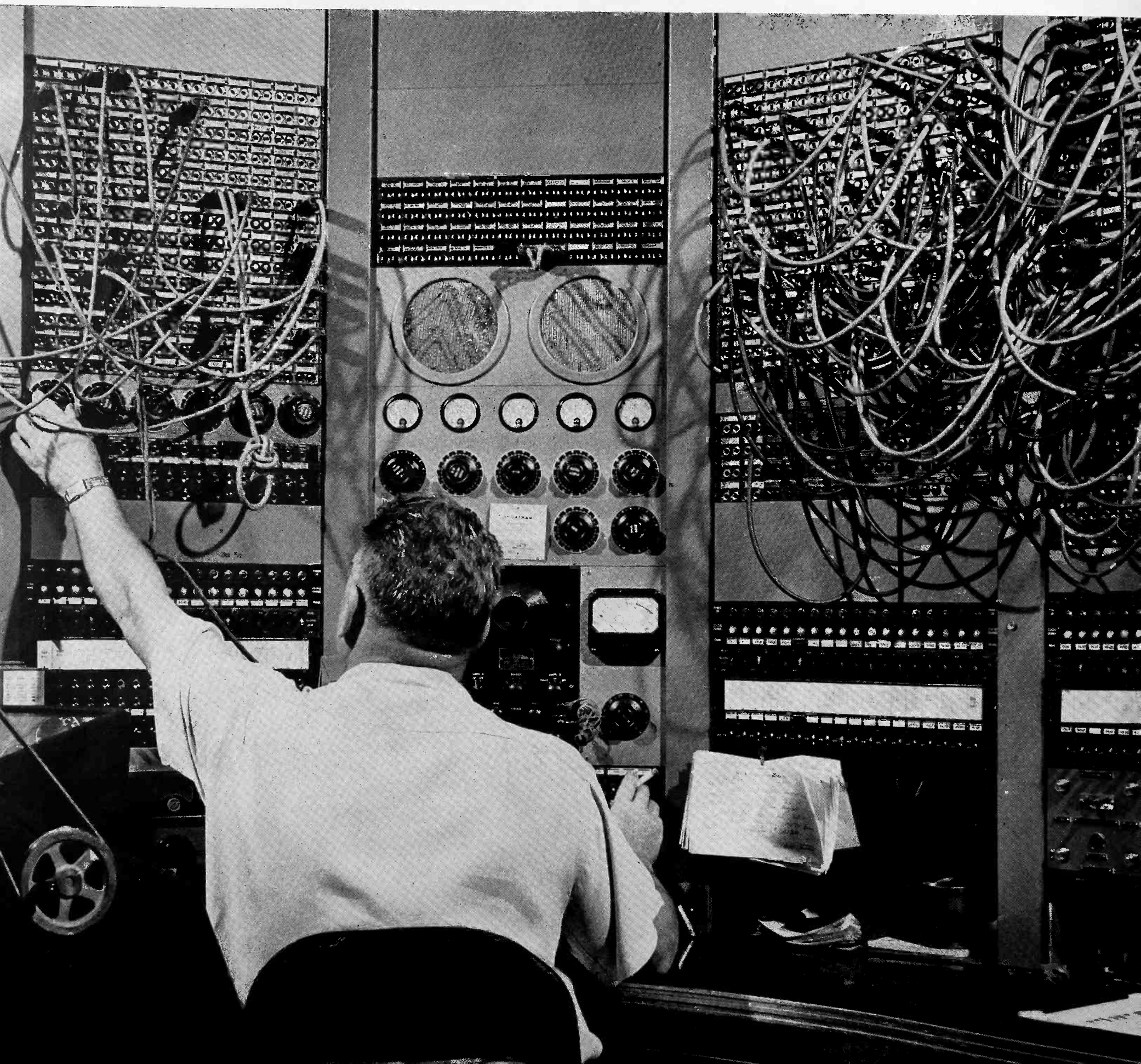


ABOVE: *Sarnoff shows hand-operated phonograph designed to deliver messages dropped behind the Iron Curtain. Cost is 50 cents, unbreakable records five cents.* BELOW: *How the phonograph operates.*

Five speakers are incorporated in RCA's International hi-fi radio receiver.

THE WORLDS OF

COMMUNICATIONS AND RADIO



RADIO CORPORATION OF AMERICA has its roots deeply embedded in the history of radio communications as a science, an art and an industry. Through research and engineering over the past thirty-eight years, it has pioneered and put into practical use many of the outstanding developments in the field of radio science; it leads the way in electronics and television.

The seed was planted when Maxwell offered the world his theory of the ether, and Hertz produced the electromagnetic waves. The growth began when Marconi sent the first faint signal in 1895. Unending research and pioneering would nurture it—first, across Marconi's garden, then across the English Channel in 1899, across the Atlantic in 1901, and on and on to encircle the globe—with messages, music and pictures traveling at the speed of 7½ times around the world in a second.

Marconi applied for his first British patent on wireless telegraphy in 1896. A year later, in July, 1897, the Wireless Telegraph and Signal Company, Ltd., (name changed in 1900 to *Marconi's Wireless Telegraph Company, Ltd.*), was incorporated in England as the first commercial wireless organization. Incidentally, that was the year J. J. Thomson discovered the electron which the radio tube was destined to generate and control. It would revolutionize all radio and extend its services for the benefit of mankind. Vital steps in this process were Fleming's invention of the valve detector in 1904, and DeForest's invention of the three-element tube, which he named the audion, in 1906.

In the meantime, Marconi had added success to success by increasing the range of his invention. Ship and shore stations were equipped. Ships of war as well as ships of commerce used the invisible method of signaling, and soon the wonder of wireless was front-page news throughout the world. The *S. S. REPUBLIC* disaster in 1909 and the tragic sinking of the *S. S. TITANIC* in 1912 revealed the great usefulness of wireless on the oceans.

The Marconi Wireless Telegraph Company of America, organized on November 22, 1899, contributed much to the advance of wireless. It served the Nation in peace and in war.

When the Armistice ended the First World War on November 11, 1918, wireless was generally confined to dots and dashes. But during the war a great transformation had taken place—radio had found an electric tongue; it had learned to talk and to sing. New vacuum tubes had been developed as keys to major advances in the development of radiotelephony and in harnessing the short waves which prior to the war had been considered beyond the range of usefulness. The war had changed all that. Radio emerged from the conflict revolutionized. As a science and an art, radio was on the threshold of a new era.

Because the Marconi companies and the Marconi inventions were to a large extent in British control, the United States faced the danger that this revolutionary method of wireless communication, with all its international implications, would be in foreign hands. The war had revealed the power over world communications as represented by the foreign ownership of the transoceanic cables. Wireless telegraphy in the hands of the United States Government had given the Nation an independent wartime communication service that spread across the hemispheres.

But Congress declined to sanction the continuance, in peace, of such a Government service. Restoration of the Government stations to the Marconi Company meant possible foreign control—even though American inventors such as DeForest, Alexanderson, Fessenden, Tesla, Edison and others had contributed immeasurably to the radio art.

It was at this juncture, in 1919, that the Radio Corporation of America was formed by the General Electric Company, as a result of suggestions by officials of the United States Navy, in order to provide an all-American communications company. On November 20, 1919, the business and property of the Marconi Wireless Telegraph Company of America were acquired by the Radio Corporation of America. Then General Electric turned over certain rights under its own radio patents to the new company, which was to carry on the business of wireless communications as well as to develop new inventions and new radio apparatus.

On December 1, 1919, RCA began business as an all-American organization, with Owen D. Young, Chairman of the Board; Edward J. Nally, President, and David Sarnoff, Commercial Manager. Primarily, the purpose of RCA was to give the United States pre-eminence in radio communications, independent of all other countries. The aim was not only to send and receive signals and messages on an international scale but also to improve and advance this new system of electric communication; to conduct progressive research and to create and supply consumer goods—all with the purpose of serving Americans everywhere. Great possibilities for expansion of wireless service at sea as well as for communication between and within nations were foreseen.

Commercial long-distance radio communication between the United States and foreign countries was inaugurated by the Radio Corporation of America on March 1, 1920, when the first messages over RCA transatlantic circuits were sent between New York and London. Before the end of 1920, service had been established with England, France, Norway, Hawaii, Japan and Germany.

This was the forerunner of an expansion that was to make America the center of world-wide radio communications. Coincidentally, introduction of radio communications brought about the first reduction in international message rates in 38 years, undercutting cable tolls from 5 cents to as much as 48 cents a word.

Radio engineers and contractors soon were busy building a *Radio Central* on a 10-square-mile tract at Rocky Point, Long Island, dedicated to world-wide communication. The receiving station was located 25 miles away at Riverhead. When construction had been completed, President Warren G. Harding, on November 5, 1921, formally opened this great new center of radio by sending a radiogram addressed to all nations.

Said President Harding:

> "To be able to transmit a message by radio in expectation that it may reach every radio station in the world, is so marvelous a scientific and technical achievement as to justify special recognition. It affords peculiar gratification that such a message, from the Chief Executive of the United States of America, may be received in every land, from every sky, by peoples with whom our nation is at peace and amity. That this happy situation may ever continue, and that the peace which blesses our own land may presently become the fortune of all lands and peoples, is the earnest hope of the American nation."

This message from the White House was personally telegraphed by David Sarnoff and acknowledged by 19 countries, four of which replied within 15 seconds.

Up to that time, the primary use of radio had been for point-to-point telegraphic communications, in which the comparative secrecy of the wireless code was sufficient to protect ordinary telegraphic confidences. For private telephone conversations, the radio was then far too public, and that fact gave false strength to the idea that radiotelephony was a limited field.

But this very "defect" created a far greater usefulness. If a far-flung audience could hear a radiotelephone message at the same time, here was a radically new means of mass communication. If radio could carry speech, it could also carry music. Out of the realization of this idea broadcasting was born. The pioneer experiments of Frank Conrad, over KDKA, the Westinghouse station at Pittsburgh, had been so successful that the Harding-Cox election returns of 1920 were broadcast to a limited number of

nearby amateur receivers. News of this triumph of radio kindled the broadcasting "craze," which spread like wildfire across the country. Immediately, endless possibilities were foreseen for broadcasting, and, quickly, hundreds of stations were on the air. Almost overnight radio listening became a national pastime.

All this and more too had been envisaged in 1916 by David Sarnoff, then Assistant Traffic Manager of the Marconi Wireless Telegraph Company of America. In a memorandum to E. J. Nally, the General Manager, David Sarnoff proposed a *radio music box* and outlined its future as follows:

> "I have in mind a plan of development which would make radio a household utility in the same sense as a piano or phonograph. The idea is to bring music into the house by wireless . . . for example, a radio telephone transmitter having a range of say 25 to 50 miles can be installed at a fixed point where instrumental or vocal music or both are produced. The receiver can be designed in the form of a simple *radio music box* and arranged for several different wave lengths, which should be changeable with the throwing of a single switch or pressing of a single button. The same principle can be extended to numerous other fields —as, for example—receiving lectures at home, which can be made perfectly audible; also events of national importance can be simultaneously announced and received. Baseball scores can be transmitted in the air by the use of one set installed at the Polo Grounds. The same would be true of other cities. This proposition would be especially interesting to farmers and others living in outlying districts removed from cities. By the purchase of a *radio music box* they could enjoy concerts, lectures, music, recitals, etc., which may be going on in the nearest city within their radius. Should this plan materialize, it would seem reasonable to expect sales of 1,000,000 *radio music boxes* within three years. Roughly estimating the selling price at $75 per set, $75,000,000 can be expected."

The plan *did* materialize! David Sarnoff's estimate that sales amounting to $75,000,000 could be expected within a three-year period was realized. Indeed, it was surpassed, for RCA's actual sales of some instruments during the three years from 1922 through 1924 totalled $83,500,000.

Most of the listeners to the early broadcast programs used crystal detectors—tubeless receiving sets. Development of vacuum tubes both as sensitive detectors and amplifiers quickly expanded the radio audience, and by 1921, broadcasting overshadowed all other developments of what had once been the revolutionary art of the Wireless Age.

The wireless amateurs, numbering between 3,000 and 5,000, had served as a reservoir for trained radio operators during the First World War. Now with music in the air, they turned from dots and dashes to use the radiophone to talk through the air. They built receiving sets that helped to reveal the great potentialities of broadcasting. The amateurs listening in with their wireless sets formed a vast field-testing laboratory; they were the nucleus of the first radio audience. Soon they took up the vacuum tubes and cast aside the old spark gaps; they helped to blaze the trail into the short-wave spectrum and contributed to the advance of the art through their home-made transmitters and receiving sets. The radio industry drew upon the amateurs for many of its leaders.

The Dempsey-Carpentier championship fight in the great wooden saucer at Boyle's Thirty Acres in Jersey City on July 2, 1921, was a broadcast that literally opened the ears of millions to the possibilities of radio reception. The lucky owners of crystal detector sets and one-tube receivers heard the blow-by-blow description in their earphones. At the final gong, they knew more about the details of the fight than those who had trekked through the heat and dust of that summer afternoon to sit at the ringside. Major J. Andrew White was the announcer, with David Sarnoff at his elbow to assist in the description through the microphone of station WJY, temporarily installed by RCA at Hoboken.

That autumn, station WJZ was officially opened by Westinghouse at Newark, New Jersey, as the first regular broadcaster in the metropolitan area. The first program featured World Series bulletins. In quick succession, WBZ opened at Springfield, Mass.; KYW at Chicago; WGY at Schenectady; and WBAY, an experimental station of the American Telephone & Telegraph Company in New York, changed its call letters to WEAF. That was the station which a year later broadcast the first commercial program, thereby leading to a solution of the problem as to *who would pay* for broadcasting: on September 7, 1922, a talk on real estate was sponsored by the Queensborough Corporation at the rate of $100 for ten minutes. The Princeton-Chicago football game was the first broadcast from the gridiron in 1922, and the New York Philharmonic Orchestra, heard on the air for the first time on November 22, in the same year, gave noteworthy recognition to radio as a new medium for the presentation of music.

Radio history was being made almost daily. In the first eleven months of 1921, General Electric and Westinghouse produced for sale by RCA 5,000 tubes a month; production in June, 1922, totalled 200,000 tubes. In 1922, the American public spent between $75,000,000 and $100,000,000 for radio sets, tubes, headphones and batteries. On October 15, 1922, high-power vacuum tubes were used for the first time in RCA transmitters handling traffic between New York, England and Germany. The vacuum tube had grown to 20-kilowatt power! Broadcasting stations increased from 30 to 556 between January 1, 1922, and March 1, 1923. Americans spent $175,000,000 for radio instruments in 1923.

Radio reception was destined for a sensational change by the announcement in 1923 that the superheterodyne circuit, developed during the war, had been designed as a commercial product, and that RCA would introduce it for home use. Because of its marked efficiency, sharp tuning and sensitivity, the "super" became a universal receiver; it superseded the regenerative set as effectively as the "regenerator" had sent the crystal detector into discard.

On January 1, 1923, Lieut. General J. G. Harbord, who commanded the Second Division in the First World War and had been General Pershing's Chief of Staff, became President of the Radio Corporation of America. David Sarnoff, then General Manager, became Vice President and General Manager.

On April 5, 1923, Sarnoff in a report to the RCA Board of Directors, said:

> "I believe that *television*, which is the technical name for seeing as well as hearing by radio, will come to pass in due course . . . . It may be that every broadcast receiver for home use in the future will also be equipped with a television adjunct by which the instrument will make it possible for those at home *to see as well as hear* what is going on at the broadcast station."

Station WJZ, acquired by RCA in the spring of 1923, moved from Newark to New York to share with WJY new modernistic studios in Aeolian Hall on 42nd Street. This put broadcasting near to the theatrical center and Broadway talent, thus making it convenient for performers to reach the microphone. Predictions were heard that a nationwide network would some day carry New York programs to all the country. Hope was stimulated by the first multiple-station network that linked WEAF, New York, WGY, Schenectady, KDKA, Pittsburgh, and KYW, Chicago, in June, 1923. President Harding spoke from St. Louis and was heard in that area through KSD, while at the same time New Yorkers heard his voice through WJZ, and Washingtonians listened through WCAP. This was the first Presidential network hookup, but not Harding's first broadcast, for he had spoken before a microphone

at the burial of the Unknown Soldier on November 11, 1921, at Arlington, Va. Later, Woodrow Wilson, in his only public address after retiring from the White House, broadcast over WEAF on Armistice Day—November 11, 1923. In December of that year, the opening of Congress was featured as the first broadcast from within the Capitol at Washington.

Microphones were installed at both the Republican and Democratic National Conventions in 1924, enabling the Nation to listen in for the first time on this *lesson in civics*. The gooseneck horn was the popular loudspeaker of that day, and the voices that issued from it spread the word that Calvin Coolidge had been nominated by the Republicans at Cleveland, and John W. Davis by the Democrats at New York. A record-breaking audience listened in at the 3,000,000 radio sets of that day when William Jennings Bryan, speaking from the convention at Madison Square Garden, called radio "a gift of Providence."

While broadcasting was making new strides daily, other phases of radio were keeping pace with it. On July 6, 1924, a radiophoto of Charles Evans Hughes, then Secretary of State, was transmitted by RCA from New York to London, where it was radioed back across the Atlantic and recorded in New York. Later in the year, pictures of President Coolidge, the Prince of Wales, Stanley Baldwin and others were flashed from London to New York.

Distance across the Atlantic was shrinking. The first international broadcast transmitted from Chelmsford, England, was picked up by RCA at Belfast, Maine, relayed by short-wave to WJZ, New York, and there rebroadcast to the American audience. The voice of broadcasting was also becoming stronger; 50-kilowatt transmitters were being tested.

The Coolidge inaugural on March 4, 1925, was broadcast by the record-breaking hookup of that day—21 stations! Several days later, on March 12, WJZ, New York, and WRC, Washington—the RCA station in the Nation's capital—rebroadcast the gong of Big Ben atop the Houses of Parliament, while it was striking midnight in London.

But radio activity was not confined to the Atlantic. On May 7, 1925, facsimile messages, maps and pictures were transmitted from New York to Honolulu, 5,136 miles, by RCA radiophoto.

The year 1925 also marked the opening of a new era in home-radio reception, when RCA introduced an all-electric receiving set, utilizing electron tubes arranged for either battery or light-socket operation. A year later headlines in the news featured a sensational development in radio tubes which would make it practical to operate home-radio receiving sets by plugging them into the house-lighting socket. RCA had developed tubes to operate on alternating current. Gone was the necessity for batteries and current-supply devices which up to this time had littered the living room alongside the radio set. Radio in the home now would be more compact, more convenient, more decorative and, particularly, foolproof and simpler in operation.

The year 1926 was destined to see many new milestones erected in radio. On the first day of the year John McCormack, noted Irish tenor, and Lucrezia Bori, star of the Metropolitan Opera, made their debuts over WJZ. It was a historic broadcast, the success of which encouraged other noted artists, who theretofore had frowned upon broadcasting, to go on the air. They were convinced by the quality of the McCormack-Bori concert that radio could do justice to their art; furthermore, radio had found a means of paying them—the commercial radio sponsor.

Broadcasters could now offer widespread "circulation"; their audience numbered millions. Advertisers grasped a new opportunity to go on the air to advertise and gain good will for their products through entertainment. They linked their trademarks with the names of popular performers and orchestras, speakers and news. Radio became a powerful advertising medium—the Fifth Estate.

Interference by overlapping stations, resulting from five years of disordered growth of broadcasting, was put to an end when President Coolidge, on February 23, 1926, signed the Dill-White Radio Bill. Up to that time the Wireless Act of 1912 had been used to regulate the new art of broadcasting, but this Act could not cope with the rapid expansion of broadcasting, and chaos had resulted on the wavelengths. The Dill-White Bill and the creation of the Federal Radio Commission restored order.

The way was cleared for increased service on all wavelengths. The picturegram of a check was sent through the April air of 1926 via the RCA system from London to New York, where it was honored and cashed. On April 30, RCA sent the first radiophoto across the Atlantic on a commercial basis; it was a picture of the Pilgrim Society dinner in London radioed to New York for publication in *The New York Times*.

Radio activity also spread to far corners of the earth as aviation tested its wings on flights over remote areas. The Byrd-Bennett plane, *Josephine Ford*, flew to the North Pole carrying a 44-meter radio transmitter. That was in May, 1926, the same month that the dirigible *Norge* sailed over the Arctic and sent the first wireless message directly from the North Pole.

Sports continued to reveal the popularity of its alliance with radio, and on September 23 of that year, the Dempsey-Tunney championship fight was broadcast by long and short waves to all parts of the world; again the World Series was broadcast by WJZ's nationwide hookup.

In 1926 the silent motion picture became a talkie. Electronics gave the film a sound track—and sound being the stock in trade of radio—it had a close relationship with the talking picture. It was natural, therefore, that in 1928, RCA should organize the R.C.A. Photophone, Inc., and enter the talking picture apparatus field.

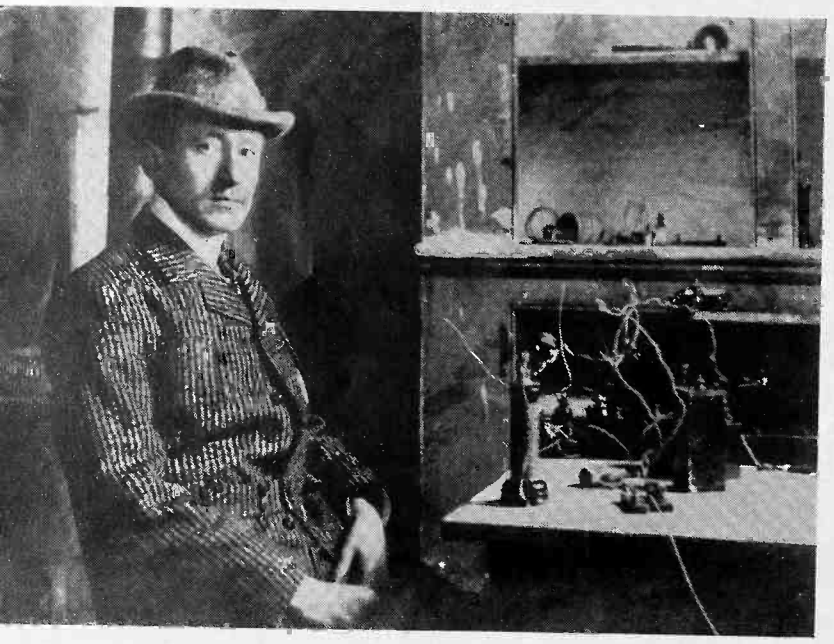
September 9, 1926, became a historic date in the annals of radio —the National Broadcasting Company was organized as a service of RCA. It was announced that the aim of the NBC "will be to provide the best programs available for broadcasting in the United States," and to accomplish its purpose NBC had two key stations in New York—WJZ and WEAF. It was stated that the National Broadcasting Company would not only broadcast its programs through WEAF, but also it would make them available to other broadcasting stations throughout the country as far as it was practicable to do so.

It was recognized that the market for receiving sets in the future would be determined largely by the quantity and quality of the programs broadcast. The aim of RCA was to make available radio receiving sets of the best tonal quality at prices which would enable all to buy. Success in this achievement inspired David Sarnoff to remark, "The richest man cannot buy for himself what the poorest man gets free by radio."

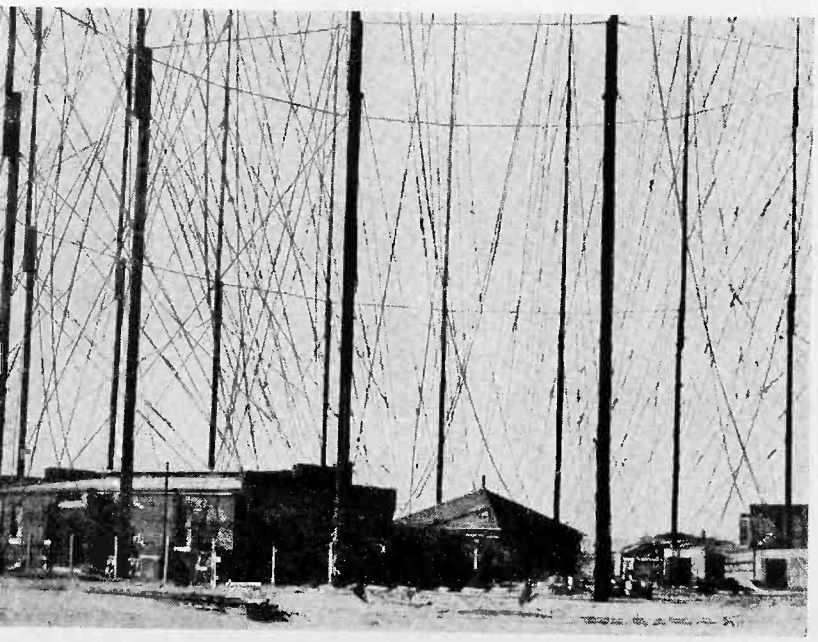
The day had passed when the radio receiving set was a plaything; it had become an instrument of service—a *household utility*. The future of radio broadcasting would be dependent largely upon the character of the programs.

Gradually, the radio network stretched out across the country from the East and from the West, finally connecting at Denver so that the football game in the Rose Bowl at Pasadena was broadcast over a 4,000-mile hookup on New Year's Day, 1927. This was soon followed by the first coast-to-coast broadcast of the opera *Faust* from the stage of the Chicago Civic Auditorium; and by the first transcontinental, 50-station hookup which carried President Coolidge's Washington's Birthday address, the initial broadcast from a joint session of Congress. The return of Charles A. Lindbergh to the United States, after his historic flight to Paris, was broadcast by the largest network of stations ever assembled up to that time. ♦

communications



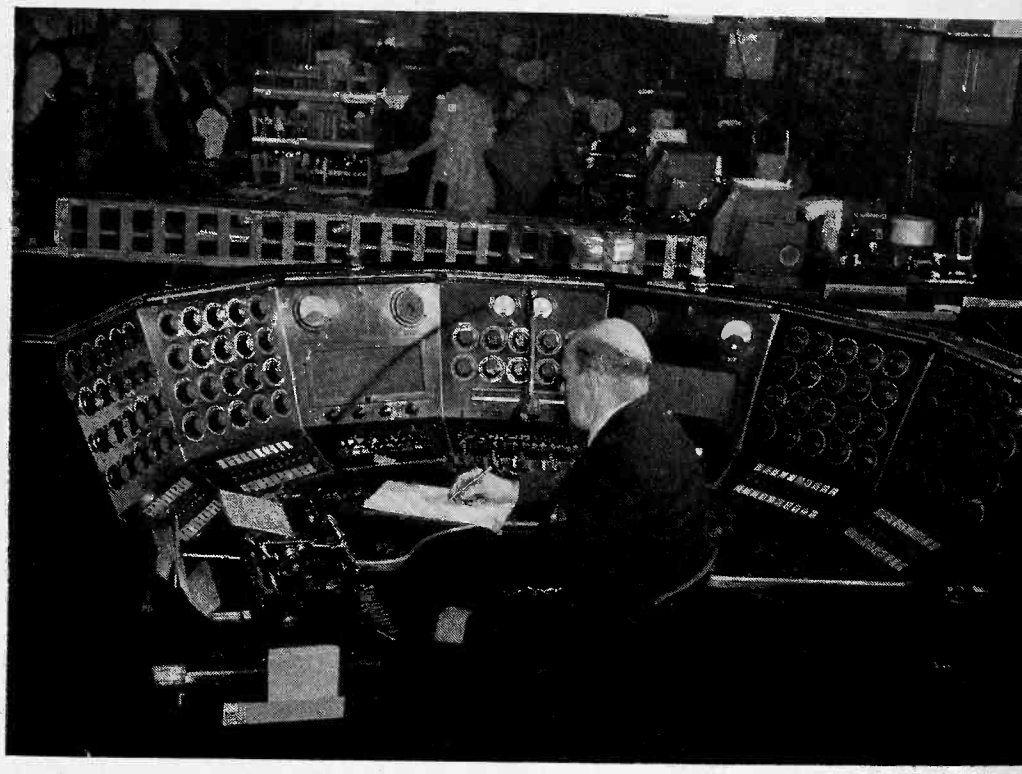
Guglielmo Marconi with the apparatus used to receive the first transatlantic radio signal on Dec. 12, 1901.



This Marconi radio transmitting station erected at Wellfleet, Mass., in 1902 succeeded in sending signals across the Atlantic.

Radio entertainment became available to ships at sea with the introduction of the RCA Radiola II—one of the earliest battery portable receivers.

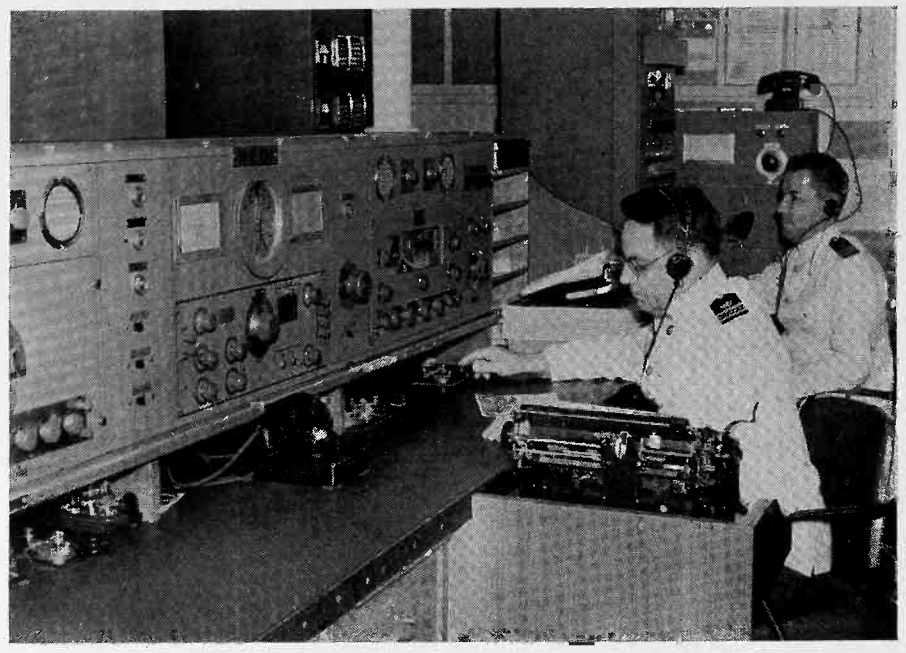
This desk once controlled all RCA world-wide communications circuits.

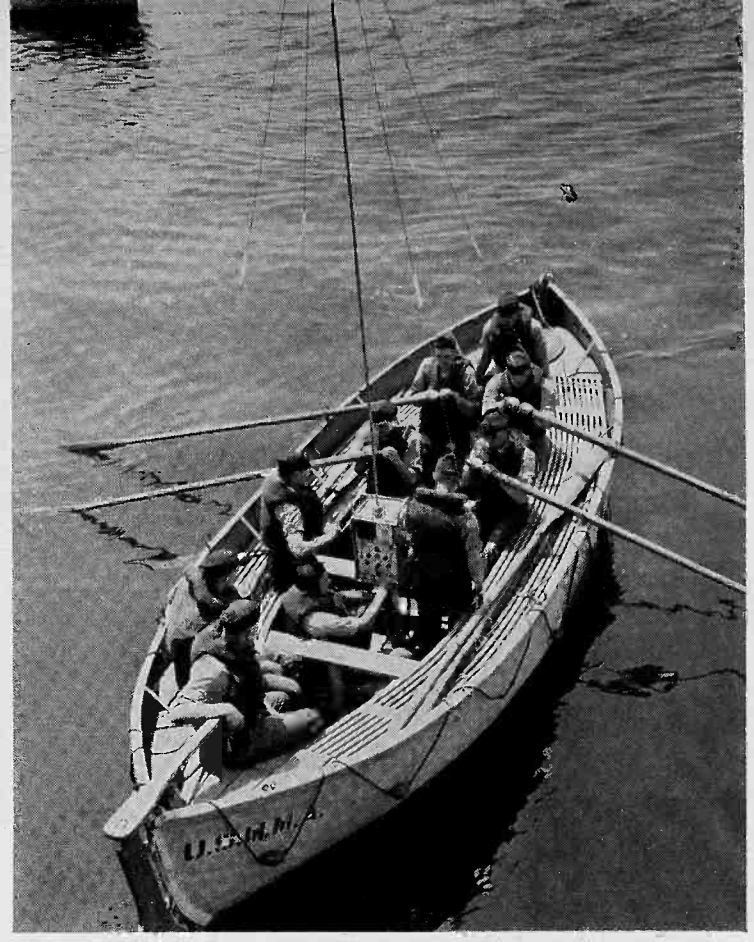


In 1924 radio photographs were transmitted for the first time from New York to London, and re-transmitted back to New York.


YORK HERALD
Tribune
Radio Flashes Pictures Over
From London to N.Y. in 6 Minu

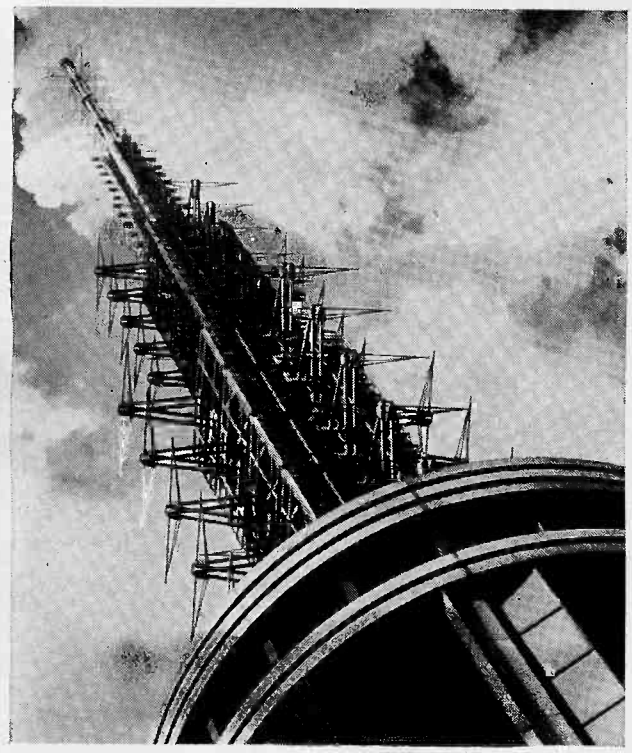
Equipment in the radio room of the "U.S.S. America" includes a direction finder and an automatic S.O.S. detector.





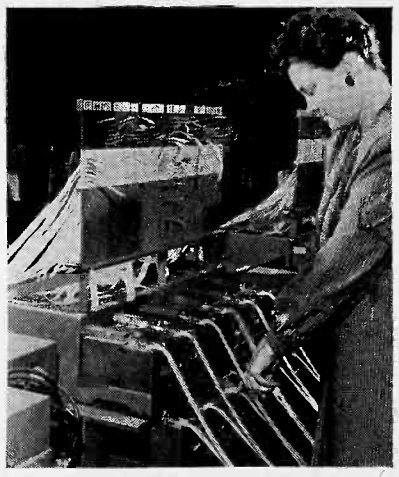
Self-powered lifeboat radio receivers developed during the war helped save many lives at sea.

RCA designed the television antenna for use atop the Empire State Building—world's tallest structure and site of the NBC pioneer television station WNBT.



Pocket radio set is used by patrolmen.

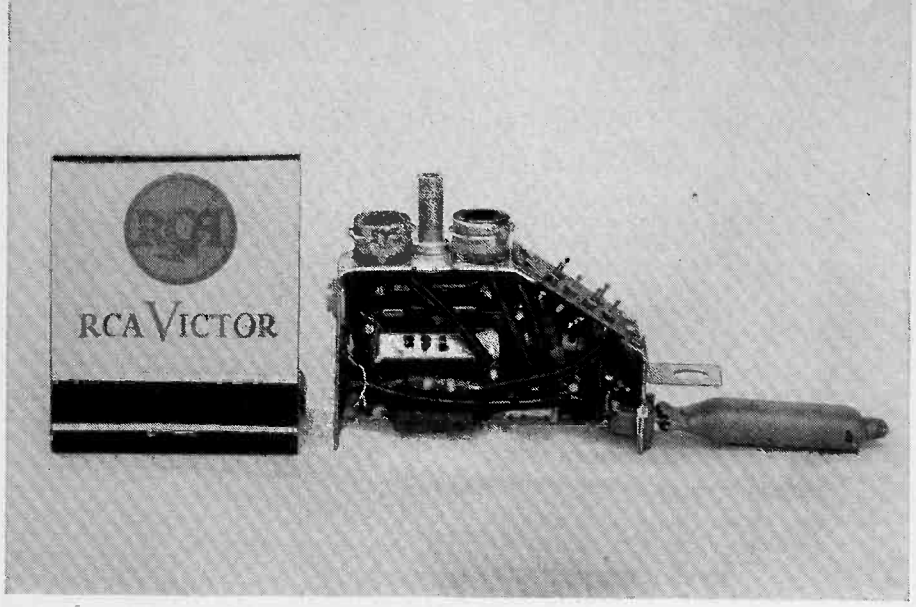
A mobile radio system is of vital importance in policing the Ohio Turnpike.



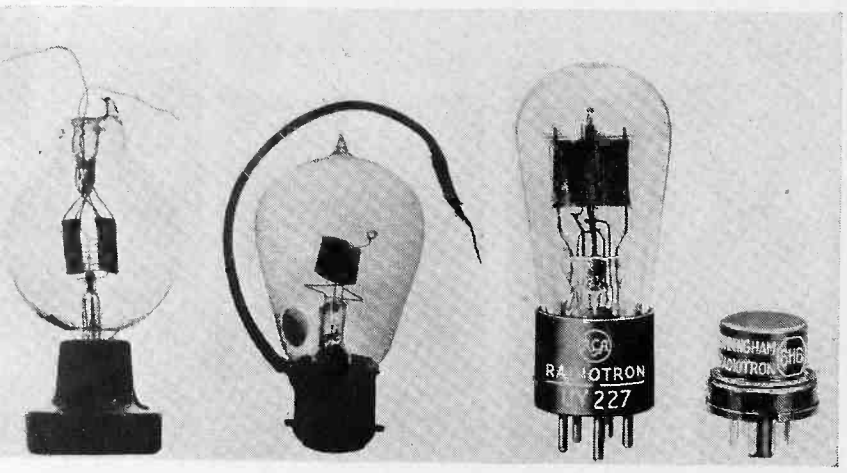
International radio messages are received on RCA tapes, decoded automatically and despatched to addressees.

Using power from the first atomic battery, Sarnoff telegraphs: "Atoms for peace. Man is still the greatest miracle and the greatest problem on this earth."

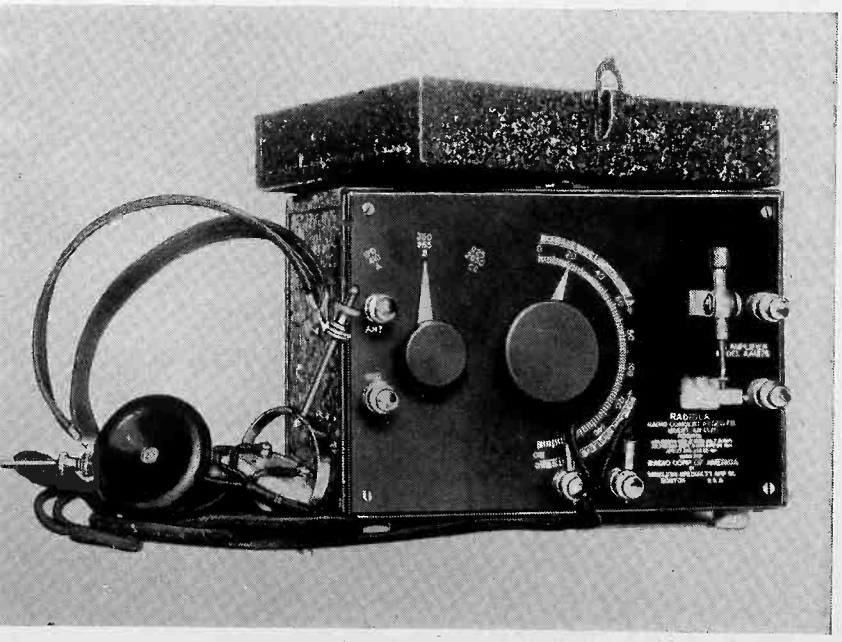
radio



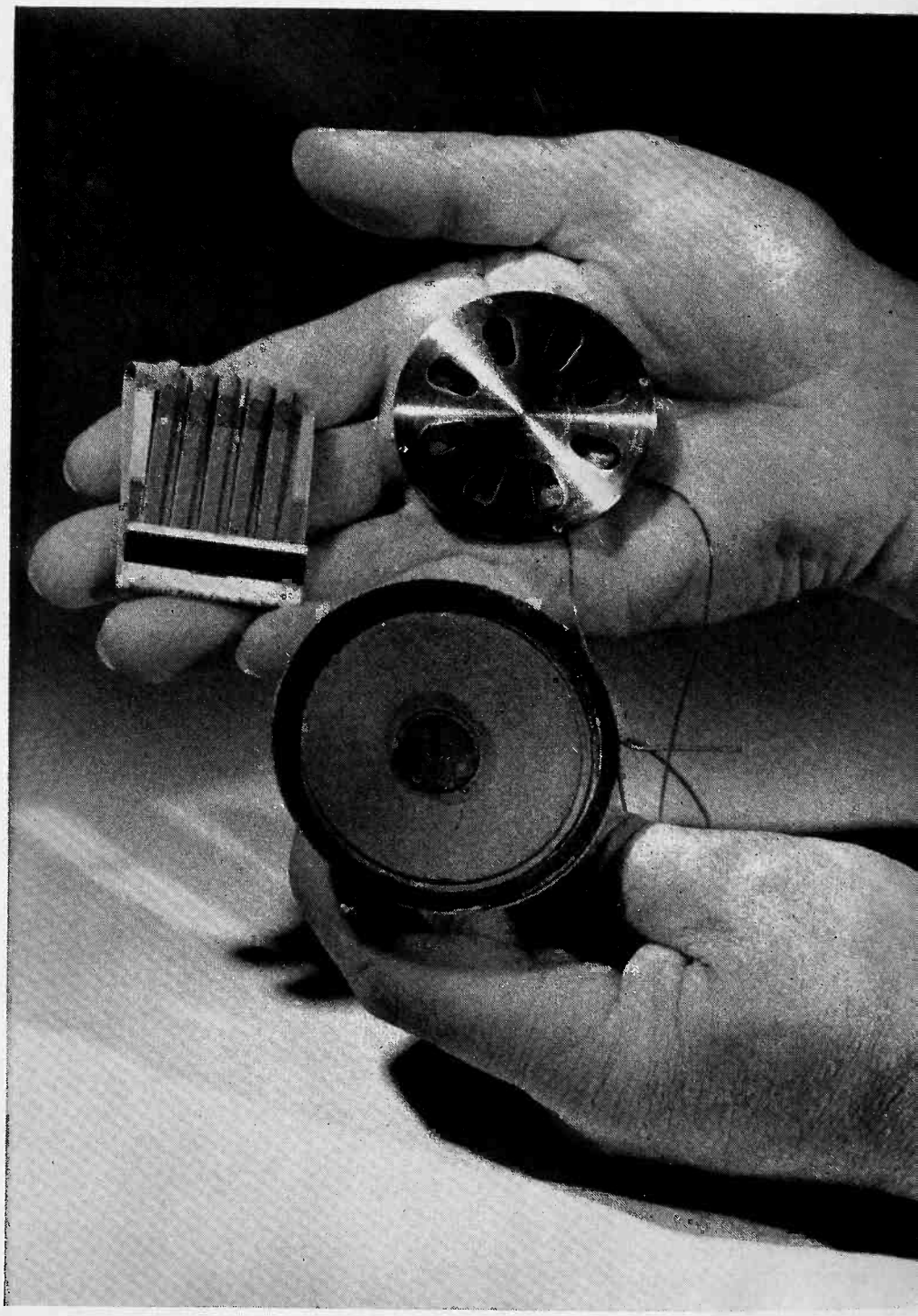
The complete receiver output section of a modern half-size walkie-talkie compared to a match folder. This assembly is a typical result of sub-miniaturization techniques.



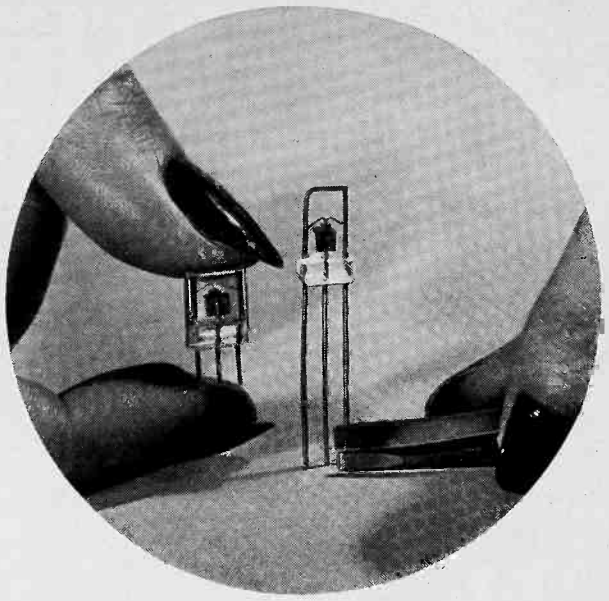
Two inventions which helped to make radio possible. Left: DeForest's first three-element electron tube, invented in 1906 and known as the audion. Right: Fleming's valve, a two-element tube invented in 1904 and forerunner of today's large family of electron tubes.



By 1920, listeners could enjoy programs from pioneer stations with the aid of the crystal detector and earphones.



The smallest loudspeaker ever built for commercial use (top) employs novel design principles which make it smaller and lighter than the conventional speaker, held in the foreground.



ABOVE: *Point-contact type transistors before and after being embedded in plastic housing.*

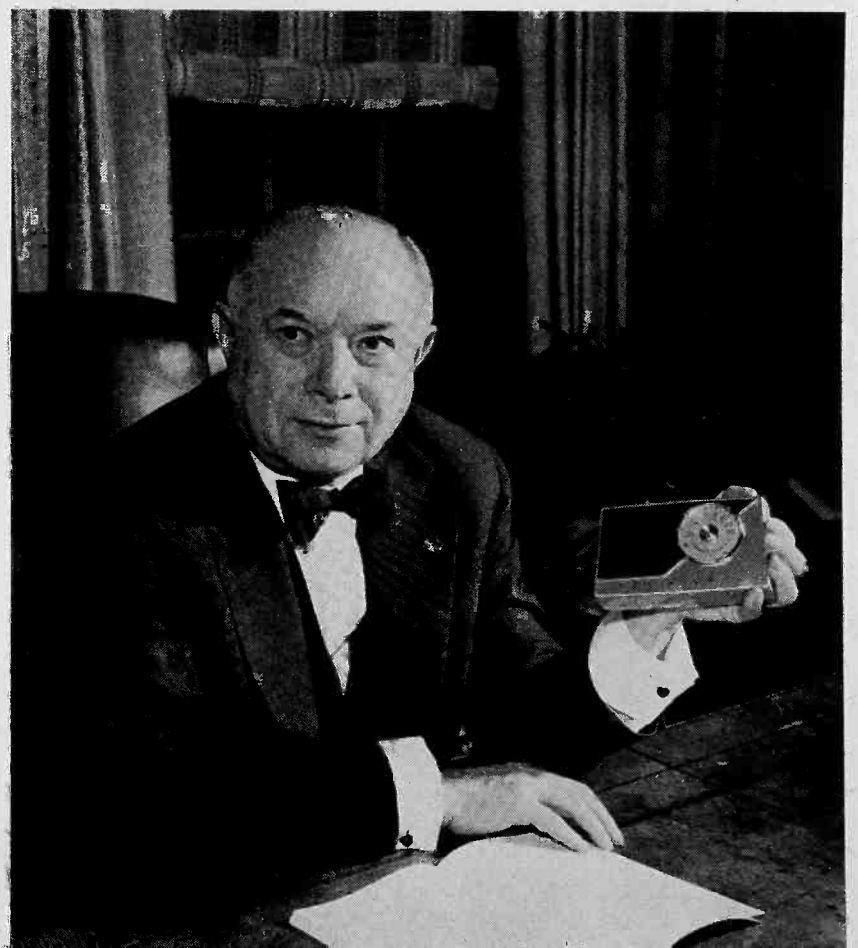
BELOW: *The tiny transistor is compared with a miniature vacuum tube which it is rapidly replacing in radio sets and other electronic apparatus.*

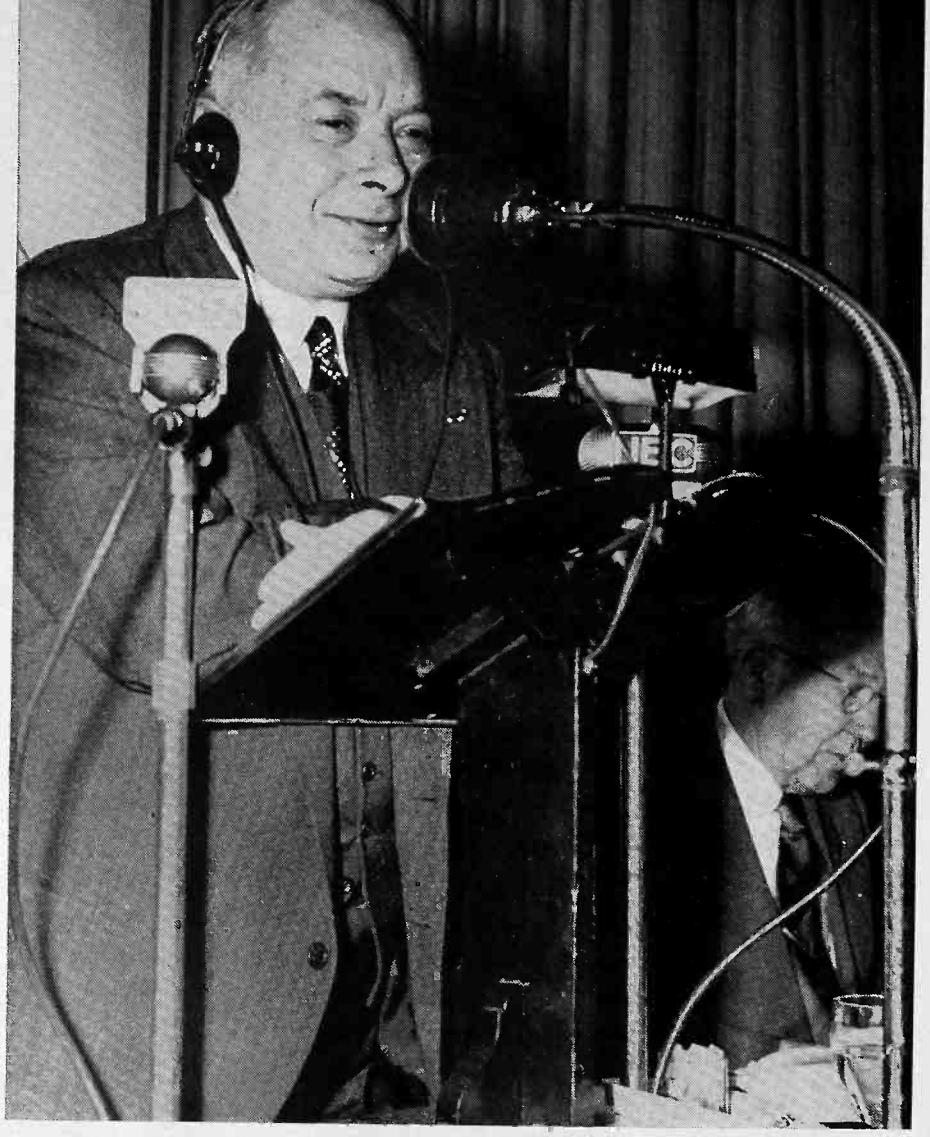
A boon to motorists is this automobile radio, operating from transistors instead of tubes. The transistors operate directly from a 6-volt car storage battery.

Assembling intricate marine radio receivers.

Clock-radios being carefully tested and prepared for shipment.

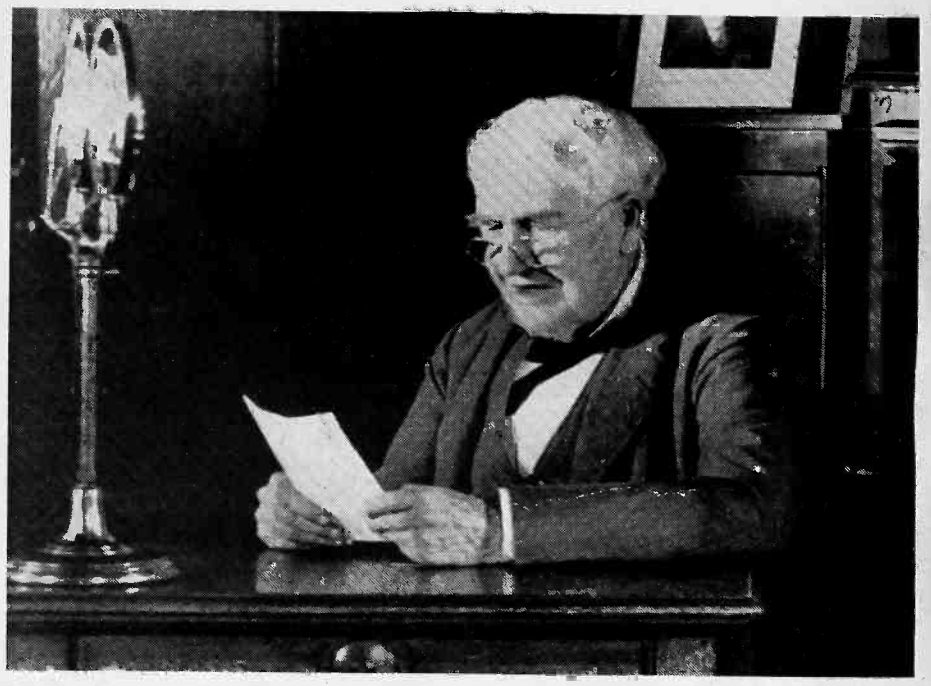
General Sarnoff displays an RCA transistor radio, which is small enough to be carried in a coat pocket.



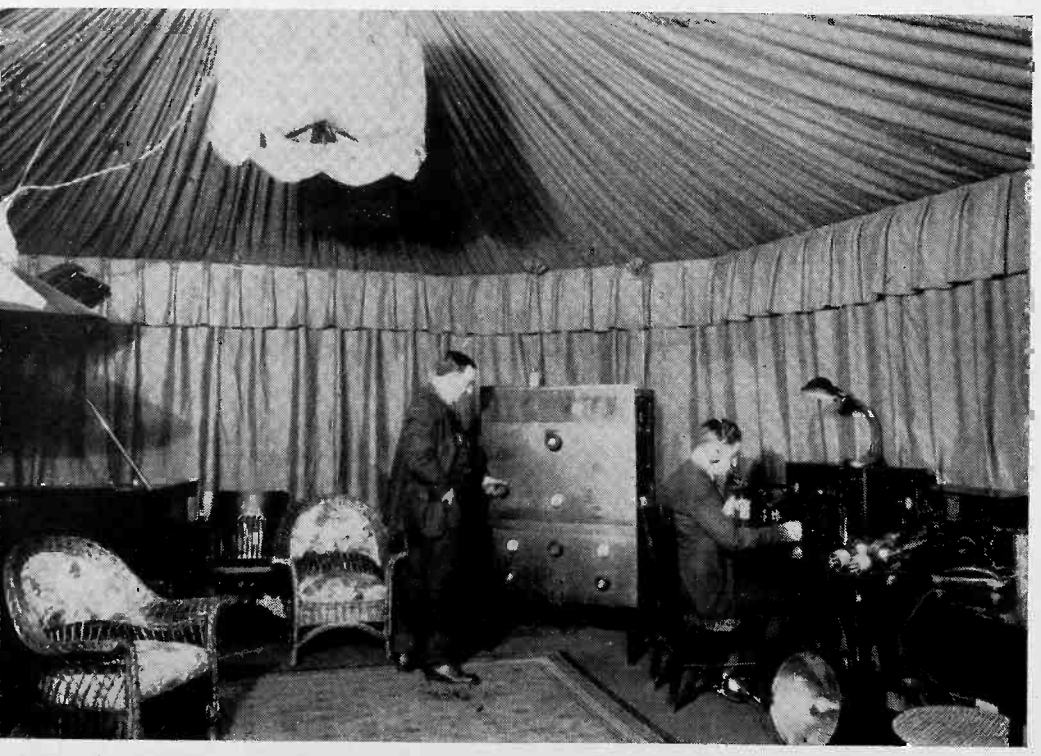


David Sarnoff talks from New York by radio to Marchesa Marconi in Rome, during a Marconi commemorative luncheon held at the Waldorf-Astoria on December 20, 1951.

With the advent of the portable self-contained battery radio receiver in the mid-Twenties, a new form of family entertainment became available. Note the characteristic horn-type speaker, partially hidden by the lamp.



Famous inventor Thomas Alva Edison, whose work contributed so much to the growth of radio, broadcast in 1928 over NBC.



Station WDY established this broadcasting studio at Roselle Park, N.J., in 1921. One microphone was hidden in the chandelier; another in the cone suspended over the piano. The station amalgamated with WJZ, Newark, in 1922.

Sound effects had their pioneer days, too. This studio picture was taken in 1926 at WGY, Schenectady, when the WGY Players performed "Rip Van Winkle."

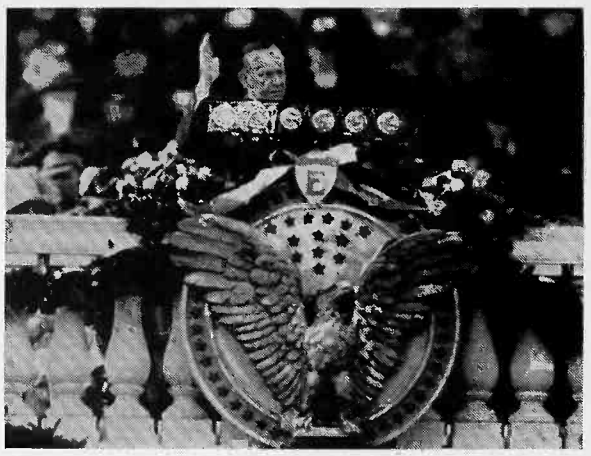
The Cities Service program, launched in 1927 on NBC, is still going strong. Here Jessica Dragonette (who joined the series in 1930) is seen with Rosario Bourdon's Orchestra.

Some of broadcasting's earliest successes were in the field of sport. J. Andrew White, pioneer sports announcer, explains the workings of a crystal receiver to Jack Dempsey prior to Dempsey's heavyweight championship fight with Georges Carpentier, at Boyles 30-Acres in July 1921. Dempsey later won the contest in the fourth round.

Graham McNamee interviews Babe Ruth between innings at a Yankee ball game.

Radio announcers soon became a part of the scene at sporting events. Bill Stern is broadcasting news of a track meet at Randall's Island.

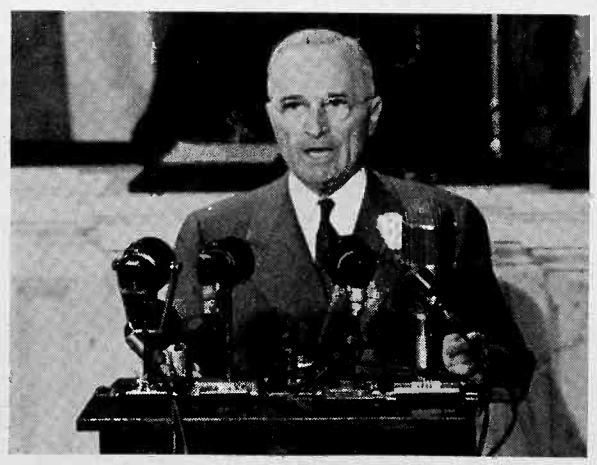
1923: President Harding.



1925: President Coolidge.

1929: President Hoover.

1942: President Roosevelt.



1948: President Truman.

Comedian Eddie Cantor's first NBC broadcast was in 1926; in the more recent photograph (right) he is much less restrained.

Will Rogers, one of America's best-loved personalities, began dispensing his homespun philosophy on the NBC network in 1926.

1953: President Eisenhower.

Jim and Marian Jordan, better known as Fibber McGee and Molly.

Weber and Field, at the height of their vaudeville fame, were in NBC's opening network show in 1926.

George Burns and Gracie Allen in a scene from one of their early radio shows.

Fanny Brice made "Baby Snooks" famous.

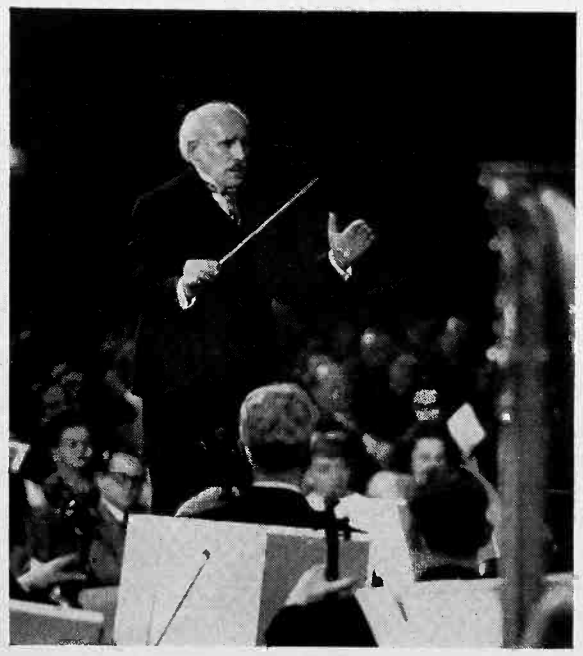
These famous performers entertained radio listeners in the early Thirties. L. to r: Bob Burns, Tommy Riggs, Edgar Bergen and Charlie McCarthy, Rudy Vallee, and Joe Penner.

Gertrude Berg, author of "The Goldbergs," the 17-year-old first family radio serial, now stars as Molly in a weekly TV version.

Violin virtuoso Jascha Heifetz rehearses for the "Telephone Hour" in the NBC studio at Radio City, New York.

Major Edward Bowes, late Broadway showman, whose famous "Amateur Hour" inspired the "Original Amateur Hour" show on NBC.

Famed musical director Walter Damrosch became music counselor to NBC in 1928 and was responsible for founding and conducting orchestral radio concerts for public schools and colleges.



Arturo Toscanini conducted the first radio performance of the NBC Symphony Orchestra.

Al Jolson was one of the many great entertainers who broadcast over NBC.

Mary Livingstone and Jack Benny in a scene from one of their many broadcasts.

An important role in modern broadcasting is played by the sound-effects man, who uses a strange assortment of equipment.

ABOVE: *San Francisco newsroom of NBC presents a picture of industry as news writers sift and prepare material.*
BELOW: *The up-to-date newsroom of NBC Radio Central, New York. (Note the row of clocks which indicate the time of day in eleven of the world's most important cities.)*

David Sarnoff inspects an ingenious display created for the Crusade of Freedom, in support of Radio Free Europe. When the microphone lights up, the chains worn by the enslaved people (top) appear to melt away.

THE WORLD OF TELEVISION

by David Sarnoff

So swiftly that America has barely awakened to its significance, television has reached from city to city across the Nation. It has brought into millions of homes the magic of its immediacy and reality—transmissions of sight and sound combined, with an impact on practically all phases of life.

Rooftops have sprouted with antennas, first a few here and there, then, seemingly in no time at all, some communities have fairly bristled with them. Behind this vibrant sign of television's advance into millions of households in the postwar span of years have been superlative pioneering efforts of scientists, engineers, industrialists, program directors and broadcasters, endowed with vision and faith in the ultimate potentialities of this great communications art.

Television's expanding vigor after World War II has transformed into reality the hopes and dreams of its pioneers. Seldom before has an industry grown so swiftly; nor has a new service received such popular acclaim in so short a time.

First introduced by RCA-NBC as a service to the American public in 1939, television was slowed to a virtual standstill by defense and wartime curtailments. But when these restrictions lifted, it soon sped ahead. In a third of the time it took the automobile industry, television now has the distinction of being among the ten major industries of America.

In the course of its tremendous growth, television has become an extremely important factor in American economy. Not only has it created thousands of jobs in production and programming, but it has been a valuable aid in the expansion of many other industries.

By increasing the general demand for goods and services by as little as 1 per cent, television's contribution to the national income is estimated at hundreds of millions of dollars annually. It is the belief that it will increase such demands by *10 per cent.*

Television sets themselves have been steadily improved since the first postwar instrument reached the market in 1946.

I have been associated with broadcasting from its inception. I have seen it grow from a precocious infant enterprise to its present dimensions as a major factor in our society and economy, and I have shared its headaches and its triumphs through those decades.

I recall vividly the year 1947; the place, Atlantic City, where NBC was holding its first Affiliates Convention. Television broadcasting was just getting started, with only 13 stations on the air and 16 applications pending.

There were some members of the industry on that occasion who cautioned me to *soft pedal* television. Station owners, they told me, were perfectly content to go along with the great sound broadcasting medium and leave television to the next generation.

I did not heed their warning. It has always been my conviction that scientific progress neither can nor should be frozen. True, every great technical advance naturally creates problems along with opportunities. But these are challenges to be met, not evaded.

Therefore, I minced no words in Atlantic City in expressing my unbounded faith in the prospects for the new medium. I urged broadcasters to seize the opportunities opened up by television. Many acted promptly on that advice and are now operating profitable television stations. I feel sure that they bear me no grudge for my optimism.

What a phenomenal growth this great new medium of mass communication has enjoyed since that time! How deeply it is already rooted in the everyday life of our people!

But this is not a time for looking backward. The most dynamic industry in history's most dynamic nation has no alternative but to look forward—without self-delusions about obstructions ahead, but with self-confidence in our ability to overcome them.

Inspiring opportunities—in radio as well as television—are still ahead of us.

If radio and television—in their own way—seek out and meet public needs, they will keep audience attention and continue to grow in influence. And every cubit added to their stature as public services makes them that much more effective as advertising media.

Radio was built on the basis of service to the American people. Television must be based on the same solid foundation. For all its drama and potential for profit, television should be no place for get-rich-quick Wallingfords, more interested in what they can take than what they can give. Sure, they may ride high for a time, but they will have no staying power. Sooner or later the public will intervene, and they will lose out to broadcasters who have shouldered the responsibilities on which continuing opportunities for profit are founded.

Television, like radio, should be a profession, with all that the term at its best implies in integrity, dignity, and above all dedication to a tradition of public usefulness. It should provide careers upon which young Americans can enter with the same proud sense of fulfilling a vital public function that they have in entering science, medicine, law, or journalism. That inner awareness of mission applies not only to stations and networks but to TV performers, production people, administrators, salesmen and technicians.

The American system of broadcasting is part and parcel of the American way of life, the essence of which is freedom tempered by a sense of responsibility. Broadcasting, like the rest of our industry, is financed by private capital that is put to work to earn a profit. If we are to maintain and enlarge our capacity to serve the public, the various elements of our broadcasting structure must be kept in sound financial condition. It is a case where self-interest and public interest coincide.

In the Spring of 1949, the cry went up that *radio is doomed.* Some of the prophets of doom predicted that within three years sound broadcasting over national networks would be wiped out, with television taking its place.

I did not join that gloomy forecast in '49, nor do I now. Years have passed, and radio broadcasting is still with us and rendering nationwide service. It plays too vital a role in the life of this nation to be cancelled out by another medium. I have witnessed too many cycles of advance and adaptation to believe that a service so intimately integrated with American life can become extinct.

We would be closing our eyes to reality, however, if we failed to recognize that radio has been undergoing fundamental changes. To make the most of its great potentials, it must now be operated and used in ways which take cognizance of the fact that it is no longer the only broadcast medium. A process of adjustment is necessary, and it is taking place.

Radio is being used widely and intensively—but it is being used differently. Family listening is giving way to individual listening.

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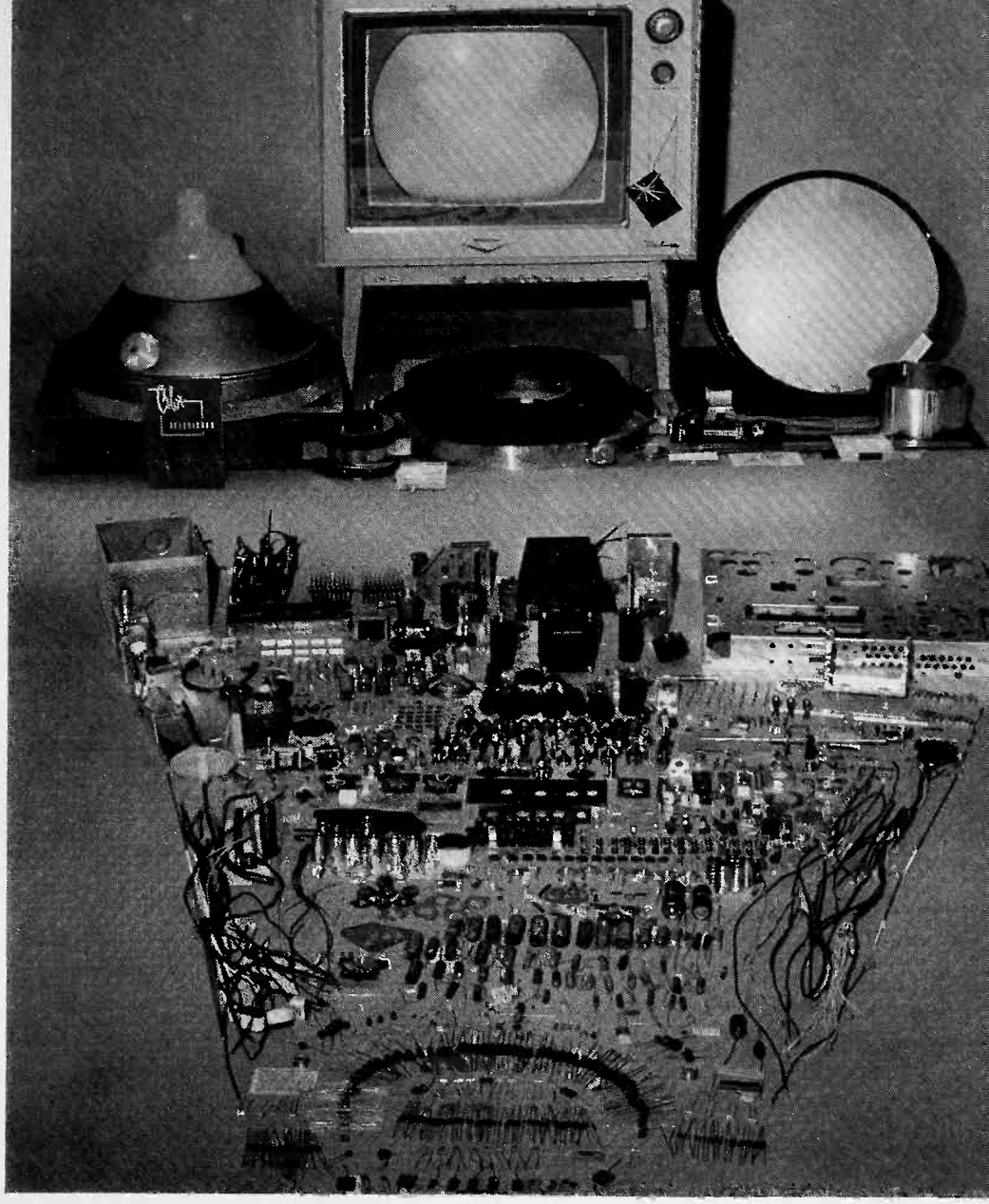
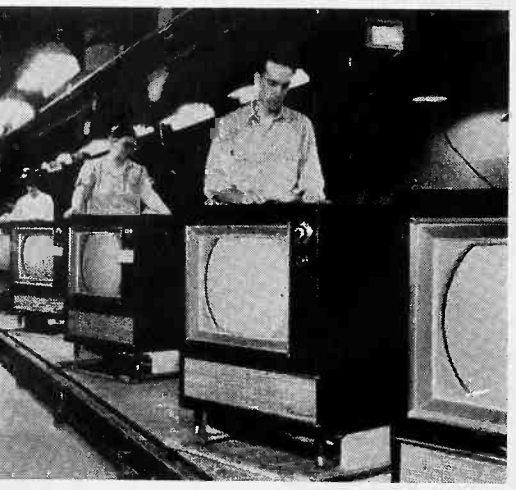
Today millions of people are furnished with news, information, and entertainment by the fine programming of radio and television networks as inaugurated by General Sarnoff.

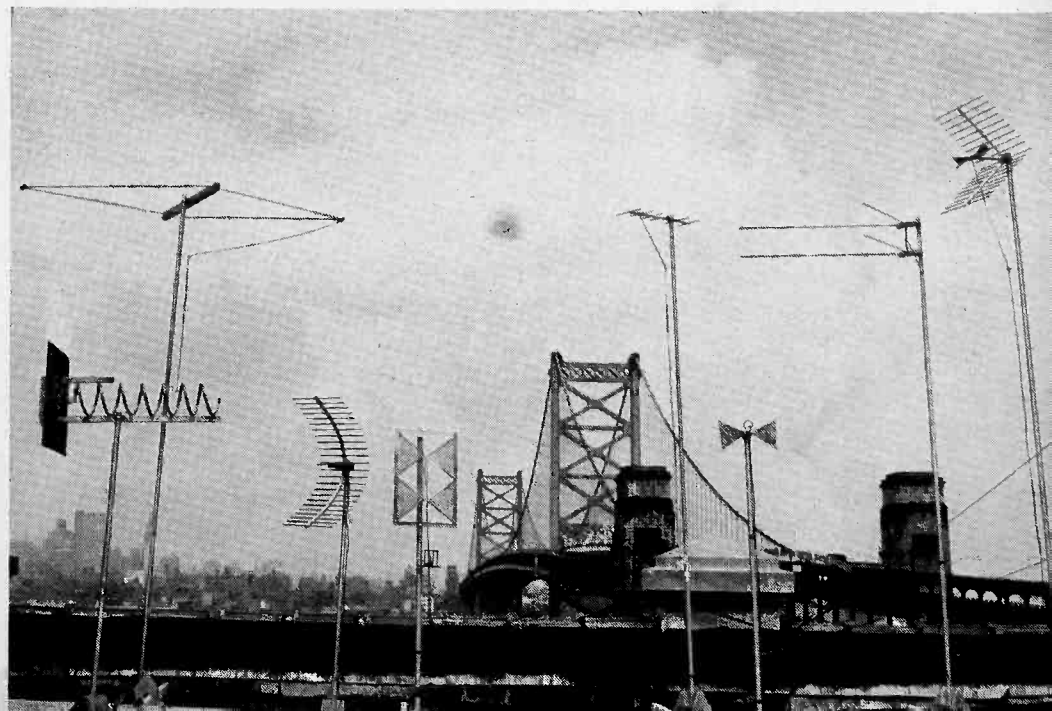


Here is what you will find inside your television set. The array of components shown would make just one RCA color television receiver.



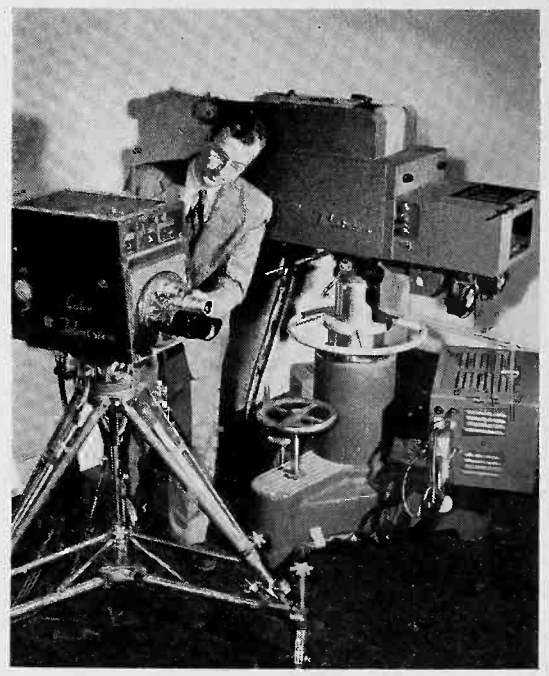
LEFT: *Experts give final adjustment to RCA Victor color television sets as they near the end of an assembly line at the RCA Bloomington, Ind., plant.* RIGHT: *Conveyor belts at RCA's modern factory carry television chassis down long line for assembly and quality control check.*

Research workers are continually striving for better television reception. These experimental ultra-high-frequency antennas were used to help improve picture quality in fringe areas and to eliminate reflections in cities.



Old meets new as E. L. Groth prepares to take a photograph of a 1956 television camera with his 1901 Eastman folding camera.

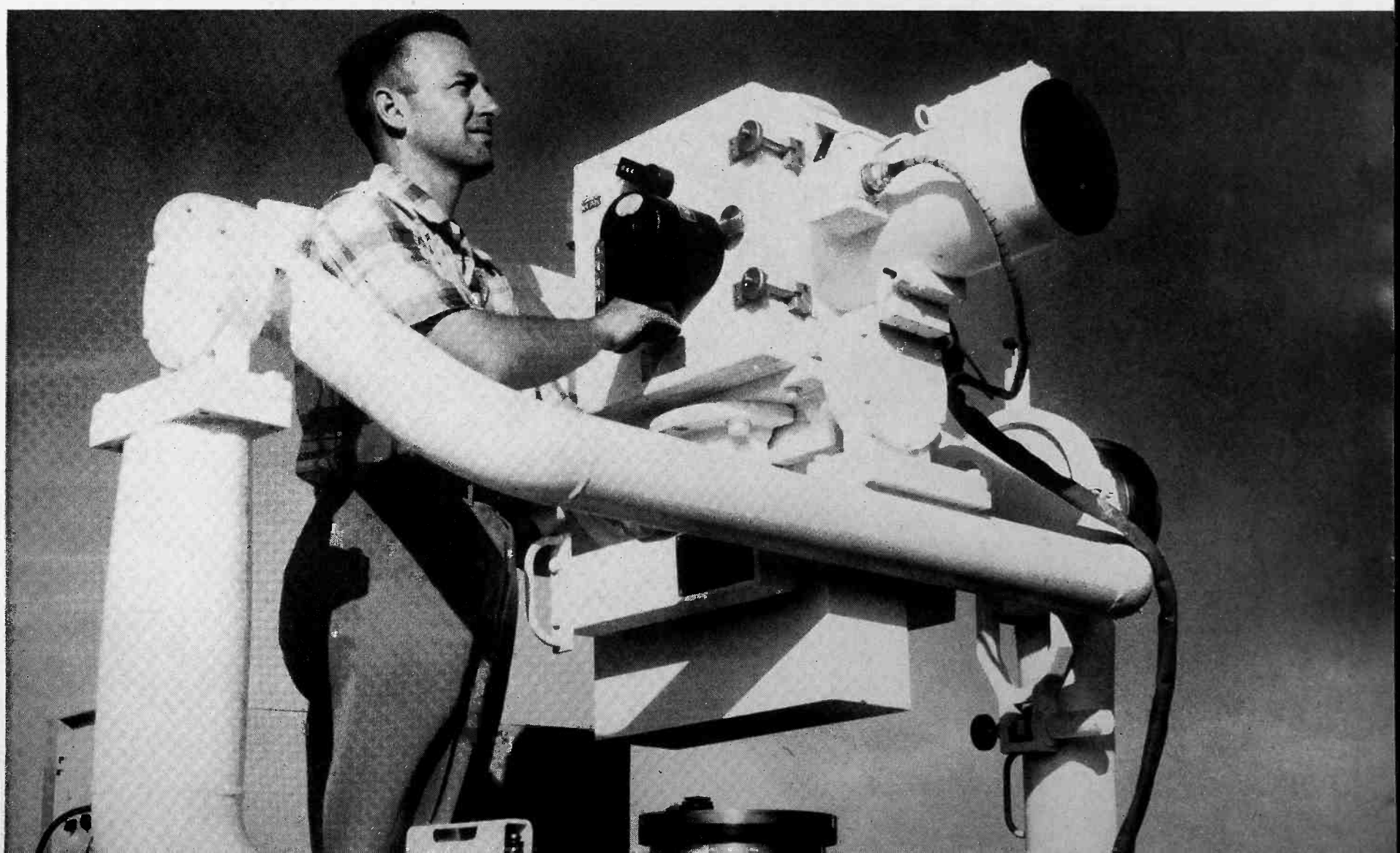
Improvements made to the Image Orthicon camera have brought about brighter, sharper, TV pictures.



Brainchild of RCA engineers is this color TV camera, which uses only one pickup tube.

Well-known news commentator Chet Huntley carries a portable TV camera and back-pack transmitter, two-way "transceiver" for radio communication (in pocket) and a light portable TV set.

A modern motion picture camera, equipped with a telescopic lens, is used to track missile flights at Patrick U.S. Air Force Base.



Felix the Cat was the subject of NBC's first historic telecast. These pictures show (extreme left) some of the apparatus used, and (right) the picture received with the early 60-line definition, which was later abandoned in favor of the improved 441-line definition.

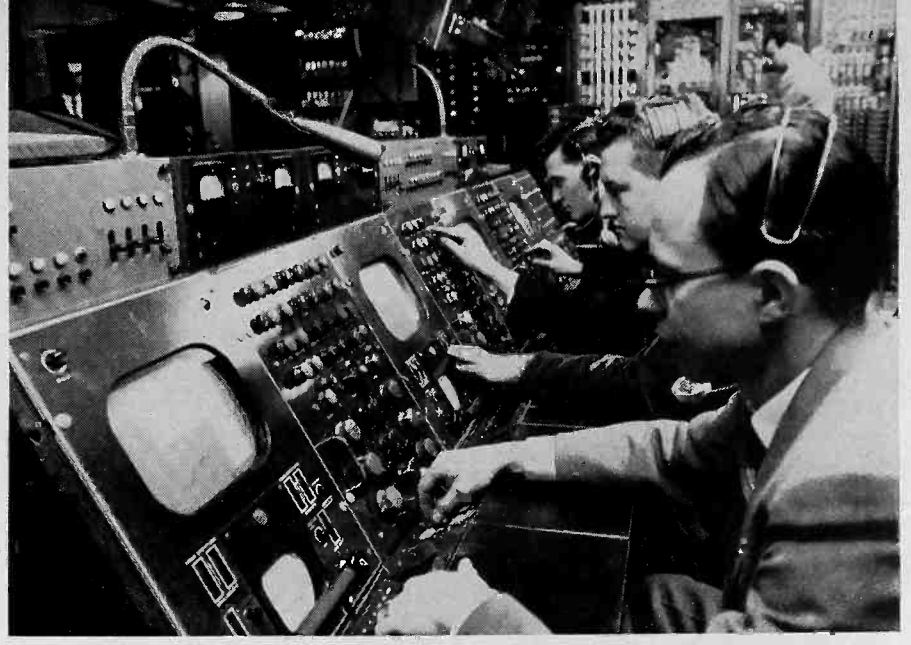
Brig. General David Sarnoff presided at ceremonies at the New York World's Fair in 1939, beginning TV service in America.

An unretouched television photograph showing David Sarnoff as he appeared on television screens in 1939.

Official opening of 1939 World's Fair by President Roosevelt was the first major event to appear on television screens.

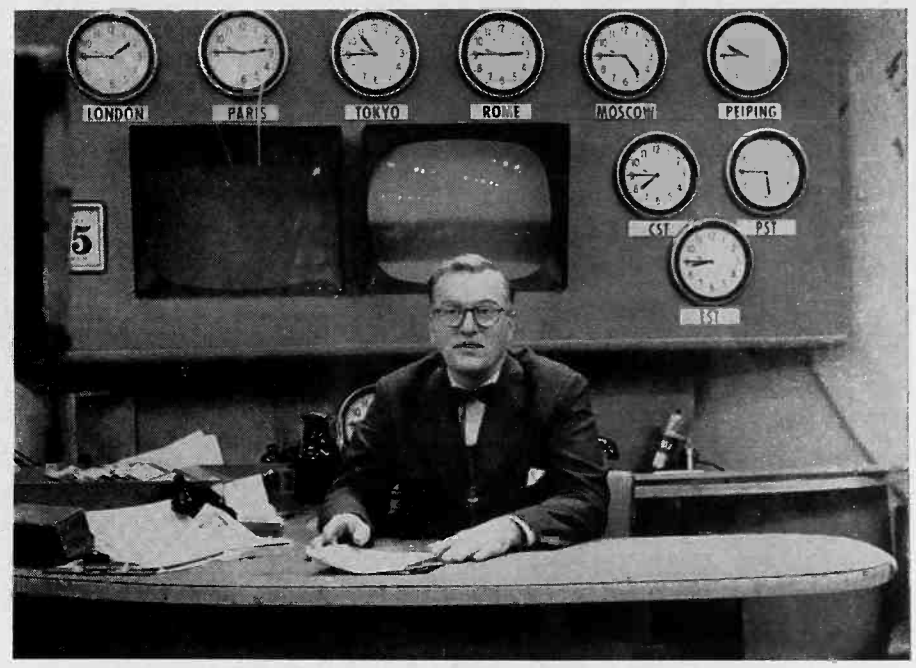
This is how the Americans saw President Roosevelt on TV at the World's Fair opening ceremony.

In NBC's TV Studio 5H at Radio City, New York, a single coordinator can view material picked up by various cameras and can switch from one to another in order to keep pace with developments of general interest.



Many TV programs have originated from the Colonial Theater, New York, where a color TV control panel was part of the intricate set-up.

As Director of "Wide Wide World," Dick Schneider has to successfully blend music, Dave Garroway's voice, and as many as 17 live pick-ups simultaneously.



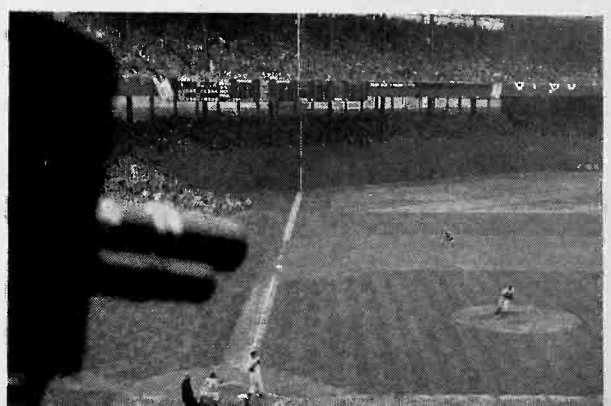
Dave Garroway perfected a technique of interpreting world headlines, and presenting personalities who made them.

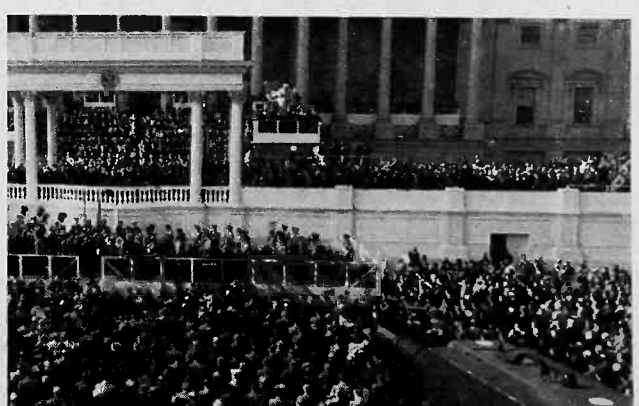
An NBC mobile TV unit brought viewers swift news and pictures of the flood in Yuba City, California, in 1955.

TV helps to create better understanding of international problems by covering sessions of the United Nations.

Through the eyes of television, President Eisenhower's first inauguration in 1953 was presented live to the American people.

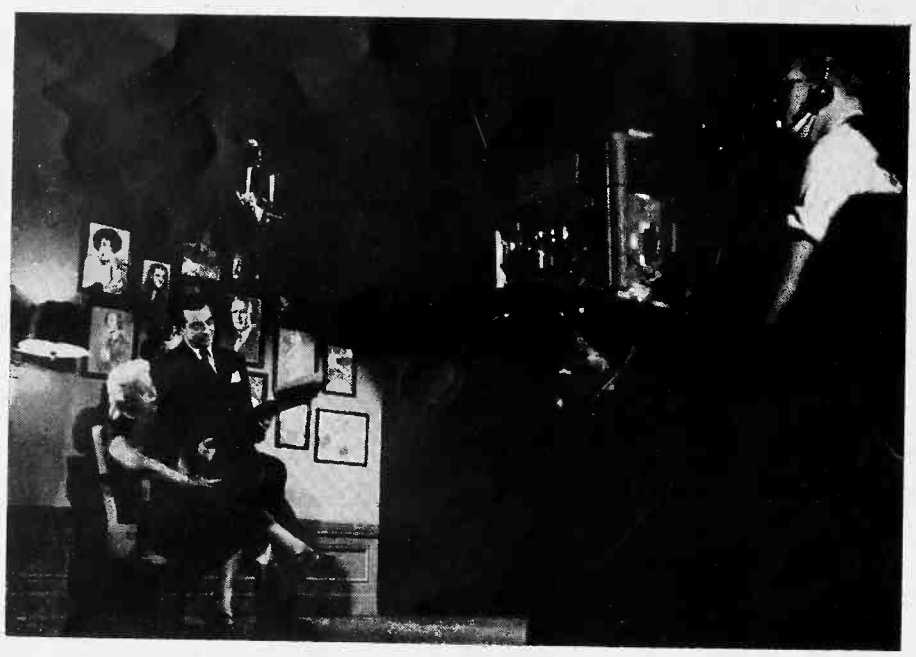
Some of TV's greatest successes have been provided by big-time sporting events. Televising of famous baseball teams such as the New York Giants stimulated interest in sport.





Performers who made a big impact on TV audiences include:

Milton Berle . . . .

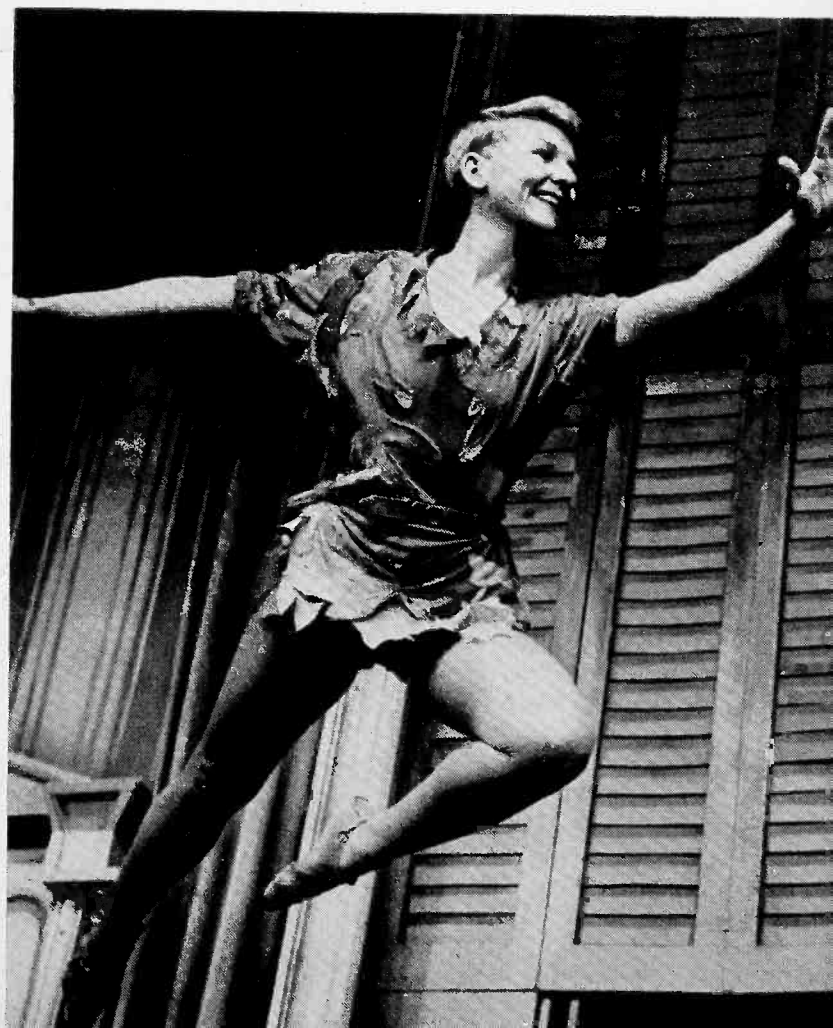


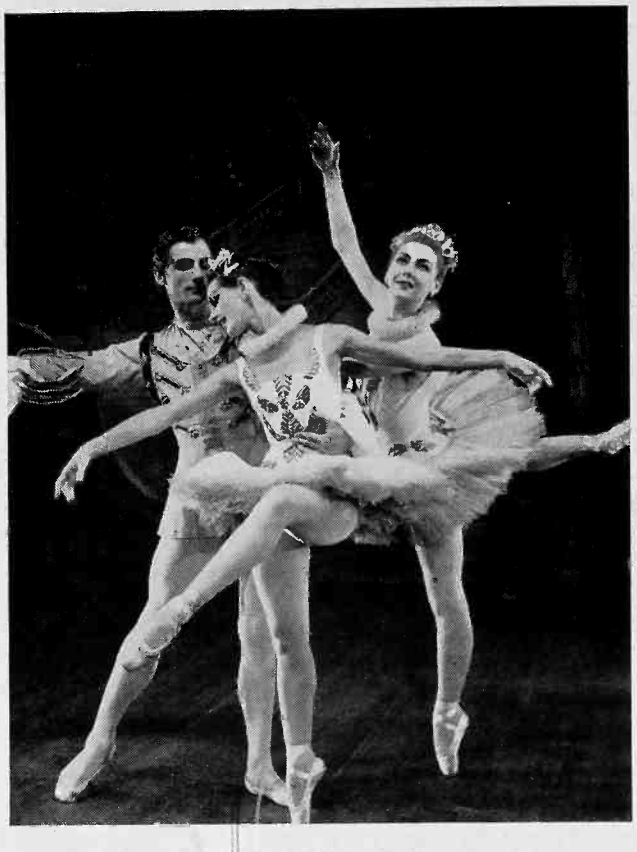
Eddie and Ida Cantor . . . .

A scene from "The Barretts of Wimpole Street" starring Katherine Cornell and Anthony Quayle, shows elaborate set-up required for color television productions.

George Jessel, Bob Hope, Steve Allen . . . .

. . . . and Mary Martin, seen here as Peter Pan.





Britain's famous Sadler's Wells Ballet (now known as The Royal Ballet) gave tremendously successful live TV performances in the U.S. This sequence is from "The Sleeping Beauty."

Victor Herbert's famous musical, "Naughty Marietta," entranced viewers as an NBC "spectacular."

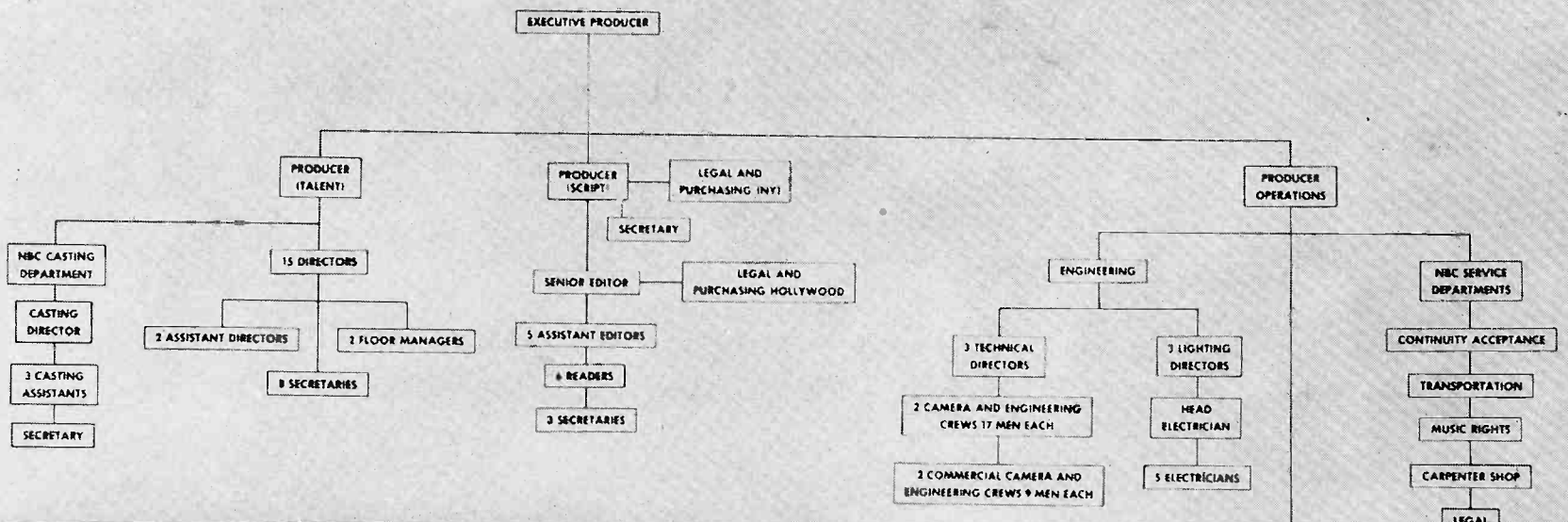
The late Ezio Pinza with Margaret Truman before the television cameras on the RCA Victor show.

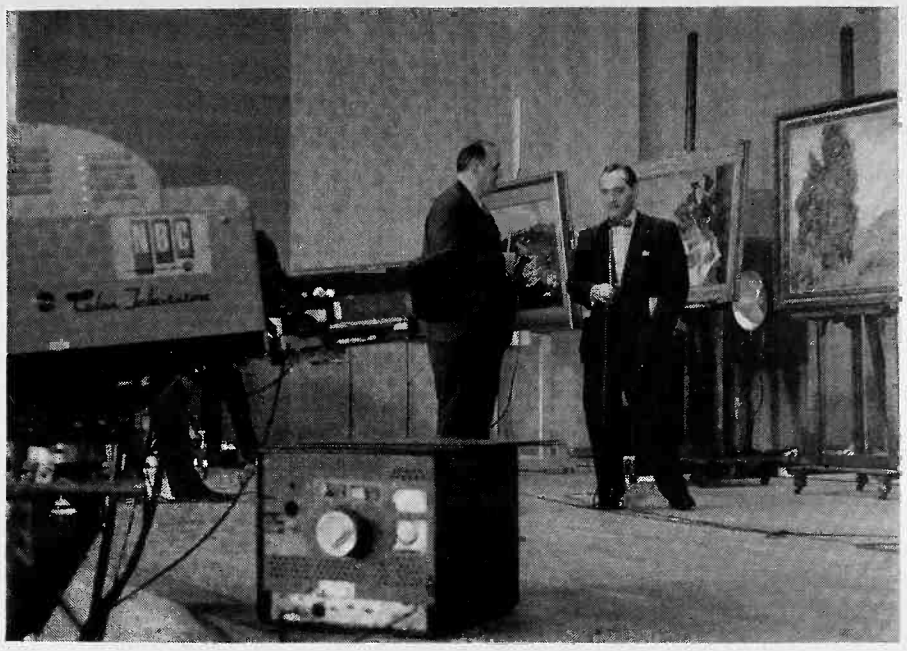
Bambi Linn and Rod Alexander's reputation as TV entertainers springs from their modern, vital dance routines.

Perry Como has one of America's most popular TV shows. Como is seen here with guest star Ginger Rogers. His friendly voice sells millions of records each year.

Organization of the NBC matinee theater looks complex and formidable when charted, but works well in practice. The scene (bottom left) shows one of the programs being transmitted.

NBC MATINEE THEATER



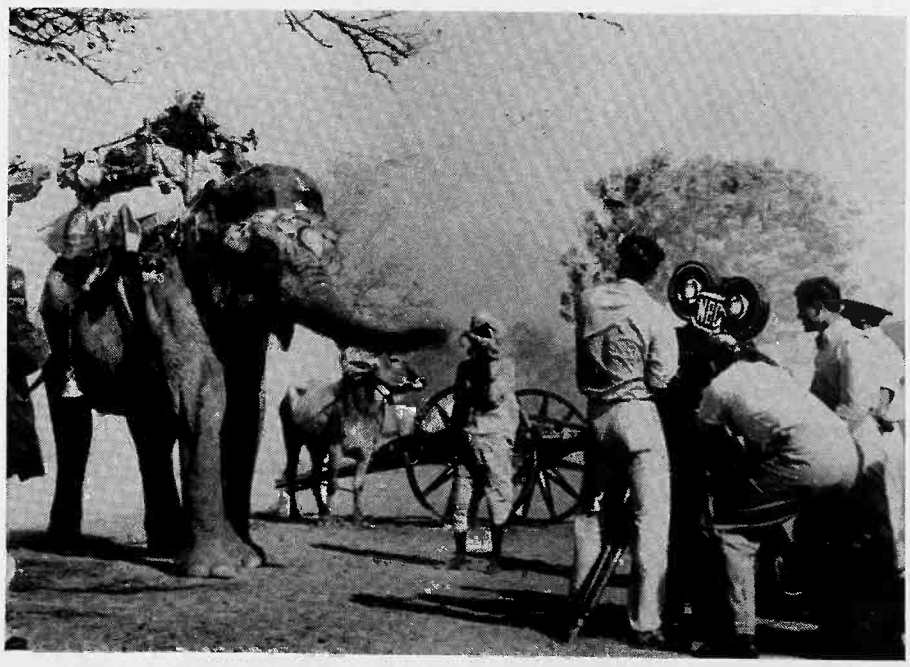


A telecast from the Metropolitan Museum of Art strongly demonstrated the versatility of color television.

television and education

One important program dedicated to artistic education is "Feitelson on Art," conducted by Lorser Feitelson, nationally-known artist and art critic.

Television's power as an educational medium is unmatched. Professor Albert E. Burke, of Yale University, brings the world to everyone's fingertips.

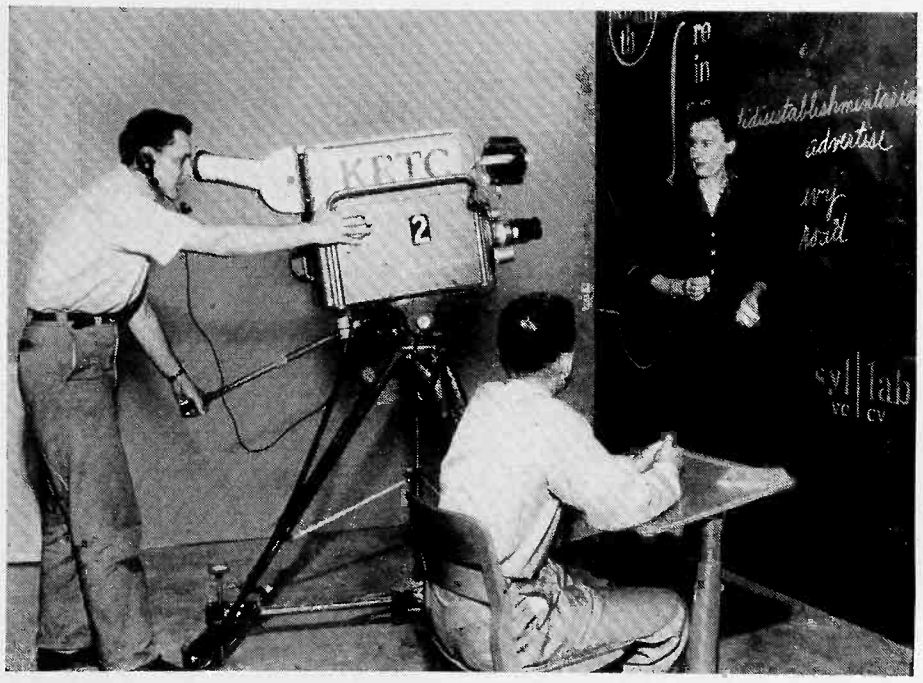


Camera crews travel the world in search of interesting material. This elephant was filmed for television on its way to a ceremonial marriage feast in India.

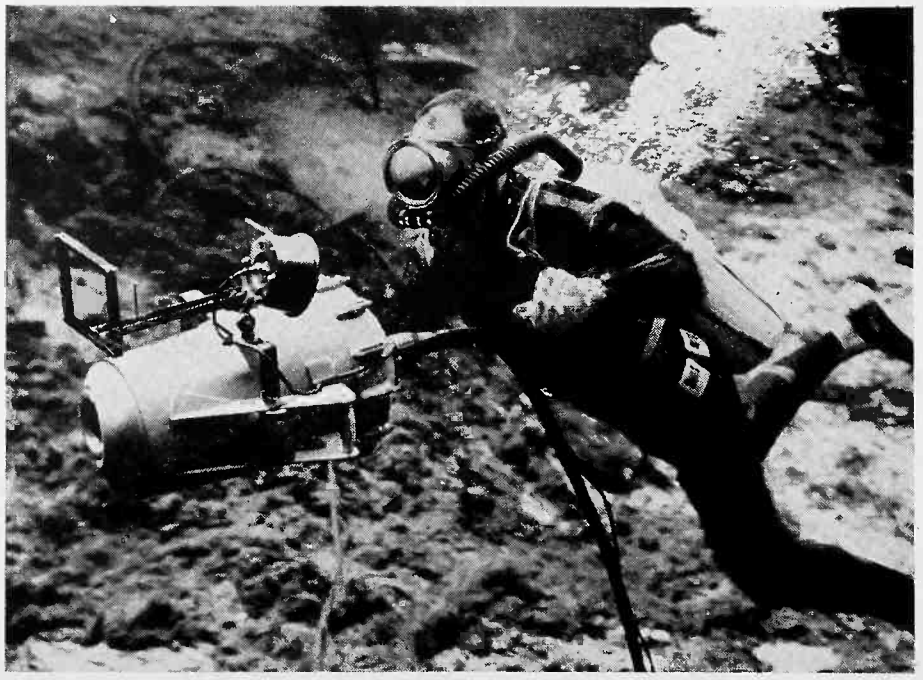
Dr. V. K. Zworykin, whose research for RCA has produced many great advances in TV, explains the use of industrial TV to a group of students.

Station KETC in St. Louis, one of the pioneers of educational television, employs top experts to conduct its programs.

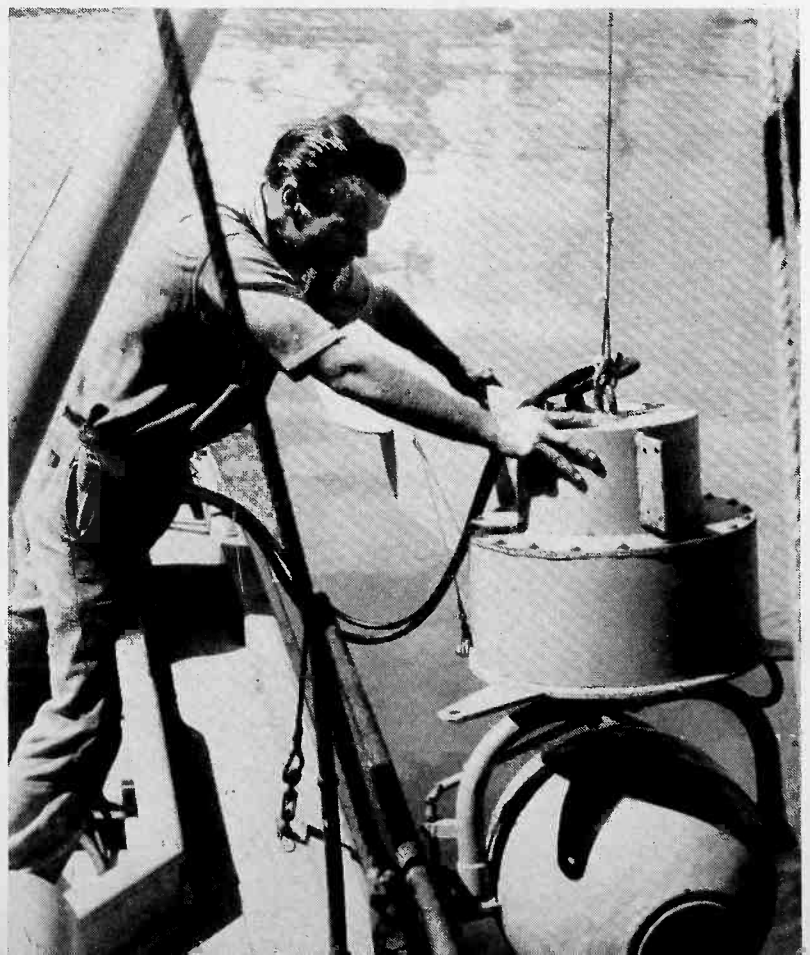
The use of closed-circuit television in classrooms at Stephens College, Columbia, Mo., enables education to be brought to a wider audience.

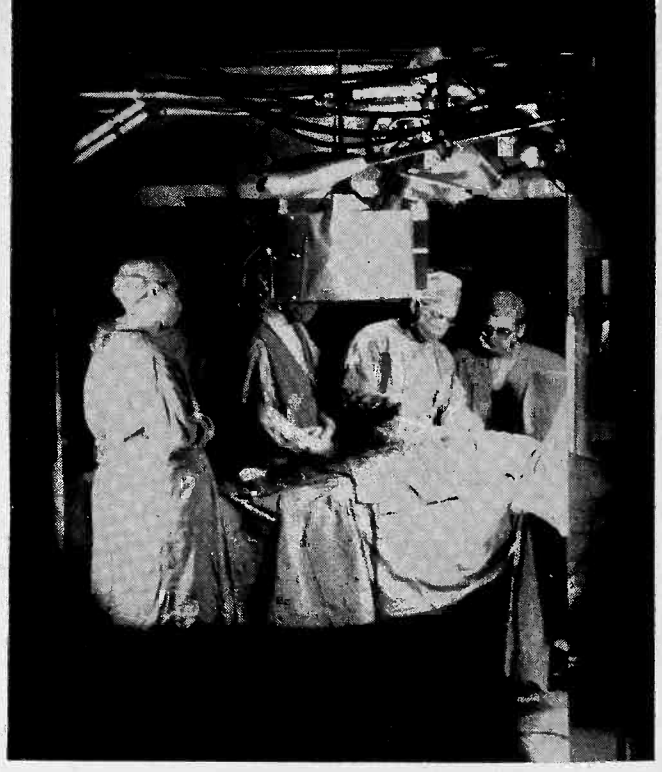


The use of underwater closed-circuit television enables the U.S. Fish and Wildlife Service to observe experimental equipment and methods under actual oceanic conditions.

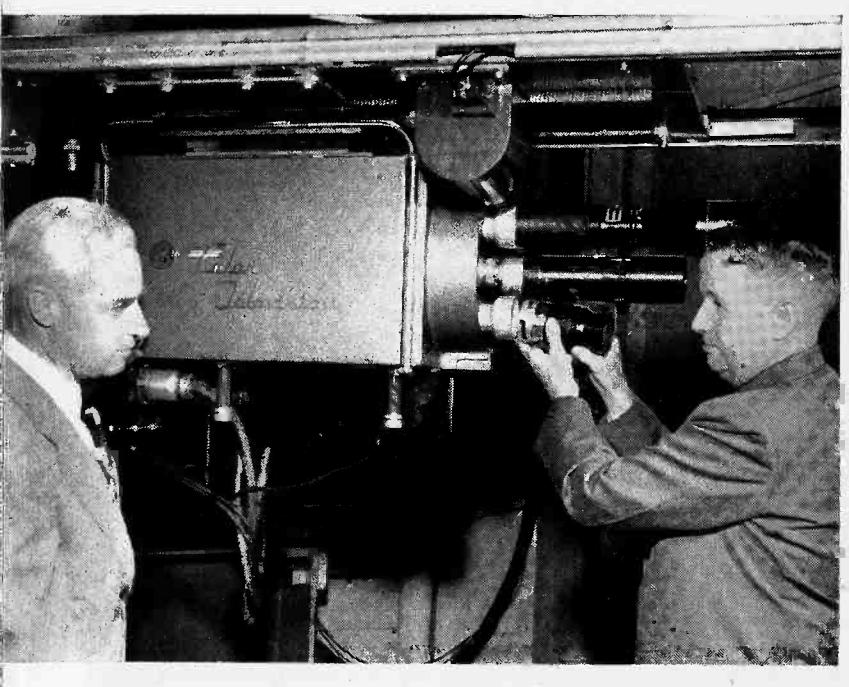


Underwater television is very useful for educational purposes. Operating the TV camera is Charles Hooper, of the U.S. Navy.

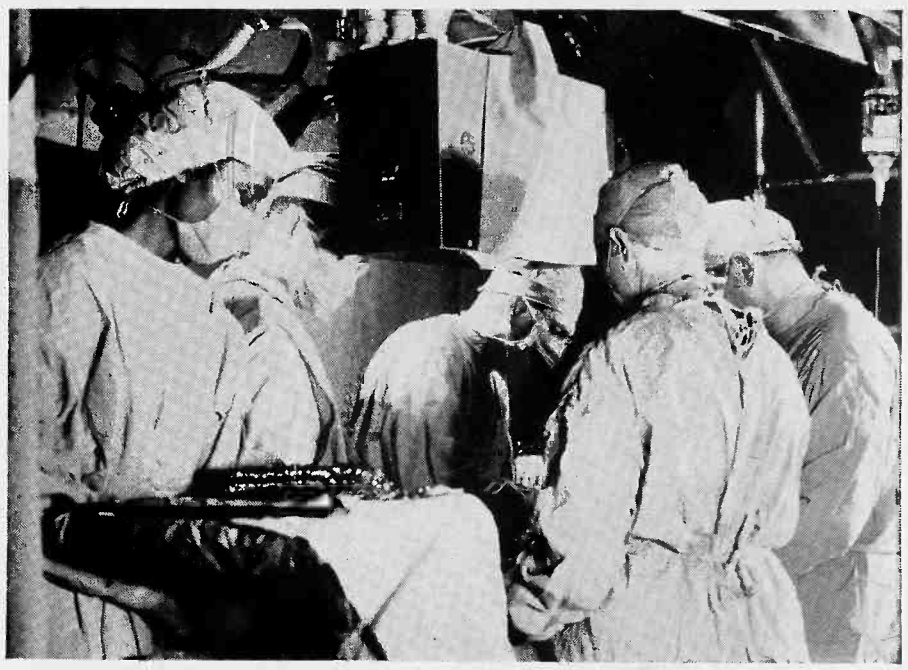




The first public demonstration of medical closed-circuit television was given at the Veterans Administration Hospital, Philadelphia.

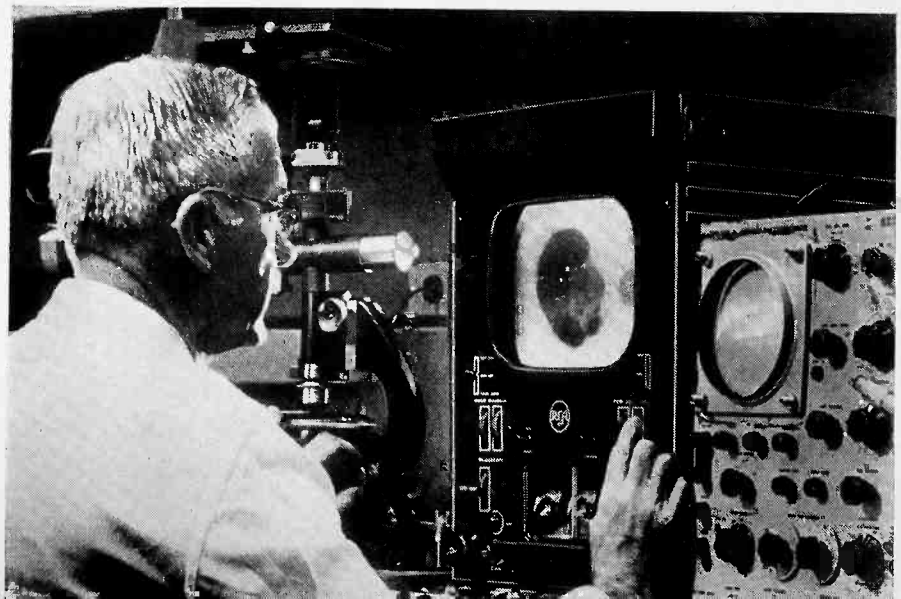


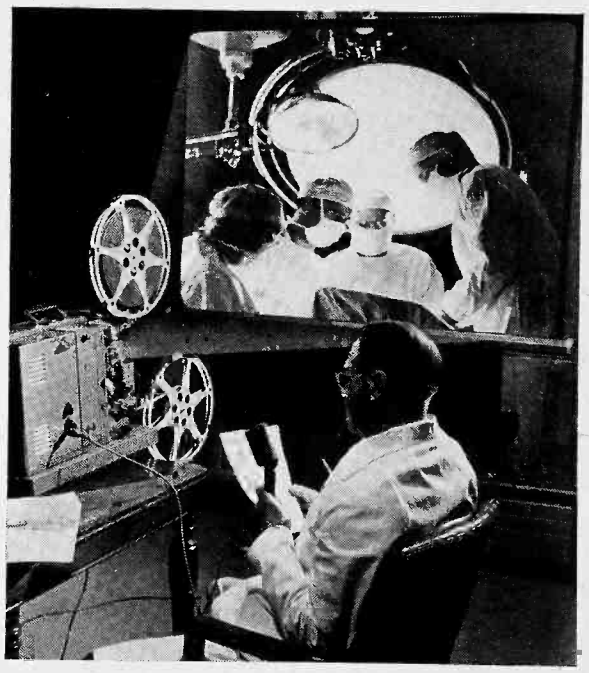
The first compatible color TV system for medical use was designed by RCA. The TV camera is fitted horizontally and "sees" the subject via a mirror which picks up reflections through an opening in a surgical lamp.



A close-up of the first medical color TV demonstration. The telecast was seen by more than 1000 members of the International College of Surgeons.

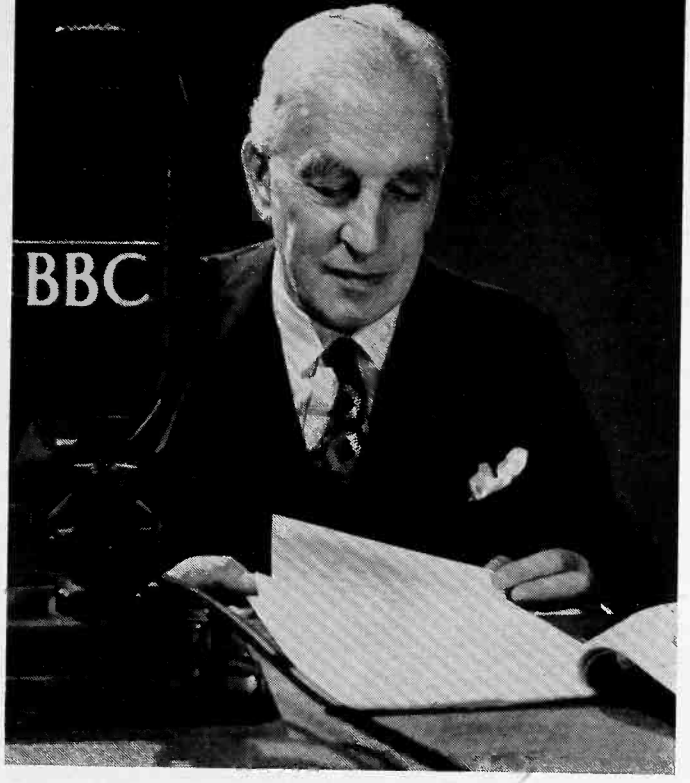
One medical use of closed-circuit television is to provide immediate comparative data of chemical activity in live normal and cancer cells.



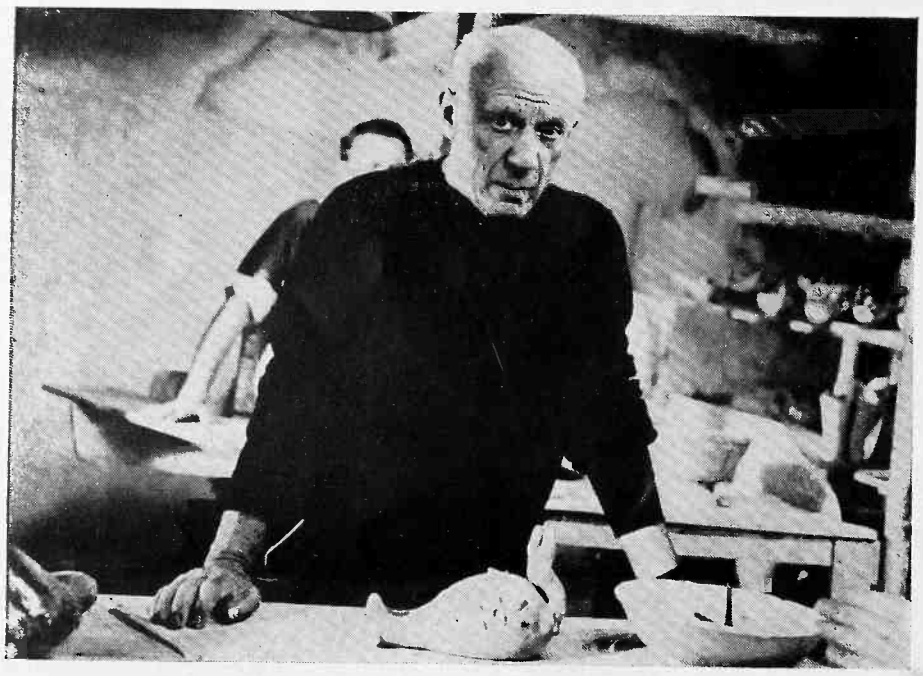


An ancillary aid to medicine is a 16 mm recorder-projector which enables sound to be recorded magnetically on the edge of 16 mm film. The recording can be played back immediately and any necessary erasures or alterations made.

The high educational ideals and worthy purpose of WISDOM MAGAZINE *have been taken up by television, the world's most powerful means of communication. NBC-TV has joined forces with* WISDOM *to present the greatest minds of our time in an unrivalled Sunday series of filmed interviews. By presenting the personal philosophies of the world's greatest men and women, thinkers and doers,* WISDOM *brings inspiration and guidance to an ever-growing audience.*



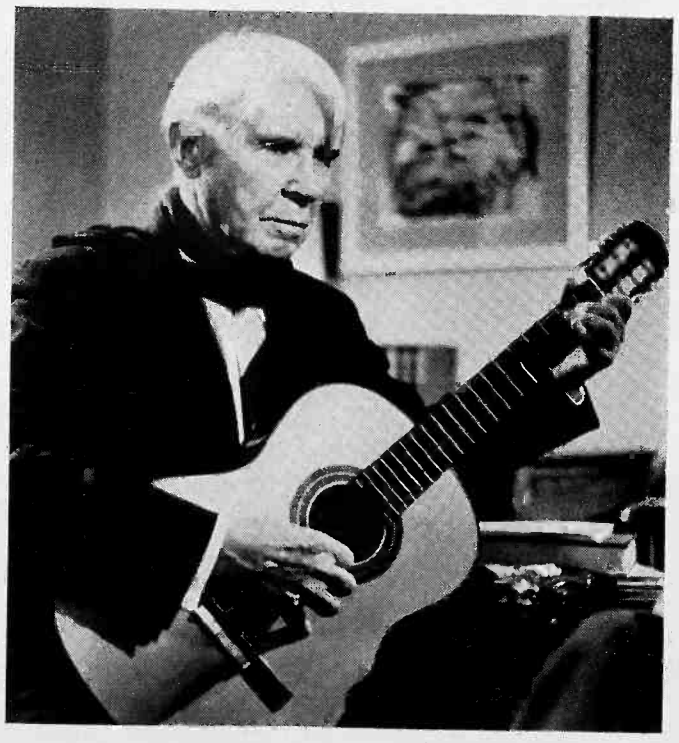
Professor Arnold Toynbee, distinguished British historian, made a valuable contribution to the WISDOM *series. . . . .*



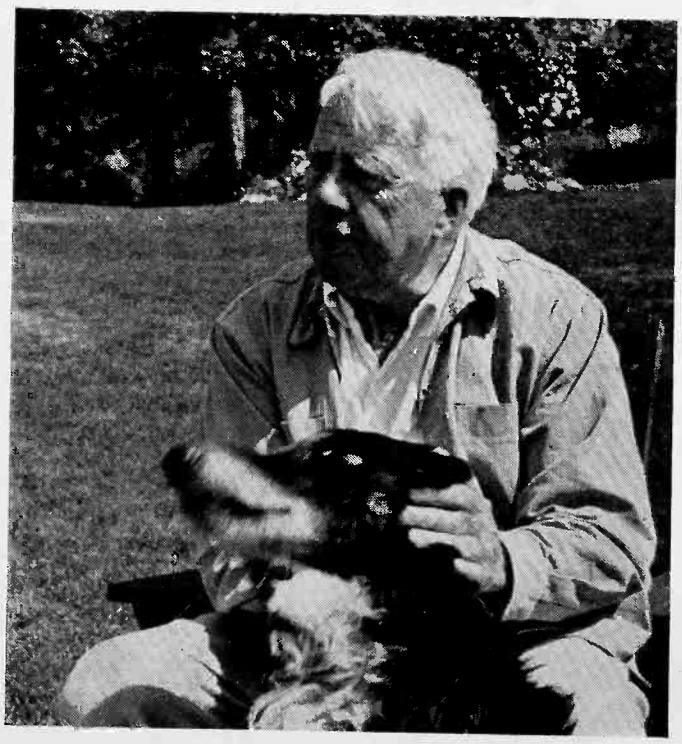
Pablo Picasso, Spanish painter and sculptor, was the first personality in the popular WISDOM *television series featuring outstanding minds of our time. . . .*

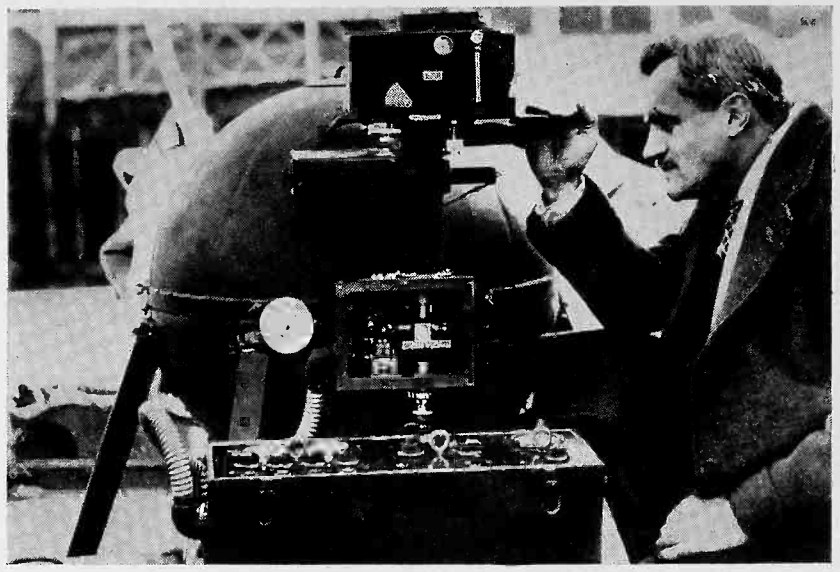
So did Sir Bertrand Russell. "I don't wish to learn to change my hopes for the world.". . . .

Carl Sandburg, famous American poet, was also the subject of a WISDOM *program.*



. . . . And evergreen Robert Frost, poet and Pulitzer prizewinner. "Freedom lies in being bold."





Arthur Compton was one of many scientists featured in "The Strange Case of the Cosmic Rays."

David Sarnoff shows the magnetic tape used by RCA for recording television pictures in color and black and white. When announcing the introduction of the tape, Sarnoff said it was a step toward an era of "electronic photography."

THE WORLD OF ELECTRONICS

by David Sarnoff

ELECTRONICS IS A MERE YOUNGSTER. It dates back only a few years before the turn of the century when the British physicist, J. J. Thomson, discovered the electron and demonstrated its true character as the tiniest thing in our universe. In the development of electronics since then, it is possible to trace five broad phases.

The *first phase* involved the application of electronic principles to communications. This began with wireless telegraphy, and in later years grew into radio-telephone and telegraph communication by long wave, short wave and microwave.

The *second phase* of electronic development brought radio broadcasting and the days when every other person you met told of having stayed up until one o'clock in the morning with earphones clamped to his head. Over the years, we watched radio transformed from an agreeable novelty into a durable force with immense cultural and economic impact. Today, there are more than 135,000,000 radio sets in use in the United States.

The *third phase* saw electronics turned with great effect to military uses during World War II. We had radar, sonar, loran, shoran and the infrared *sniperscope*, to name just a few of the electronic devices that figured prominently in the war. Since then, our Armed Forces have come to rely increasingly on electronics. Today, for example, electronic gear accounts for fully one-third the cost of an all-weather jet fighter plane, and electronic guides direct our long-range missiles to their targets. We have the word of no less an authority than General Carl Spaatz, former Air Force Chief of Staff, that in any future war "superior electronics would be decisive."

The *fourth phase* of electronic development brought television—first in black-and-white and now in vivid, exciting color—to broaden and brighten our existence. During the first post-war year, television sets in the hands of the public numbered fewer than 10,000 and programming was confined to a few hours daily from a handful of broadcasting stations. Now, little more than a decade later, there are over 45,000,000 television sets in use, covering four out of five American homes, and there are more than 500 TV stations. The impact of television on our lives is acknowledged by social scientists, by pollsters, and even by cartoonists.

The *fifth phase* of electronic development has barely begun, yet even now it gives promise of exerting a further and still greater influence on our lives. This new phase is known as Industrial or Commercial Electronics, and involves the widespread application of electronics to our factories and offices. It is a vital ingredient of what has come to be known as *automation*.

In this new phase, electronics is being called upon more and more to provide the sensing devices, the means of communication, and the computing systems. The more complex the task, the more important is electronics' role likely to be in performing it.

In American factories, the wizardry of electronics is adding startling new dimensions to human efficiency. For example: we have airborne fire-control equipment that guides the course of jet planes by means of special electronic computers. We have oil refineries that can be run at full capacity from a control panel of moving dials and flashing lights. We have atomic processing plants where the entire operation is in the hands of a few persons at a push-button console.

While the story of automation in *industry* has captured the popular fancy and caught the bold headlines, the story of automation in the *office* is fully as fascinating and provocative in its implications. Clerical work had grown to such staggering proportions that business—and Government, too—were in danger of being buried beneath their own paper. Not long ago, the Hoover Commission reported that in the past forty years the volume of Government letters had increased sixty-fold. It found that the Government now produces 25-billion pieces of paper annually—enough end-to-end, according to the Commission, to reach to the moon thirteen times. To keep up with the rise of paper work, our clerical force has almost doubled in fifteen years to a total of 8,000,000 people—enough to populate a city the size of New York. Yet even this number has not been adequate, with conventional office machines, to handle our clerical chores at a time when the growing complexity of the economy has made office work increasingly difficult and important.

Now electronics has come along to offer business a powerful new ally in the battle with paper work. The electronic revolution in the office is dramatically symbolized by the mammoth computers that promise to make molehills out of mountains of paper.

Yet, great as the accomplishments of industrial and commercial electronics have been so far, we are still in the pioneering stage. Let me tell you about three areas in which developments are now under way that will have a substantial impact in the years ahead.

One of these areas is *medicine*. Conventional instruments like the stethoscope seem likely to give way to diagnostic robots with years of medical skill "built in." Electronic devices will relieve doctors of routine by performing automatically many of the tests given in the standard medical examinations. A whole series of measurements, such as the cardiogram, blood pressure, temperature and blood count would be recorded simultaneously on a single piece of electronic equipment. Prescribed norms for the patient's age, fed into the system in advance, would provide an accurate basis for comparison. The results could be made available immediately. Furthermore, this permanent record could be fed into a computer at the patient's next visit to give the doctor an instantaneous picture of the important changes that had taken place.

No physician, of course, could ever remember every symptom of every disease. But an electronic computer might conceivably do just that. It might have stored in its memory the best medical knowledge of the day—knowledge it could apply promptly to a particular patient's symptoms and come up with an accurate diagnosis. Or the computer, instead of being programmed to diagnose, could be programmed to forecast a person's life expectancy for insurance company records.

A second area that holds great promise for the future is *personal radio communications*. With a tiny gadget about the size of a pack of cigarettes, you will be able to carry on a conversation with friends or business associates wherever you happen to be—on the golf course, on a fishing trip, or even on a transatlantic flight.

Your receiver will have a decoding unit that will respond to only one of a million or more possible arrangements of pulses sent out from a transmitter. In this way, you will be assured of complete privacy in your conversation, even though you will be on the largest party line in the world.

A third area of exploration involves *voice-controlled electronic systems*. Basic studies already have led to the development of a rudimentary phonetic typewriter that can type a few simple words and phrases spoken into a microphone. Through experiments with this system and further development of the novel principles employed in it, we can expect to achieve new and versatile systems capable of "understanding" and carrying out verbal orders.

The business man of the future may well dictate his interoffice memos and personal letters directly to an electronic typewriter that will produce them phonetically in response to his voice. We may also look forward to the day when spoken instructions will be used

to control the programming and operation of computers in business. To be really fanciful, we might picture the householder of the future talking into a little pocket transmitter to issue such instructions as "dishwasher on," "thermostat 72 degrees," and so on—activating controls which cause these things to happen instantly.

When the developments I have just outlined—and others that are now in our laboratories—arrive on the market, they will effect far-reaching changes in many businesses.

This fifth phase of electronic development that I have been discussing has been pictured by some calamity criers as a Fifth Horseman of the Apocalypse. They claim to see it as an ominous agent of doom and gloom that will bring an appalling eruption of trouble. These propagandists of panic, who harp on the science-fiction horrors of automation, are strangely reminiscent of the alarmists of the Nineteenth Century. Those misguided zealots, you will recall, stoned factories because one machine promised to do the work of one-hundred men. However, it was not long before they learned that the machines created many more jobs than they eliminated.

Even in our own century we have seen violent reactions to developments that were significantly new and progressive. I remember when radio broadcasting came along, the phonograph companies said, "People want music when they want it. They'll never be content with any selections that radio stations put on. Broadcasting will never succeed." Well, not only has broadcasting succeeded but millions more phonograph records are being sold today than were ever sold before broadcasting was established.

When talking pictures arrived, the silent movie industry looked down its multi-million-dollar nose at the upstart. "Once the novelty wears off," they prophesied, "this will flop. People," they said, "go to a movie for peace, quiet and illusion—not for distracting sound." Well, where are the silent movies, today?

When television emerged, it faced the scorn of many people in the movie industry. They referred to it derisively as "that little peep-hole." Well, today motion picture companies are producing their products for television and some of them are making more money from their sales to television than they are from their sales to theatres. Indeed, some movie men have become so enamored with television that they would like to take it over and care for it—"as their very own."

Today the disciples of despair are predicting that automation will bring widespread unemployment. These forecasts, it seems to me, are as fallacious as they are familiar. I do not believe that automation will result in unemployment. On the contrary, I believe it will mean more and better jobs.

We have the word of our most eminent economists that the major problem in the years ahead will not be unemployment, but how to stretch the labor force to keep pace with our growing population and our rising standard of living. During the next two decades, the total population of the United States is expected to increase by two-fifths. Over the same period, the man-hours of labor will rise by only one-fifth. This means that if we are to continue enjoying an ever higher standard of living, our output of goods and services must increase far more than the number of people producing them. The answer to *increased* productivity will be automation.

Where mechanization tended to make the worker a part of the machine, automation reverses the process and frees man's work from routine. It provides broader scope for the exercise of his highest skills. It promises jobs calling for those human attributes, such as imagination and judgment, that automation never can duplicate. The result is bound to be a massive upgrading of skills.

Already we have seen, on a small scale, what happens when automation moves into the factory and the office. Upgraded employees have been liberated from the dreary tasks that used to dominate their day, and assigned to more responsible work at higher pay. Ultimately, automation will free millions from arduous and hazardous toil. It will increase employment, reduce hours of labor, and increase our leisure time.

As our national economy adjusts to this new force, there will inevitably be problems—the kinds of problems that have always accompanied technological change. But one of America's greatest sources of strength has been its ability to accommodate and even to encourage, technological change without changing its own basic emphasis on individual freedom and human dignity.

So it is, then, that automation—a concept born of the latest phase of electronic development—has become critically important to us and to our allies. It offers the stimulating prospect of greater security, wider industrialization, a higher standard of living, and a better and happier life. If we have the wisdom and the will to face up to our opportunities, electronics can broaden our horizons beyond all expectation and contribute immeasurably to the prosperity we seek for ourselves and for all mankind. ♦

SCIENTISTS

IN A SCIENTIFIC AGE

by David Sarnoff

ALL MY LIFE I have been fascinated by the tremendous forces that can be harnessed for the good of mankind and have been more interested in what *can* be built than what *has* been built. There is great stimulation and satisfaction in looking for new frontiers of the mind that point the way to human progress.

Just as Calvin Coolidge, when asked for his views on sin, said he was "agin it"; in the same way, when you ask me about research, I must answer, "I'm fer it." Scientific research is the basis of all the material things we have today, and it will be the basis of the better things we hope to enjoy tomorrow. Many years ago I hitched my wagon to the research star, and I have never regretted it.

Perhaps the contributions research is making, and can make, to our way of life can be best understood by looking at the definition of the word *research* itself. It means: "careful or diligent search; critical and exhaustive investigation or experimentation having for its aim discovery of new facts, their correct interpretation and practical application."

In other words, research is creative and constructive. It creates new ideas, products and services bringing new vitality to business.

Research gives America economic strength that is essential to our national security. As such, it is a bulwark of peace.

Research is a challenge to competition. Those who accept this challenge gain a tremendous advantage over those who disregard it or entrust pioneering in science to others.

From the broad viewpoint, our whole pattern of life—the homes we live in, the cars, the planes, the trains we ride in—are all

products of scientific research. And our social, political, and economic institutions—even the conflicts involving them—are affected by that research.

We must face the fact that we live in a scientific age. We live in a period that has bridged time and distance. We have harnessed the forces of nature so that life is easier for more people than it ever was before. But in harnessing those forces, we have also created problems that leave many people with a feeling of insecurity. So we find the world presently engaged in a great ideological struggle. The work done in the research centers of our country will, to a great extent, determine the outcome of that struggle.

It has always been true that the *things* men live *with* largely determine the *ideas* men live *by*. When the Western world learned how to use gunpowder, it meant the beginning of the end of knighthood and the feudal system. When Eli Whitney invented the cotton gin, it was the beginning of the end of slavery. When the tractor and the harvester and the reaper were developed, we began to see a trend away from the small family farm. The automobile changed the whole pattern of rural life. Radio and television already have changed many of our ways of daily life, and bid fair to change the whole pattern of our political life.

As we face the challenge of these times, we can be sure that the way we are going to live—the kind of economy and the kind of government we are going to have—will be determined largely by the things industry produces and the use that will be made of them. These things are the end products of research.

I am not preaching a materialistic doctrine here. We are all well aware that there is a spiritual factor that enters into this equation, and perhaps it is the most important factor of all. Many things have been produced in the course of history that had great potentialities for good, but some of them were used to destroy man, rather than to benefit him. We must always remember that nothing we produce is either good or bad unless our use makes it so.

Those of us who create, produce, and distribute the world's goods have a responsibility to do all in our power to see that they are put to good use.

I have never known any invention that benefited mankind that did not, in some way, benefit industry.

Certainly, all of us can accept the basic truth that nothing ever stands still. Our country, our civilization, our business, must either go forward, or fall back. Today, science and industry are linked by arteries of progress and their life blood is technical research. Without continued pioneering and research, those arteries would harden. The spirited advance of industry would be slowed; progress would decline and come to an end.

The pattern of our industrial progress is clear. It lies in a partnership between those who create good things and those who produce and distribute and service them. It lies in teamwork between research and industry.

When a businessman thinks about the problems of his own company, he cannot fail to recognize that they are closely related to the fundamental problems that beset the world today. Neither researchers nor businessmen, working by themselves, can solve these problems. But, working together, they can do much to help find the practical solutions.

Now, what can each bring to this partnership for progress? First, let us consider the research part of the team. One of the greatest contributions researchers have to make is their objectivity. They have a capacity for looking at a problem without any preconceived notions as to the method of solving it. Sometimes when you suggest ideas to executives they may tell you "it can't be done." But you will rarely find a research man who will tell you, before he has tried, that anything suggested "can't be done."

Research, after all, is the search for the truth. And in their constant search for the truth, researchers build on today's knowledge, always aware that it is not complete knowledge. They are aware, too, that what they regard as the truth today, may tomorrow be revealed to be a fallacy. Because of this they have a capacity for analyzing problems with a clarity that often escapes businessmen.

Research men have a native curiosity that makes them constantly search for new knowledge. They are always looking for the *how* and *why* of things.

Scientists have patience and persistence. Generally, they have more time in which to do their work. But businessmen, who live "under the gun" of the highly competitive fields in which they operate, try to meet today's problems today. They are inclined to be impatient when they do not find a ready answer. Research men know that with time there is an answer to most things. Those businessmen who do not appreciate the value of research might have long since abandoned the search for a cure for cancer as a hopeless one. But the men of science and the people in industry who support them will never abandon that search until they find a cure . . . and I feel certain they will find it.

That positive statement is based on my faith in the men of science and their ability to deliver. Time and time again men in research at RCA have been asked to solve a problem and they have rarely let us down. It is like watching a magician to see them pull an electronic rabbit out of a scientific hat. My entire business career has been built on my faith in the ability of our men of science to produce the things for which we could discover a public need

These men of science are wonderful people—too long neglected, too little recognized and too poorly rewarded. Their scientific skills and knowledge constitute a vital national resource. We must appreciate the great value of these skills, and we must learn to put them to good use.

I tip my hat to the men of science who have contributed so much to the prosperity of industry and the strength of our nation.

Our scientific friends can add still greater value to this partnership if they keep in mind that any product, no matter how fine it may be technically, is worth little unless it can be produced and sold at a price the public can afford to pay. This is what the businessman has in mind when he talks about a realistic approach to his problem.

Now, what have businessmen to bring to this partnership? First, and most important, of course, is that they should give understanding and encouragement to men of research. The principal tool in research is the mind of the scientist. Brains that radiate new ideas and new knowledge are not commonplace in this world. And we have great need of them. So let us be sure to handle them with understanding and with care.

Then, of course, there is money. And believe me research does cost money. It is true that the scientist, alone, sitting on a hilltop, may conceive the idea for an invention. If it's simple enough, perhaps he can build a sample in his own little workshop. But for most products, it is a long way from the idea to the production line and public acceptance. That line leads through expensive laboratories, expensive equipment, and expensive promotion and exploitation.

Taxes being what they are, the day of the private philanthropist has pretty well gone. The wealthy patrons who sponsored men of science, just as they sponsored musicians and artists and writers, are fading from the picture.

Who is to foot the bill? Some people say—let government do it. And you may be sure that if industry doesn't do it, government will have to do it. But I think there are at least three good reasons why we should *not* let this happen.

In the first place, we all know that any time the businessmen of the country fail to meet a revealed public need and abdicate their responsibility to government, they are fostering the very thing they want least. That is, increased government control of their operations

and increased government control of the daily lives of all the people.

In the second place, I firmly believe that government control of research would destroy the very qualities that enable researchers to make such an important contribution to society. For government control means that rigid lines would be set for research; and these lines may not meet changing requirements. Certainly industry is best qualified to define its own research needs. And the partnership between research and industry loses its meaning when government can dictate the subject and objective of research in any competitive system of private enterprise.

The third reason, of course, is that the only money the government has is the money it gets directly or indirectly from industry and the people industry serves. If, then, government supports industrial research, business will still be paying for it. Therefore, it behooves businessmen, in their own self-interest as well as in the public interest, to bear their fair share of the financial load.

Let me make it clear that I would be the last one to want to exclude government from scientific research. There are certain fields where the primary responsibility for specialized research belongs to the government. This is especially so in the field of armaments and weapons of war. There is need for government participation in research projects concerned with our national defense. But if the day were ever to come when the primary responsibility for industrial research rested in Washington, all of us, I am sure, would regret it.

The wonderful thing about research is that the more of it you do, the more of it there is left to do. Like the Horn of Plenty, it is never empty. It is like hunting a word in the dictionary. Each word is defined in terms of other words. So, when you seek a definition, you are inevitably led to another word that suggests new ideas. Just so, each piece of research opens new fields for further exploration.

There are some companies in America that spend millions of dollars on advertising and sales promotion, but still refuse to spend a cent on research. They say they are putting their money where it "pays off." It is not for me to tell another man how to run his business, but I believe these companies would find—as we have found—that it would "pay off" many times over if they were to make even a small investment in practical industrial research.

Let me recall a little story that illustrates this point. I shall always remember one afternoon back in the twenties when Dr. Zworykin came to my office with a tale of magic. He told me he had invented an electronic eye. For half an hour I listened intently, and then exclaimed, "It's too good to be true. What will it cost to develop the idea?" "Maybe about $100,000," answered Zworykin. "All right," I said, "it's worth it."

My hunch was strong that, before the idea could be developed into a practical system of electronic television, Zworykin's figure would prove to be only the cost of admission. But the idea seemed to me sound; so I bought the ticket.

Many years and much money went into this effort before we could raise the curtain on commercial television. And I was not disappointed. By the time we raised the curtain, and invited the public to come in, we had spent fifty million dollars!

But regardless of the cost, it was worth it. For it was the key to electronic television. Today, there are millions of television sets in the United States and there will be millions more. Out of the parent industry there are being born healthy children: industrial television, whereby a factory manager can sit in his office and watch the work going on in all his plants; a department store chief can watch from his desk the traffic on all his floors; medical television, whereby a specialist in New York can watch and direct an operation in San Francisco; the electron microscope, which enables specialists in their medical laboratories and students in their classrooms to view enlarged slides of bacteria hitherto invisible by any other means.

Consider what all this means to better living and industrial progress! Do you think all these developments, and more to come, from this pioneering effort in research are worth the 50 million dollars RCA put in television before we ever got a cent back? I do.

One of the benefits that appeals to me most about research is this: You hire one research man and you get several thousand of them; for such is the close working relationship and the exchange of ideas in this field that each research man profits by and builds on the work of all the others. I firmly believe that research is a good buy, and I am happy to see that businessmen in increasing numbers are coming to recognize that fact.

The second thing that business can contribute to this partnership is an understanding of the needs and interests of the consuming public. Businessmen, who live by trade, are in a position to bring to their researchers a realistic picture of the fields in which they should explore if they are to serve the public interest.

Research people are receptive to such guidance. Nobody wants to work in a vacuum. A song writer wants to produce songs that will be sung and a researcher wants to produce products that will be used. Businessmen can help their researchers by suggesting to them the products and services they believe will enjoy the greatest public acceptance. Experience has taught me that men in research will respond to the challenge of such suggestions.

I know of no better formula for success in business than this: Look around you . . . see a product or service the public needs . . . then ask your researchers to develop it, your production men to manufacture it, and your merchandisers to sell it.

A word of caution. In our efforts to solve production or merchandising problems, we cannot permit direction of research to become too rigid. Industry is interested primarily in *applied research*, and this feeds upon new knowledge revealed through *basic research*. Therefore, we cannot afford to put blinders on our men of science and research.

They say that no one knows the way a football will bounce. Nor does one know where scientific research will lead. The history of science provides many examples of accidental discoveries that led to unexpected developments. Specific research projects often result in collateral discoveries. And frequently those collaterals turn out to be more important than the original object of the search. Just as Columbus, seeking a route to the Orient, discovered a new world, so scientists, working on a specified project, have come upon unexpected new worlds.

Goodyear accidentally spilled a sulphur-rubber mixture on the kitchen stove and invented the process of hot vulcanization of rubber; Carothers created nylon as a result of his pure research efforts to create giant molecules. More recently, Sir Alexander Fleming, the British bacteriologist, discovered penicillin while carrying on research on influenza when some mold accidentally got on a culture plate and created a bacteria-free circle around itself.

In our zeal for applied industrial research, let us not forget that it all rests on basic research. And that through basic research any one of us may hit the jackpot. Businessmen should tell their researchers what they *do* want them to work on. But they should never get in the habit of telling them what they *don't* want them to work on. We cannot, we *must* not, put strait jackets on minds.

Businessmen can and should bring to this partnership their money, their encouragement, their advice, their ability to make available to the public the things that researchers develop, and—above all else—faith in the sincerity and ability of scientists to produce results.

In the words of Dr. Samuel Johnson, "The future is purchased by the present." And I know of no better way for industry to assure its future and our country's future than to join wholeheartedly in the full utilization of scientific research for the common good. →

THE WORLD OF RESEARCH

IN DECEMBER 1953, General Sarnoff made the following statement: "Whatever the size of the electronics, television, and radio business seven years hence may be, I am sure that more than 50 per cent of the volume will be in products and services that do not exist today." This statement is an excellent indication of the importance attached to research by the management of the Radio Corporation of America.

For the continued success of a dynamic industry in a dynamic society, basic research is the one indispensable ingredient.

Research in RCA is as old as the corporation itself. From the organization in 1919 of the first group in Riverhead, New York, research has grown steadily. First carried out under operating units, research activities began to be transferred in 1942 to the newly constructed center of the RCA Laboratories in Princeton, New Jersey.

A slow but steady expansion has taken place since then, available laboratory and shop space having been expanded by about one-third. The Laboratories staff now numbers more than one thousand.

The work of the Laboratories is directed toward improvement in methods, devices, production, and operation in every branch of radio, television, electronics, and allied activities, and toward the creation of new products and services. Concurrently, the Laboratories are concerned with fundamental research, the pursuit of knowledge whose usefulness has not yet become evident. RCA believes that all contributions to knowledge are eventually of practical worth, and that, in the long run, fundamental discoveries are of greatest value.

The varied and interacting nature of research at the Laboratories is evidenced by the various disciplines represented by the scientists working there. Broadly speaking there are electrical engineers, physicists, chemists, metallurgists, and ceramic engineers, and within some of these groups there are subdivisions. The electrical engineer may be concerned with a device or a system, the physicist may work in theoretical or applied physics, and the chemist may be active in any of several fields.

The research lies in six areas distinguished from each other chiefly by subject matter. Each area is covered by a Research Laboratory under the general administration of the Vice-President, Research. Research Contracts and Laboratory Services perform those functions needed for the orderly and effective prosecution of research, while the Industry Service Laboratory serves licensees as well as the manufacturing and operating groups.

SYSTEMS RESEARCH LABORATORY

The Systems Research Laboratory is concerned with the improvement of existing systems and the development of new systems involving electronic techniques. In the field of radio and television broadcasting, extensive theoretical and experimental studies are made of transmission lines, antennas, and propagation. Much work is done on color television, including receivers, transmitters, and test equipment. In the course of the color television work, it was necessary to investigate the mechanism of color vision, flicker perception, and similar physiological phenomena. Magnetic storage and switching units are developed for use in computers and other devices. Applications of electronic phenomena are devised; for example, microwave spectral absorption has been used to control a time standard with a degree of accuracy far greater than has been possible with more conventional methods. Complete radar systems, from power supply to antenna, are devised and constructed. The work of the Systems Research Laboratory ranges from basic studies to practical solutions of design problems.

RADIO RESEARCH LABORATORY

The Radio Research Laboratory is chiefly concerned with research in radio communication. Among the subjects and equipment included in this field are transmitters, receivers, and antennas, as well as studies of radio propagation at all frequencies, including ionospheric and tropospheric scatter propagation. Special attention is given to single-sideband transmitters and receivers. Detailed studies of the surface of the sun are made in order to discover the relationship between solar phenomena and long-distance radio propagation. Terminal equipment such as facsimile, code-to-message converters, high-speed printers, and electronic multiplex are also studied in this laboratory. Investigations in the field of radio relaying include research on radiating equipment, multi-channel terminal equipment and microwave propagation. These activities are carried out in laboratories adjacent to the transoceanic communications facilities of RCA Communications, Inc., on Long Island, N. Y.

ACOUSTICAL AND ELECTROMECHANICAL

The Acoustical and Electromechanical Research Laboratory engages in fundamental research in fields such as recording, reproduction, thermoelectrics, electrophotography, and magnetics. Acoustic elements are developed for pickup and reproduction of sound. These elements involve various forms of dynamical systems, so that the work must be guided by theoretical analyses and by application of dynamical analogies. Research in musical engineering led to the electronic music synthesizer. Analysis of speech sounds is directed towards the development of speech controlled machines, of which the phonetic typewriter is an example. A system for recording and reproducing television signals from magnetic tape in both black and white and color has been developed.

New magnetic materials are developed for use in high frequency transformers, memory devices, and permanent magnets and for the coating of magnetic tape. In the field of electrophotography, photosensitive surfaces are developed, coatings for paper are investigated, and suitable processing techniques are devised. The integrated system is called *Electrofax*. Special forms of cathode ray tubes are investigated with a view to obtaining very high speed printing of facsimile signals and electronic computer outputs. Electronic cooling systems employing thermoelectric phenomena are also investigated.

ELECTRONIC RESEARCH LABORATORY

This laboratory investigates new principles which have potential utility in electronic devices. Research, using modern analytical and experimental tools, covers such areas as electrical conduction through solids and gases, electron optics, electron beam dynamics, and transistor physics. Results are applied to electron devices suitable for operation in all parts of the radio spectrum as well as for television pickup and reproduction. The diversity of the work is indicated by such projects as studies of radiation damage in semiconductors, exploration of millimeter-wave generation in solids at liquid-helium temperatures, optical and visual phenomena in color reproduction, improved transistors, photoconductive television pickup tubes, magnetron and traveling-wave microwave amplifiers, physical measurements in single-crystal semiconductors and tri-color television reproducer principles.

PHYSICAL AND CHEMICAL RESEARCH

In the Physical and Chemical Research Laboratory, basic research studies are made of electronic and related phenomena, and of means for synthesizing new materials exhibiting these phenomena. Theoretical and experimental work is done to gain better fundamental understanding and control of phenomena such as crystal growth, perturbation effects in solids, magnetism,

luminescence, semiconduction, photoconduction, thermionic emission, photoemission, and secondary emission. These pioneering studies frequently require the development and use of new techniques and apparatus. The present facilities include a computer laboratory with digital and analog computers, special hyper-clean rooms for chemical operations, a unique isolated building with equipment for experiments at extremely high temperatures and pressures, electron microscopes, X-ray diffractometer, mass spectrometer, wide-range recording spectroradiometer, and a cryostat for producing liquid helium. Because of the broad scope and fundamental nature of the Physical and Chemical Research Laboratory, it often gives vital assistance to other groups in the solution of a specific problem. Such assistance may be in the form of a new theory to explain some anomalous effect, measurement of a subtle property, synthesis of a superior material for a certain use, and mathematical, chemical, or spectroscopic analyses.

SPECIAL PROJECTS RESEARCH LABORATORY

RCA has always carried on projects of interest to the United States Government, particularly to the military services. Many of the devices which were used so effectively during World War II were made possible through the application of knowledge gained before the war through research. During the war, research was devoted exclusively to work in fields where the results could be applied directly to the war effort and to the development of devices and instruments of direct use to the armed forces of the United States and its allies. The results of peacetime research are often applicable to developments in the military field. Continual contact with the Defense Department leads to programs directed toward military objectives. Research will continue to be conducted in the fields which produced radar, sonar, shoran, infrared applications, and many other tools of military significance.

INDUSTRY SERVICE LABORATORY

The results of research at RCA Laboratories serve the manufacturing and operating groups. In addition, the inventions resulting from this research are made available through licensing agreements to the radio industry and others. Special laboratories are located in New York City, Princeton, Newark, Chicago, and Hollywood, where skilled engineers conduct development work, interpret research results in practical form, prepare bulletins covering new developments, advise industry engineers, and conduct apparatus performance tests. In this way the basis for the best in radio and electronics is made available to the industry and thus to the public.

PATENT OPERATIONS

Most of the members of Patent Operations are located at the David Sarnoff Research Center in Princeton. The group renders patent services to the entire organization.

One phase of the patent attorney's job begins with the submission of the disclosure of an invention. Searches are made to determine the novelty and patentability of the invention. If the search report is favorable, the patent attorney—versed in the art and often both an engineer and attorney—consults with the inventor and drafts a patent application to be filed in the U. S. Patent Office. The patent attorney prosecutes the application, making necessary amendments, until the application is allowed and is issued as a patent. This activity, carried on by Domestic Patent Operations, is paralleled by the work of the Foreign Patent Operations group, where applications for patents in foreign countries are prepared.

Patent Operations activities, however, extend beyond the preparation and prosecution of patent applications. Appeals and interferences are prosecuted. The patent attorney may make studies and reports on the applicability of patents to various apparatus. He may also be called upon to give patent approval to make, use, or sell products or processes.

For young men wishing to enter the patent profession, RCA's training policies enable them to acquire the necessary experience. For those already possessing engineering and law degrees, on-the-job training is given which includes the writing of patent applications under the tutelage of experienced supervisors. For those who have an engineering degree and who want to obtain a law degree while working in patent law, opportunity exists in RCA's Washington office to be employed as a patent searcher and attend law school.

THE RESEARCH MAN AT WORK

One of the factors which makes research at RCA pleasant and rewarding is the freedom of action given to the scientist. Having entered upon an investigation or a project, he has independence and latitude in the manner in which he will carry out his portion of it. There is, quite naturally, supervision, but an effort is made to give as much autonomy as possible, with the individual keeping his supervisor informed of his progress and of anything for which he might be held responsible.

While team or group research has come steadily to the fore, there is still a definite need and place at RCA for the scientist who is best suited for individual research. And, of course, when he reaches a point at which he requires the services or assistance of another laboratory or department, they are readily available to him.

The research team has proved itself at the Laboratories to be a very efficient instrument. For long range programs or for projects of immediate interest and need, the group of scientists, often of diverse disciplines but working together toward the same result, has been impressively effective. This fusion of talents and common effort cutting across academic boundaries has been valuable not only from the point of view of getting problems solved, but also for the interaction of efforts and ideas of these scientists, which in many cases has produced applications far beyond the scope of the immediate task. This team research by men of diverse training and talents has another value, a value to the men performing it. It is the stimulus of a fresh viewpoint provided by co-workers who see the problem from a different perspective.

Education is regarded at RCA as an ongoing process. It includes not only the work which a man does to keep abreast of developments in his field, but also continued formal study. Many of the research workers at the Laboratories go on with graduate study for advanced degrees with the encouragement and, in some cases, the financial assistance of the corporation. Four fellowships are made available each year, on a competitive basis, to young scientists and engineers who are employed in the Laboratories and operating units. These fellowships, which are awarded to men shown to be fully qualified for graduate study and research, carry a substantial annual grant as well as a stipend for tuition, fees, apparatus, and other expenses. Part-time work is carried on by many at Princeton University.

POLICY ON PAPERS AND PUBLICATIONS

RCA encourages its people in the writing of papers, articles, and books which are contributions to knowledge and which reflect credit upon the authors and their company. In a typical year, 79 papers were presented by RCA authors at scientific meetings, and 68 papers were published in 22 different technical and semi-technical journals, magazines, and books. Many books by RCA authors are standard reference works in their fields.

EMPLOYEE PATENT POLICY

Technical personnel agree at the time of their employment to assign to RCA inventions and the patents thereon made during the course of their employment which relate to RCA's business. A plan has been in operation for several years in RCA under which a standard incentive payment is made for patent applications filed on behalf of RCA employees. ♦

RCA's first research laboratory was housed in a tent on Long Island N.Y. The laboratory was established a few months after the corporation was formed in 1919.

DAVID SARNOFF

COMMEMORATING THE FORTY-FIFTH ANNIVERSARY OF DAVID SARNOFF'S ENTRY INTO THE FIELD OF RADIO ON SEPTEMBER 30, 1906, THIS PLAQUE IS DEDICATED BY HIS ASSOCIATES IN THE RADIO CORPORATION OF AMERICA AS A SYMBOL OF THEIR ESTEEM AND ADMIRATION.

AS A PIONEER OF WIRELESS, HE HAS CONTRIBUTED IMMEASURABLY TO THE DEVELOPMENT OF RADIO, TELEVISION AND ELECTRONICS AS NEW SERVICES TO THE NATION AND TO THE AMERICAN PEOPLE.

A CREATIVE CRUSADER OF PROGRESS ENDOWED WITH A PENETRATING VISION, DAVID SARNOFF HAS CONTINUALLY LED THE WAY ACROSS NEW FRONTIERS IN SCIENCE, ART AND INDUSTRY TO MAKE THE UNIVERSE VIBRANT WITH INTERNATIONAL COMMUNICATIONS.

THESE LABORATORIES, THE RCA VICTOR PLANTS, THE RCA WORLD-WIDE RADIO CIRCUITS AND THE NBC RADIO-TELEVISION NETWORKS, SYMBOLIZE HIS FAITH IN SCIENCE, HIS CONSTRUCTIVE PLANNING AND ENDURING ACHIEVEMENTS.

DAVID SARNOFF'S WORK, LEADERSHIP AND GENIUS COMPRISE RADIO'S PREEMINENT RECORD OF THE PAST, TELEVISION'S BRILLIANT PERFORMANCE OF THE PRESENT, AND A RICH LEGACY IN COMMUNICATIONS FOR THE FUTURE.

THIS LABORATORY OF RCA IS NAMED
THE DAVID SARNOFF RESEARCH CENTER

SEPTEMBER 30, 1951

LEFT: *To commemorate David Sarnoff's 45th anniversary in radio, the RCA laboratories at Princeton, N.J., were named "The David Sarnoff Research Center."* RIGHT: *A close-up of the bronze plaque which was unveiled at the event, in September, 1951.*

A striking aerial view of The David Sarnoff Research Center in its country setting at Princeton, N.J.

and increased government control of the daily lives of all the people.

In the second place, I firmly believe that government control of research would destroy the very qualities that enable researchers to make such an important contribution to society. For government control means that rigid lines would be set for research; and these lines may not meet changing requirements. Certainly industry is best qualified to define its own research needs. And the partnership between research and industry loses its meaning when government can dictate the subject and objective of research in any competitive system of private enterprise.

The third reason, of course, is that the only money the government has is the money it gets directly or indirectly from industry and the people industry serves. If, then, government supports industrial research, business will still be paying for it. Therefore, it behooves businessmen, in their own self-interest as well as in the public interest, to bear their fair share of the financial load.

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Let me recall a little story that illustrates this point. I shall always remember one afternoon back in the twenties when Dr. Zworykin came to my office with a tale of magic. He told me he had invented an electronic eye. For half an hour I listened intently, and then exclaimed, "It's too good to be true. What will it cost to develop the idea?" "Maybe about $100,000," answered Zworykin. "All right," I said, "it's worth it."

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THE WORLD OF RESEARCH

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luminescence, semiconduction, photoconduction, thermionic emission, photoemission, and secondary emission. These pioneering studies frequently require the development and use of new techniques and apparatus. The present facilities include a computer laboratory with digital and analog computers, special hyper-clean rooms for chemical operations, a unique isolated building with equipment for experiments at extremely high temperatures and pressures, electron microscopes, X-ray diffractometer, mass spectrometer, wide-range recording spectroradiometer, and a cryostat for producing liquid helium. Because of the broad scope and fundamental nature of the Physical and Chemical Research Laboratory, it often gives vital assistance to other groups in the solution of a specific problem. Such assistance may be in the form of a new theory to explain some anomalous effect, measurement of a subtle property, synthesis of a superior material for a certain use, and mathematical, chemical, or spectroscopic analyses.

SPECIAL PROJECTS RESEARCH LABORATORY

RCA has always carried on projects of interest to the United States Government, particularly to the military services. Many of the devices which were used so effectively during World War II were made possible through the application of knowledge gained before the war through research. During the war, research was devoted exclusively to work in fields where the results could be applied directly to the war effort and to the development of devices and instruments of direct use to the armed forces of the United States and its allies. The results of peacetime research are often applicable to developments in the military field. Continual contact with the Defense Department leads to programs directed toward military objectives. Research will continue to be conducted in the fields which produced radar, sonar, shoran, infrared applications, and many other tools of military significance.

INDUSTRY SERVICE LABORATORY

The results of research at RCA Laboratories serve the manufacturing and operating groups. In addition, the inventions resulting from this research are made available through licensing agreements to the radio industry and others. Special laboratories are located in New York City, Princeton, Newark, Chicago, and Hollywood, where skilled engineers conduct development work, interpret research results in practical form, prepare bulletins covering new developments, advise industry engineers, and conduct apparatus performance tests. In this way the basis for the best in radio and electronics is made available to the industry and thus to the public.

PATENT OPERATIONS

Most of the members of Patent Operations are located at the David Sarnoff Research Center in Princeton. The group renders patent services to the entire organization.

One phase of the patent attorney's job begins with the submission of the disclosure of an invention. Searches are made to determine the novelty and patentability of the invention. If the search report is favorable, the patent attorney—versed in the art and often both an engineer and attorney—consults with the inventor and drafts a patent application to be filed in the U. S. Patent Office. The patent attorney prosecutes the application, making necessary amendments, until the application is allowed and is issued as a patent. This activity, carried on by Domestic Patent Operations, is paralleled by the work of the Foreign Patent Operations group, where applications for patents in foreign countries are prepared.

Patent Operations activities, however, extend beyond the preparation and prosecution of patent applications. Appeals and interferences are prosecuted. The patent attorney may make studies and reports on the applicability of patents to various apparatus. He may also be called upon to give patent approval to make, use, or sell products or processes.

For young men wishing to enter the patent profession, RCA's training policies enable them to acquire the necessary experience. For those already possessing engineering and law degrees, on-the-job training is given which includes the writing of patent applications under the tutelage of experienced supervisors. For those who have an engineering degree and who want to obtain a law degree while working in patent law, opportunity exists in RCA's Washington office to be employed as a patent searcher and attend law school.

THE RESEARCH MAN AT WORK

One of the factors which makes research at RCA pleasant and rewarding is the freedom of action given to the scientist. Having entered upon an investigation or a project, he has independence and latitude in the manner in which he will carry out his portion of it. There is, quite naturally, supervision, but an effort is made to give as much autonomy as possible, with the individual keeping his supervisor informed of his progress and of anything for which he might be held responsible.

While team or group research has come steadily to the fore, there is still a definite need and place at RCA for the scientist who is best suited for individual research. And, of course, when he reaches a point at which he requires the services or assistance of another laboratory or department, they are readily available to him.

The research team has proved itself at the Laboratories to be a very efficient instrument. For long range programs or for projects of immediate interest and need, the group of scientists, often of diverse disciplines but working together toward the same result, has been impressively effective. This fusion of talents and common effort cutting across academic boundaries has been valuable not only from the point of view of getting problems solved, but also for the interaction of efforts and ideas of these scientists, which in many cases has produced applications far beyond the scope of the immediate task. This team research by men of diverse training and talents has another value, a value to the men performing it. It is the stimulus of a fresh viewpoint provided by co-workers who see the problem from a different perspective.

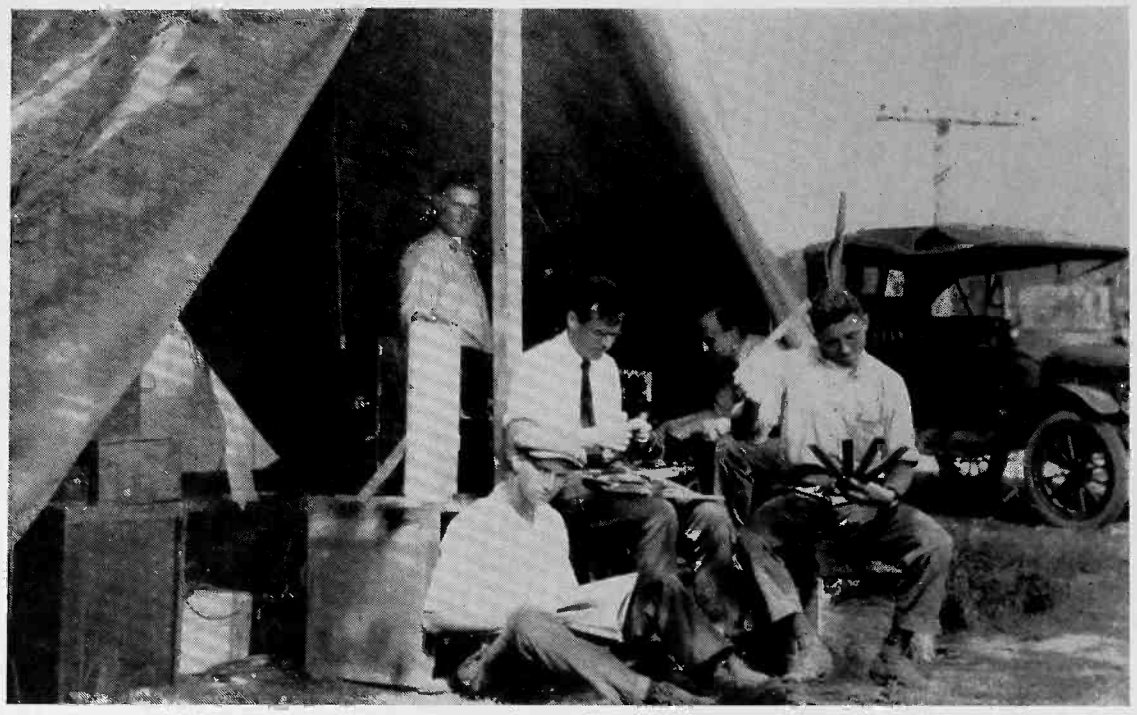
Education is regarded at RCA as an ongoing process. It includes not only the work which a man does to keep abreast of developments in his field, but also continued formal study. Many of the research workers at the Laboratories go on with graduate study for advanced degrees with the encouragement and, in some cases, the financial assistance of the corporation. Four fellowships are made available each year, on a competitive basis, to young scientists and engineers who are employed in the Laboratories and operating units. These fellowships, which are awarded to men shown to be fully qualified for graduate study and research, carry a substantial annual grant as well as a stipend for tuition, fees, apparatus, and other expenses. Part-time work is carried on by many at Princeton University.

POLICY ON PAPERS AND PUBLICATIONS

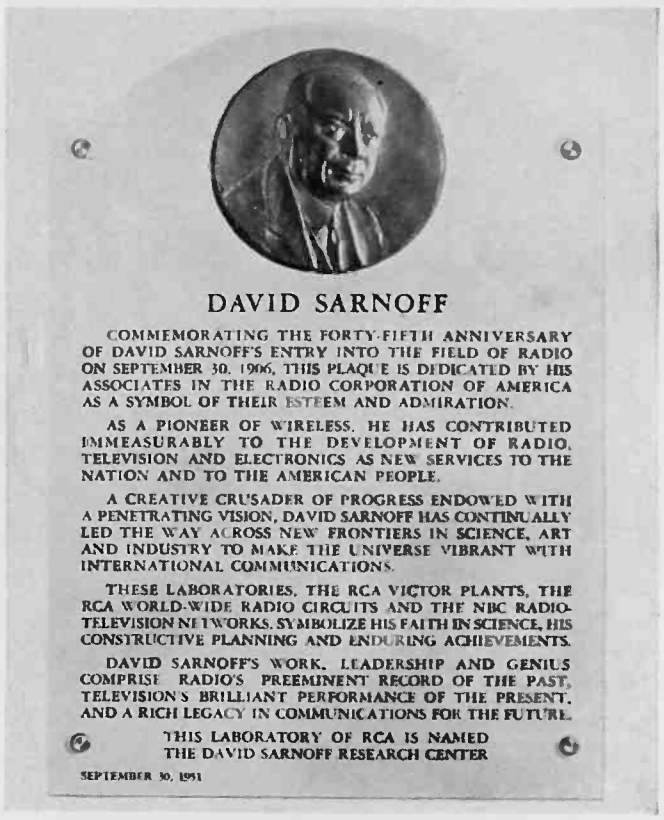
RCA encourages its people in the writing of papers, articles, and books which are contributions to knowledge and which reflect credit upon the authors and their company. In a typical year, 79 papers were presented by RCA authors at scientific meetings, and 68 papers were published in 22 different technical and semi-technical journals, magazines, and books. Many books by RCA authors are standard reference works in their fields.

EMPLOYEE PATENT POLICY

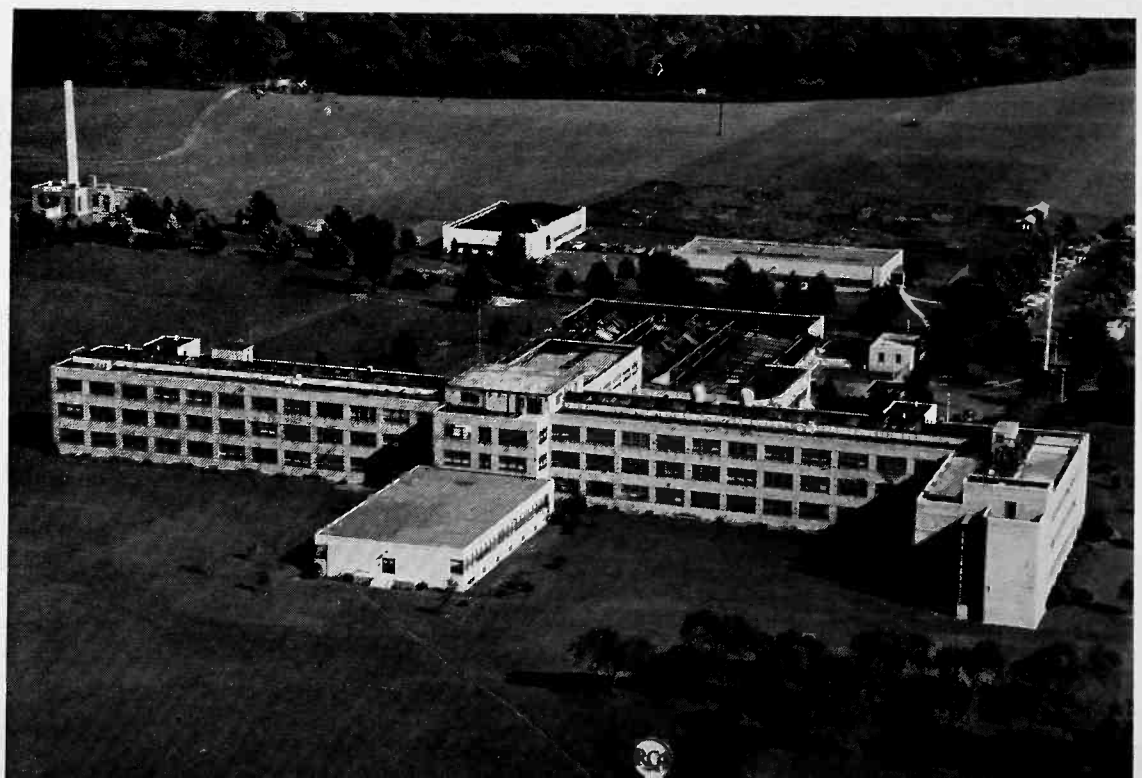
Technical personnel agree at the time of their employment to assign to RCA inventions and the patents thereon made during the course of their employment which relate to RCA's business. A plan has been in operation for several years in RCA under which a standard incentive payment is made for patent applications filed on behalf of RCA employees. ♦



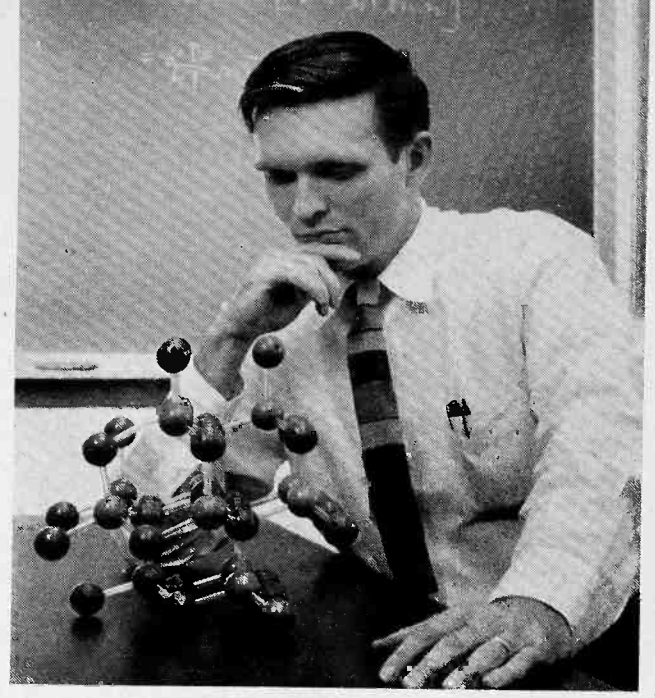
RCA's first research laboratory was housed in a tent on Long Island N.Y. The laboratory was established a few months after the corporation was formed in 1919.



LEFT: *To commemorate David Sarnoff's 45th anniversary in radio, the RCA laboratories at Princeton, N.J., were named "The David Sarnoff Research Center."* RIGHT: *A close-up of the bronze plaque which was unveiled at the event, in September, 1951.*



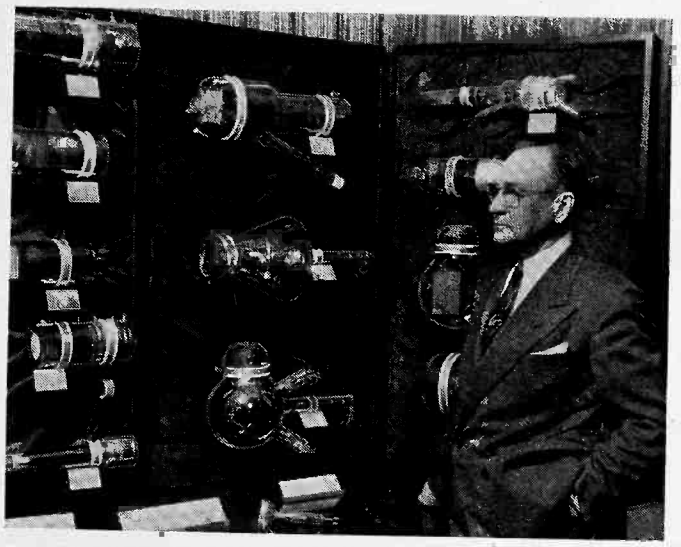
A striking aerial view of The David Sarnoff Research Center in its country setting at Princeton, N.J.



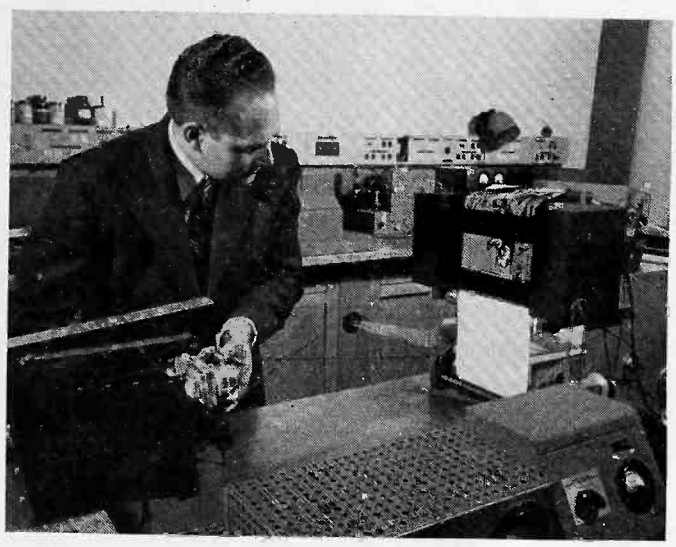
An RCA physicist studies the crystal structure of zinc sulphide with the aid of a large model.

Models of crystal structure help research men in developing their theoretical knowledge of electronics.

Scientific ideas take shape on the drafting board.



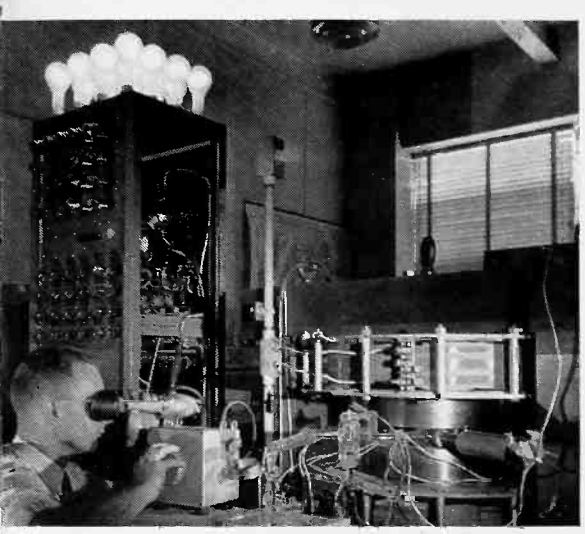
Dr. Vladimir K. Zworykin with historic TV tubes he helped to develop as Technical Consultant to RCA.



Adjusting a laboratory model of a continuous microfilm enlarger making prints on Electrofax paper.

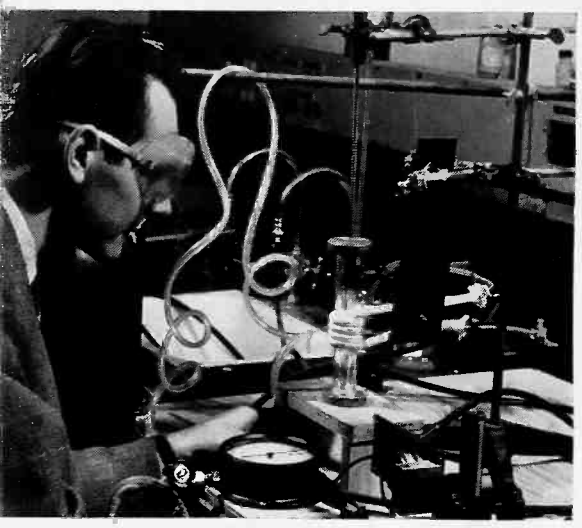
Informal discussions between co-workers lead to an interchange of useful ideas and information.

Demountable vacuum systems are used in studying the interaction of electron beams with microwaves.



The evaporating source in a mass spectrometer registers its temperature within the optical pyrometer.

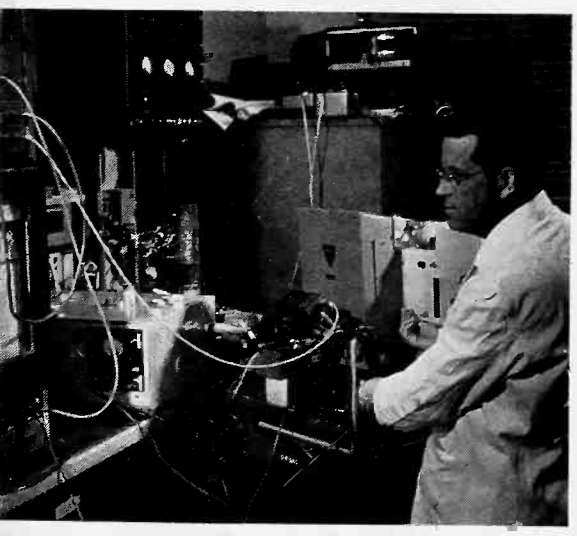
This electronic synthesizer will create any musical tone; it translates coded information into musical sounds for disk recording.



A germanium crystal is grown with the aid of heat generated by a small radio-frequency furnace.

A cathode-ray oscilloscope is used to determine the performance of an experimental model color receiver.

A compact table model electron microscope was developed by RCA for use in colleges, hospitals, and industrial laboratories.



The excitation and emission spectra of crystals are determined with a grating-type spectroradiometer.

The enormous magnification possible with the electron microscope makes it invaluable for work in many fields.

"I have been lucky in the splendid men and women–tens of thousands of them in the half century since I hitched my wagon to the electron—who have been my associates and friends. I am profoundly aware that their hands and minds and hearts made possible the accomplishments for which I have been given excessive credit. The temptation is to mention names. But there are so many, so very many to whom I am indebted for help and understanding, for patience and loyalty, that I had better not attempt it. Besides, my debt is owed in large measure to men and women whose names I do not know. They form the great body of the organization and their energies and devotion are cemented into the magnificent structure of the Radio Corporation of America and its associated enterprises."

David Sarnoff

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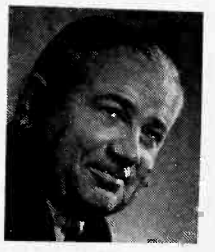

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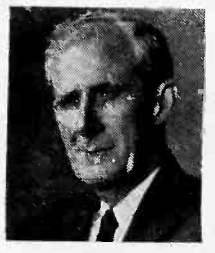

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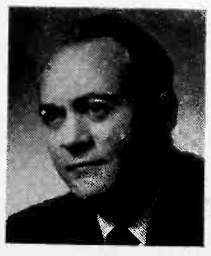

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THE GREAT CHALLENGE TO INTELLIGENCE

by David Sarnoff

WE LIVE IN A TIME that is testing the spirit of man. It is a time vibrant with challenge, and also with promise and opportunity. Great are the miracles of science at our fingertips, but with all their latent power they are not enough to solve the human problems of our day or to assure peace for our time and for unborn generations. Science is a means to achievement, but is not an end in itself. Its triumphs will be empty victories unless they help to make better people living fuller, more satisfying and nobler lives.

No discovery, or man-made machine, is good or evil in itself. If we are to become the masters of science—not the slaves—we must learn to use the powers of Nature and Science with good purpose; and that purpose must be to advance the well-being of our fellow man. The machine has neither mind nor soul nor sense of moral values. Only man has been endowed with these divine attributes and he must be stimulated to appreciate, to develop and to express these precious gifts of God.

In the last ten years, man has acquired immense new knowledge and developed new means that can either advance or destroy civilization. Unless we learn to harness those new powers for useful and beneficent purposes we shall find ourselves the victims of our own progress, trapped by our own genius. That is the great challenge to man if he is to survive—not merely in the physical, but in the spiritual sense.

It is not our scientific skills that have kept us together as Americans and attracted countless millions to our ranks down through the centuries. Rather, it was our early recognition of the transcendent importance of the things of the spirit—of common understanding and sympathy and mutual aid.

Nor is it science alone that creates the brotherhood of man on earth. Science gives us a common meeting ground—a sharp tool, it is true, but the mortar of brotherhood must come from the heart, not the laboratory.

We have entered the Electronic and Atomic Age as apprentices. We are far from being journeymen-workers in this complex domain. With every new advance we become more acutely conscious of how much remains to be done, how little we know, and what a vast and unknown area lies before us for exploration and analysis.

Under the impetus and demands of war the electron and the atom were rushed into service. At that time it was natural that the first thoughts about the use of atomic energy were concentrated on the development of weapons that would hasten the end of the war and achieve victory. But, like fire, atomic energy can serve man as well as consume him in its flames. Indeed, both the electron and the atom hold incalculable treasures for peace and civilization which the world will squander unless success is achieved in due time to make them instruments for good rather than evil. Tremendous is the opportunity for those who would build for peace, progress and prosperity, for they have these two wondrous building blocks of the universe—the electron and the atom. Man has learned these vital secrets of Nature in our own lifetime and the responsibility is ours to do all we can to guide these new forces toward beneficent uses for all mankind.

Man could not release the energy from the atom, control it by the electron, send messages and travel through space were it not for a Supreme Architect who has designed the Universe to function in an orderly fashion. The sun, the moon and the stars are not *accidents*. Their harmonious interrelationship and their effects upon life on this earth may be beyond our own full comprehension, but they are clear manifestations of a Supreme Intelligence.

To blend material and spiritual powers harmoniously, man must be guided by the teachings of religion as well as the lessons of science. And in the spiritual crusade for a free and peaceful world, science and religion can be powerful allies. Ever since the dawn of civilization, religion and science have been the golden keys in man's age-old efforts to unlock the secrets and the truth about the Universe so that they might be converted into human values. As we learn the lessons they teach, we become more aware of the mysteries of Nature and of Life itself.

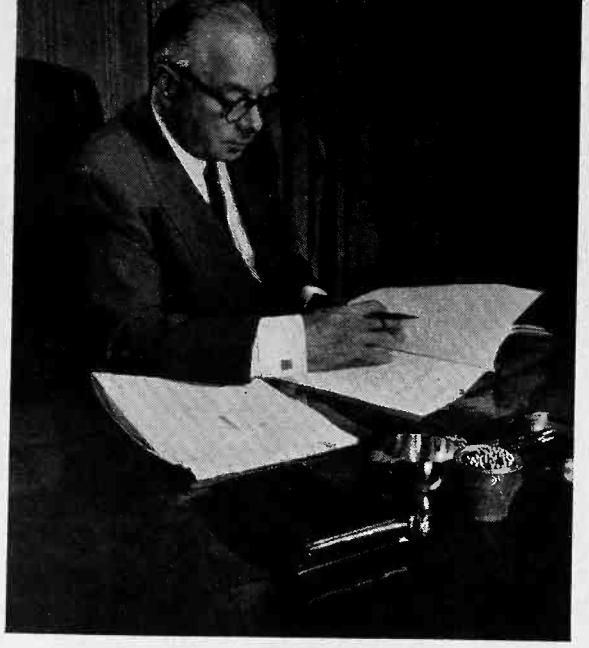
I shall always remember an occasion when I was with Marconi on board his yacht, the Electra. We were experimenting with shortwaves, endeavoring to establish communication with Australia from the English Channel. It was five o'clock in the morning when we finished our experiments for the day. We were about to retire when he said to me: "David, there is one thing I would like to know before I die—I know *how* this thing works, but I would like to know *why!*" Like many before him, he died without an answer to his question. We still do not know the answer to this and similar questions.

Life itself is an impenetrable secret. The enormous machinery of the Universe and the immensity of space are astounding. Life would be frightening were it not for faith.

We must have the faith to believe that the Creator of the Universe did not bestow upon mortal man his intelligence, his ability to research, to discover, to invent and engineer, in order to destroy the very things he was empowered to produce.

I believe we are witnessing a revival of faith in the destiny of mankind. We see hope in the very recent surge of interest in harnessing *atoms for peace.*

Let us not be discouraged when, at times, the signs of friendship and brotherhood between some nations are invisible. Rather, let us find courage and hope in the fact that nations consist of people, and deep in the hearts of all people there exists a feeling of kinship and a cherished desire to dwell together on this earth *in peace.* Man, by recognizing the kinship of all people as brethren, and by following the simple precepts of brotherhood, can climb to new heights of glory and to a finer destiny. ◆



from the Wisdom of

DAVID SARNOFF

I distinguish between knowledge and wisdom. They are two different things. I believe that knowledge is not necessarily a guarantee of wisdom. Some people who have very little knowledge have a great deal of wisdom, and some people who have a very great deal of knowledge have very little wisdom. That doesn't mean that knowledge is unimportant, or that wisdom would not be helped by knowledge, but wisdom is the combination of experience with life, the attitude of man towards man; it is human understanding; it is character; it is a combination of many things. To know how another person is going to react to a given situation is a product of wisdom, not of knowledge. We have retrogressed in wisdom in the last 2500 years, although we have gone forward in knowledge. I think we have gone back in wisdom in our failure to appreciate fundamental values of life. The things that we regard most important today are not as wise as the things that were regarded most important in the past. Our present preoccupations more and more revolve upon our achievements, status, and what other people think of us. Learning, understanding and spiritual development are not as apparent today as in the past. In the past that type of understanding and wisdom was limited, but the thinkers had it. They took more time to think because they didn't regard anything else as important. Those people were more concerned with spiritual and ethical and moral concepts than they were with particular things. Today I don't know that you can point to a Socrates, Plato or Aristotle. When we speak of wisdom today, we always go back to somebody that isn't alive today.

Practice has tended to get priority over theory. Exploration and discovery have usually been judged less by what they added to the treasurehouse of knowledge and understanding than by what they added to industry and everyday life. The scientist devoted to basic inquiries into the unknown has been given relatively little credit and, certainly, not enough cash.

One still meets the question, "Of what value is a program of abstract science without a definite and *useful* goal?" More and more of the men responsible for research are beginning to acknowledge the fallacy of that question. It is becoming increasingly clear to them that the pursuit of knowledge as an end in itself, the passionate urge to vanquish some segment of ignorance, is justified, in the long run, even in terms of utility.

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It's a curious fact that many of the things which seemed most distressing in their time—problems, crises, conflicts—are among the most satisfying memories in the perspective of time. I offer this observation in passing by way of consolation to young men and women wresting with tough problems today.

More than ever, man's soul is involved in the equations of our lives.

State of mind is a very important factor in success because you can condition your mind to a point where it enables or prevents you from going forward and doing things. You can poison your own mind and limit your own capacity. Don't admire the fellow that says he has an open mind — it is usually a mind with nothing in it. A man who has a state of mind based on knowledge and wisdom, experience and reason, has won half the battle, and, conversely, the other man has lost the battle. State of mind based on balanced judgment is a precious possession, but being unreasonably optimistic means nothing to me, nor does being excessively worried.

If a man has the opportunity to express, unimpeded and unhampered, the forces within him, whatever they may be, and to develop those forces, that to my mind is the greatest measure of success. If I could play the violin and were given the opportunity to develop my talents, and I achieved this self-expression, then I would say I was a success. The same holds true for a brick-layer. If I wanted to be the best brick-layer, and achieved it, this would be success. A part of this success would be the means of being able to provide, but wealth is not an evidence of success, nor its possession an evidence of achievement. Success is: the opportunity to express the forces within one; to achieve such measure of happiness as one can derive from his work; to be able to have at least enough of the goods of the world so one is independent and not dependent on somebody else; and the opportunity to serve others, to advance something, to leave the world a little better than you found it, and, finally, to achieve as much peace of mind as one can. I think one has to divide that formula between those who are sensitive persons and those who are not. I doubt that anyone endowed with imagination can achieve success, happiness or peace of mind. If a man is a perfectionist, or has imagination, it changes the formula.

Without creativity the world would be lost. Whether that be in science, politics, psychology, business, or anything else. The world depends not only on creative ideas, but on a constant flow of them.

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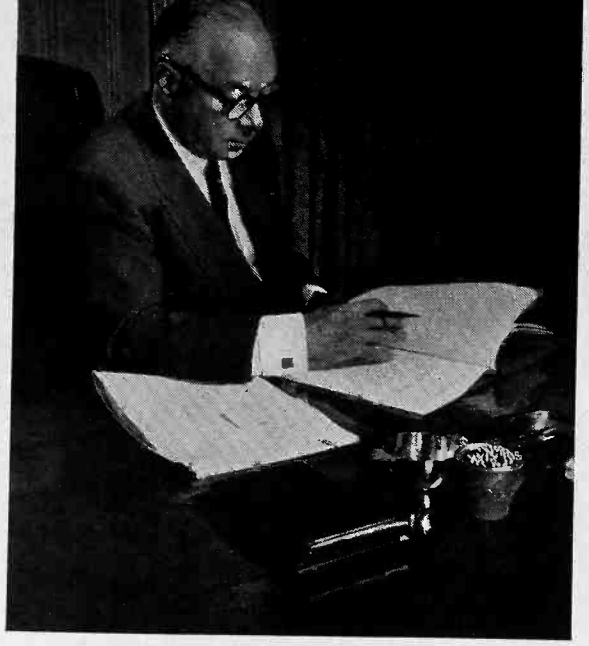

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No man by himself can achieve very much. If he is great and his product is limited to his own output he is very small. He is an atom and unless he can create a chain reaction he is only an atom. I regard human relationships between business itself and between big business and little businesses, or little businesses and little business, a competitive struggle so great that it often brings out the worst there is in man as well as sometimes the best in him.

I think that the ultimate solution to the problem of war must be a United Nations type of organization, with an international force behind it, and true disarmament on the part of every nation. An effective United Nations must in the future include all nations of the world and should have not only the power of deliberation but the power of enforcement. Other nations need to be educated, particularly the peoples of the nations of the world now captive. We don't necessarily have to do so much to educate them to the advantages of the systems of the free world as to the disadvantages of their own systems, because the truth about them is more important than the truth about us. Until they are able to recognize falsity, the tensions in international relations will continue to exist. To win the cold war is of the utmost importance because we can then prevent a hot war.

A hunger for faith and salvation, for age-old values beyond the material and the temporal, gnaws at the mind and spirit of man.

Our most vital task is to repair the dividing line between Good and Evil, between right and wrong, and restore the basic moral imperatives. Unless that is done, we shall continue to appease Evil in the name of shabby expediencies that bring us only temporary illusions of peace.

The great Prophets and Teachers were stubborn and uncompromising on essential principles. Where age-old truths were at stake, they never sought safety in the middle ground of compromise. They did not countenance the modern heresy of tolerance of the intolerable.

To meet the challenge of the future, our imagination must be bold; but it must be balanced by wisdom based on knowledge.

More than anything else mankind needs today a consistent view of the good society and the good life—and the courage stoutly to defend it. That view is not to be found in the sophistications of those who sneer at moral values. It resides in the total experience of the human race, as expressed in its noblest literature and moral systems.

Let us not lose the sense of the awe and mystery of life. Our very triumphs in penetrating nature have disclosed our mortal limitations. The more we learn, the more remains to be learned. Science, far from making us arrogant, teaches us to be humble. In this universe of endless wonders, the most wondrous is the human mind capable of delving so deeply, and the human heart aware of depths it can never plumb.

The dominant physical fact in the next quarter-century will be technological progress unprecedented in kind and in volume. In relation to the total history of the human race, the last hundred years have been no more than a split second.

There is no longer margin for doubt that whatever the mind of man visualizes, the genius of modern science can turn into functioning fact.

The very fact that electronics and atomics are unfolding simultaneously is a portent of the amazing changes ahead. Never before have two such mighty forces been unleashed at the same time. Together they are certain to dwarf the industrial revolutions brought about by steam and electricity. There is no element of material progress we know today—in the biological and chemical fields, in atomics and electronics, in engineering and physics—that will not seem, from the vantage point of 1980, a fumbling prelude.

The material triumphs now at our disposal and the greater ones to come must be translated into a happier life for mankind everywhere. We must give a clear right-of-way to the things that are good, beautiful, and enriching.

It is not possible to do much with the young mind if you don't improve the old mind. Older people are going to be here for a longer time. I think the old problem of juvenile delinquency is a problem of adult delinquency. Improving the mind is not quite as important as improving the quality and character of the human being so he will be able to distinguish between right and wrong. Some of the best minds have had some of the most deplorable characters. I don't associate mind with character. First assure character and then work on the mind. You build the mind on a foundation of good character, the basis of which is home, church, school. In that respect we have retrogressed rather than improved. Parents can't expect their children to be better than the example set at home. They can't practice all the things that are wrong and then expect the children to do all the things that are right. Such training is the responsibility of parents, teachers, and churches.

Not labor but leisure will be the great problem in the decades ahead. That prospect should be accepted as a God-given opportunity to add dimensions of enjoyment and grace to life. We have reason to foresee a fantastic rise in demand for, and appreciation of, the better, and perhaps the best, in art, music and letters.

Education is not a thing esoteric and apart, but integral with the nation and its activities.

One hopes that by 1980 a decent education will have become as indispensable as a decent suit of clothes.

This Nation has reached a new fork in the road of its destiny—a road across which Science stands astride awaiting man's commands—commands that can lead to utter destruction or turn all the world toward a greater civilization.

Science, far from nurturing pride, encourages humility. Its every victory reveals more clearly a Divine design in nature, a remarkable conformity in all things, from the infinitesimal to the infinite, that surpasses mortal understanding.

We cannot banish dangers, but we can banish fears. We must not demean life by standing in awe of death.

It seems to me unqualifiedly good that more and more of the weight of arduous toil will be unloaded onto the backs of machines: that the sum total of pain and agony will be further reduced by the progress of healing; that modern communications will bring peoples and nations into closer contact, leading to better understanding of one another.

I cannot believe that God expects us to worship him at particular hours of the day or night or in a particular form. I think that prayer is not something we ought to do for the benefit of God but for ourselves if it benefits us. A temple or church is only to create atmosphere — if you can walk into any place and take off your street garments mentally and can contemplate and think in terms that have nothing to do with the outer world, and if that gives you satisfaction, then I think it is fine and is in itself a form of prayer. Places of worship readily furnish that atmosphere; therefore they are good.

Science and religion are partners in man's constant effort to learn the truth about himself and the universe.

The most futile intellectual exercise is the discussion as to whether an industrialized society is "desirable." We might as reasonably argue whether the tides and the seasons are desirable. The genie of science could not be stuffed back into the bottle even if we so wished.

This is a world that holds plenty of problems and perils, but these are always part of the price of monumental achievements. Our failures, and they are many, for the most part spring from our success. They reflect the growing pains of an extraordinary period in human history.

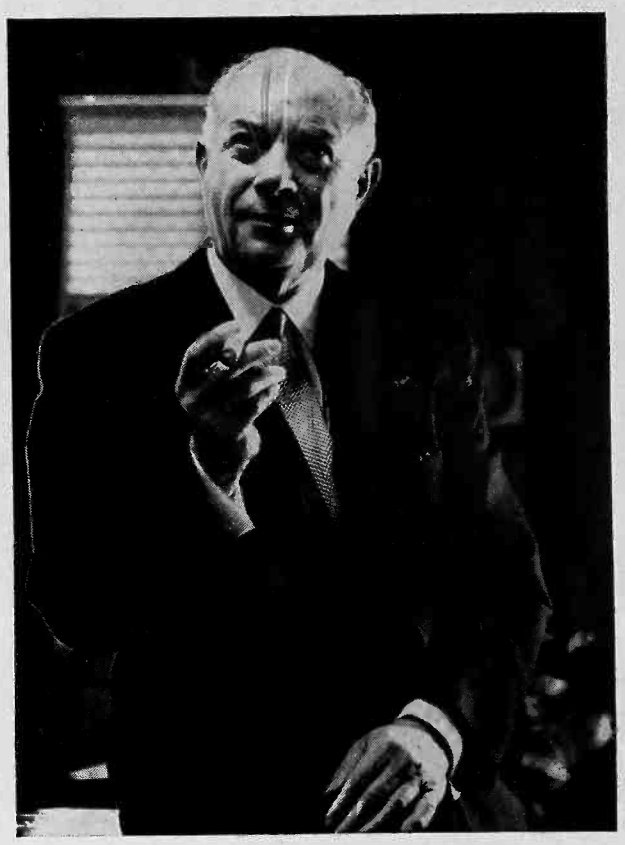
Men's dreams are on drafting boards in myriad laboratories.

In recent years, there has been such obsessive emphasis on security, that I fear it has obscured older and more real values. Some young people have adopted Ferdinand the Bull, smelling flowers from dawn to dusk, as the symbol of the good life. I have been disappointed, at times, to find boys in their twenties, or even in their teens, worrying about pensions and old age security when they will have reached sixty-five. There seems to me something unhealthy where youth is so lacking in confidence. Maybe we have to re-learn the meaning of ambition and of struggle. When has anything worthwhile been attained except by overcoming obstacles? And the thrill, believe me, is as much in the battle as in the victory.

The inability of man as a social and economic creature to keep step with his science—that is the crux of his dilemma today. He is mature technologically while still an adolescent spiritually. Physical distances have shrunk, but the distances between the hearts of men and of nations are wide as ever.

The need for able and courageous leaders in every area of our national life is pressing. There is less time than there used to be for youth to dawdle and postpone the plunge into responsible affairs.

Having conquered nature, man faces the task of conquering himself. As my good friend Bernard M. Baruch put it recently, "To attain the stability we yearn for in this world, we must first find stability within ourselves." Not until this happens shall we be truly integrated and whole.



To put it bluntly, we have no choice. Either all men learn to live and work together, or all men will perish together.

Whatever course you have chosen for yourself, it will not be a chore but an adventure if you bring to it a sense of the glory of striving—if your sights are set far above the merely secure and mediocre. In one's personal life, as in world affairs, appeasement can be the shortest road to failure.

The job ahead is to assimilate the scientific progress, to turn every potential for human benefit into a living reality.

Creative science finds its fullest and truest expression only in a climate of freedom.

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There is no satisfaction that can come to the head of an organization greater than to be able to sit back and watch the results achieved by men under his direction without having to give them orders to tell them what to do. Give them the mission and let them perform. Let them make their mistakes, too, because no one is perfect. There is only one way to learn and that is by the mistakes you make as you go along. But the mistakes must not be such as to cause grave consequences.

Peace and brotherhood can be achieved. Two of the most potent forces in civilization — religion and science — can be used to create *one world* in its truest and greatest sense. Through religion, we can minimize the evils of envy and greed, intolerance, and a lust for power. Through science, we can reduce the physical burdens of mankind, make the earth more fruitful, create plenty in place of scarcity, break down the barriers of ignorance and misunderstanding and make life more meaningful for everyone.

No man by himself can achieve very much. If he is great and his product is limited to his own output he is very small. He is an atom and unless he can create a chain reaction he is only an atom. I regard human relationships between business itself and between big business and little businesses, or little businesses and little business, a competitive struggle so great that it often brings out the worst there is in man as well as sometimes the best in him.

I think that the ultimate solution to the problem of war must be a United Nations type of organization, with an international force behind it, and true disarmament on the part of every nation. An effective United Nations must in the future include all nations of the world and should have not only the power of deliberation but the power of enforcement. Other nations need to be educated, particularly the peoples of the nations of the world now captive. We don't necessarily have to do so much to educate them to the advantages of the systems of the free world as to the disadvantages of their own systems, because the truth about them is more important than the truth about us. Until they are able to recognize falsity, the tensions in international relations will continue to exist. To win the cold war is of the utmost importance because we can then prevent a hot war.

A hunger for faith and salvation, for age-old values beyond the material and the temporal, gnaws at the mind and spirit of man.

Our most vital task is to repair the dividing line between Good and Evil, between right and wrong, and restore the basic moral imperatives. Unless that is done, we shall continue to appease Evil in the name of shabby expediencies that bring us only temporary illusions of peace.

The great Prophets and Teachers were stubborn and uncompromising on essential principles. Where age-old truths were at stake, they never sought safety in the middle ground of compromise. They did not countenance the modern heresy of tolerance of the intolerable.

To meet the challenge of the future, our imagination must be bold; but it must be balanced by wisdom based on knowledge.

More than anything else mankind needs today a consistent view of the good society and the good life—and the courage stoutly to defend it. That view is not to be found in the sophistications of those who sneer at moral values. It resides in the total experience of the human race, as expressed in its noblest literature and moral systems.

Let us not lose the sense of the awe and mystery of life. Our very triumphs in penetrating nature have disclosed our mortal limitations. The more we learn, the more remains to be learned. Science, far from making us arrogant, teaches us to be humble. In this universe of endless wonders, the most wondrous is the human mind capable of delving so deeply, and the human heart aware of depths it can never plumb.

The dominant physical fact in the next quarter-century will be technological progress unprecedented in kind and in volume. In relation to the total history of the human race, the last hundred years have been no more than a split second.

There is no longer margin for doubt that whatever the mind of man visualizes, the genius of modern science can turn into functioning fact.

The very fact that electronics and atomics are unfolding simultaneously is a portent of the amazing changes ahead. Never before have two such mighty forces been unleashed at the same time. Together they are certain to dwarf the industrial revolutions brought about by steam and electricity. There is no element of material progress we know today—in the biological and chemical fields, in atomics and electronics, in engineering and physics—that will not seem, from the vantage point of 1980, a fumbling prelude.

The material triumphs now at our disposal and the greater ones to come must be translated into a happier life for mankind everywhere. We must give a clear right-of-way to the things that are good, beautiful, and enriching.

It is not possible to do much with the young mind if you don't improve the old mind. Older people are going to be here for a longer time. I think the old problem of juvenile delinquency is a problem of adult delinquency. Improving the mind is not quite as important as improving the quality and character of the human being so he will be able to distinguish between right and wrong.
Some of the best minds have had some of the most deplorable characters. I don't associate mind with character. First assure character and then work on the mind. You build the mind on a foundation of good character, the basis of which is home, church, school. In that respect we have retrogressed rather than improved. Parents can't expect their children to be better than the example set at home. They can't practice all the things that are wrong and then expect the children to do all the things that are right. Such training is the responsibility of parents, teachers, and churches.

Not labor but leisure will be the great problem in the decades ahead. That prospect should be accepted as a God-given opportunity to add dimensions of enjoyment and grace to life. We have reason to foresee a fantastic rise in demand for, and appreciation of, the better, and perhaps the best, in art, music and letters.

Education is not a thing esoteric and apart, but integral with the nation and its activities.

One hopes that by 1980 a decent education will have become as indispensable as a decent suit of clothes.

This Nation has reached a new fork in the road of its destiny—a road across which Science stands astride awaiting man's commands—commands that can lead to utter destruction or turn all the world toward a greater civilization.

Science, far from nurturing pride, encourages humility. Its every victory reveals more clearly a Divine design in nature, a remarkable conformity in all things, from the infinitesimal to the infinite, that surpasses mortal understanding.

We cannot banish dangers, but we can banish fears. We must not demean life by standing in awe of death.

It seems to me unqualifiedly good that more and more of the weight of arduous toil will be unloaded onto the backs of machines: that the sum total of pain and agony will be further reduced by the progress of healing; that modern communications will bring peoples and nations into closer contact, leading to better understanding of one another.

I cannot believe that God expects us to worship him at particular hours of the day or night or in a particular form. I think that prayer is not something we ought to do for the benefit of God but for ourselves if it benefits us. A temple or church is only to create atmosphere — if you can walk into any place and take off your street garments mentally and can contemplate and think in terms that have nothing to do with the outer world, and if that gives you satisfaction, then I think it is fine and is in itself a form of prayer. Places of worship readily furnish that atmosphere; therefore they are good.

Science and religion are partners in man's constant effort to learn the truth about himself and the universe.

The most futile intellectual exercise is the discussion as to whether an industrialized society is "desirable." We might as reasonably argue whether the tides and the seasons are desirable. The genie of science could not be stuffed back into the bottle even if we so wished.

This is a world that holds plenty of problems and perils, but these are always part of the price of monumental achievements. Our failures, and they are many, for the most part spring from our success. They reflect the growing pains of an extraordinary period in human history.

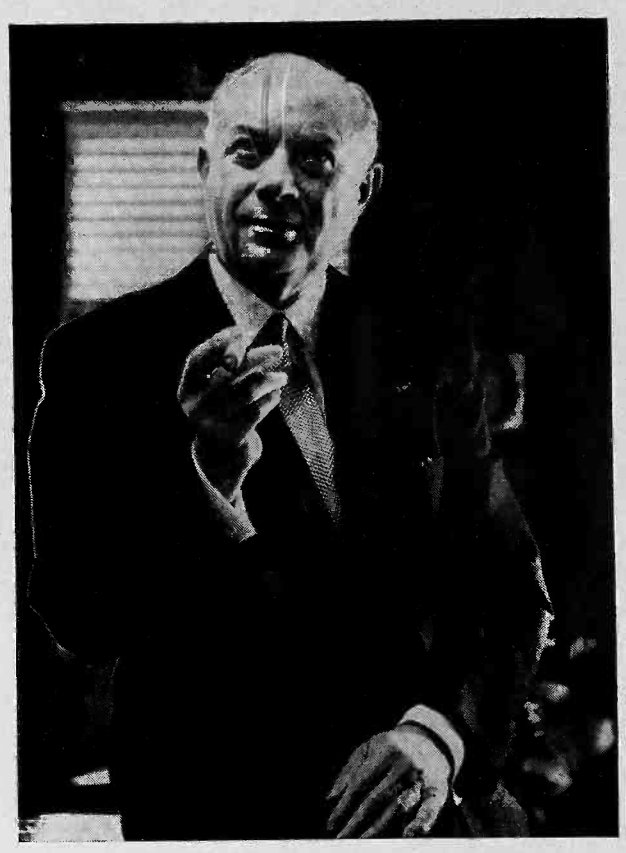
Men's dreams are on drafting boards in myriad laboratories.

In recent years, there has been such obsessive emphasis on security, that I fear it has obscured older and more real values. Some young people have adopted Ferdinand the Bull, smelling flowers from dawn to dusk, as the symbol of the good life. I have been disappointed, at times, to find boys in their twenties, or even in their teens, worrying about pensions and old age security when they will have reached sixty-five. There seems to me something unhealthy where youth is so lacking in confidence. Maybe we have to re-learn the meaning of ambition and of struggle. When has anything worthwhile been attained except by overcoming obstacles? And the thrill, believe me, is as much in the battle as in the victory.

The inability of man as a social and economic creature to keep step with his science—that is the crux of his dilemma today. He is mature technologically while still an adolescent spiritually. Physical distances have shrunk, but the distances between the hearts of men and of nations are wide as ever.

The need for able and courageous leaders in every area of our national life is pressing. There is less time than there used to be for youth to dawdle and postpone the plunge into responsible affairs,

Having conquered nature, man faces the task of conquering himself. As my good friend Bernard M. Baruch put it recently, "To attain the stability we yearn for in this world, we must first find stability within ourselves." Not until this happens shall we be truly integrated and whole.



To put it bluntly, we have no choice. Either all men learn to live and work together, or all men will perish together.

Whatever course you have chosen for yourself, it will not be a chore but an adventure if you bring to it a sense of the glory of striving—if your sights are set far above the merely secure and mediocre. In one's personal life, as in world affairs, appeasement can be the shortest road to failure.

The job ahead is to assimilate the scientific progress, to turn every potential for human benefit into a living reality.

Creative science finds its fullest and truest expression only in a climate of freedom.

Machinery, artificial fertilizers, triumphs in biology and horticulture are wringing long-hidden treasures from the ever-young earth. Even the oceans and the air are beginning to yield new harvests of sustenance for humankind. Having eaten of the Tree of Knowledge, man was condemned to get his bread by the sweat of his brow. But evidently there was a Divine mercy at the heart of that curse. For man has applied his knowledge to obtain bread with ever less sweat.

We must face the fact that man has shown greater ability to explore the secrets of nature than to explore his own heart and mind. We have been able to harness the forces of nature better than we have been able to master ourselves.

America and the world need fresh energies, the fire and the zeal of youth, no less than the experience of elders.

Let us not paralyze our capacity for good, by brooding on man's capacity for evil.

We need, as a nation, not only more *man power* but more *mind power*. Universities represent the prime reservoirs of that *mind power*.

Neither personal success nor wealth can any longer provide a guarantee of safety for the individual. They mean little unless the larger problems affecting the community and the nation are solved. To meet the demands of these times, each of us must be prepared to make contributions to society even at what may seem a personal sacrifice.

The nuclear physicists and engineers have turned the key that unlocks the incalculable energies confined in the atom. Though born in war and baptized in destruction, those energies are already being harnessed to man's constructive purposes, for production and transport and healing. This, the latest miracle, is so recent and impressive that we have not yet accepted it psychologically as we have accepted the miracles that went before.

We are too prone to make technological instruments the scapegoats for the sins of those who wield them. The products of modern science are not in themselves good or bad; it is the way they are used that determines their value.

In the electronic and atomic age, man's hunger for freedom and social justice, for beauty and inner grace, is as keen as ever.

My experiences testify to the opportunities provided by America for initiative, self-expression and advancement.

Machines are no substitute for minds. The most effective "electronic brain" is no substitute for thinking. The machine can never process more than is fed into it.

Knowledge is not enough, unless it leads you to understanding, and, in turn, to wisdom. And wisdom implies an appreciation of the basic laws of nature and of man's behavior. It calls for patience to select or develop the best means to achieve the best possible results. In this deeper and truer sense education is a never-ending process, drawing its sustenance from both work and play, and nurtured by love, sympathy and aspiration to brotherhood.

Education is a foundation stone of the nation.

The electron and the atom are remolding mortal existence — for good or ill, depending on our wisdom and self-discipline in using their tremendous powers.

The most important factor to keep in mind is to continue your education. Science and industry will reward you for your talents and energy. Out of your efforts may come new inventions, new products, new processes and services. There is everything yet to be accomplished in our lives and in our work. What man has done, man can do better.

If you are to deserve your birthright of freedom, you must be prepared to cultivate and defend it. We dare not shut our minds to the truth that our civilization is being menaced by a strong and fanatic enemy. He is determined and tireless, working day and night to encompass the annihilation of the things we most cherish.

When bankers look upon the balance sheet of a business concern in which they are interested, because they have lent money or have been asked to lend money, they must remember that the assets and liabilities and the record of earning of the past five, ten, fifteen or twenty years no longer are sufficient to assure the success of the enterprise for the future. The health of an enterprise may depend more upon the imagination, courage, adaptability and wisdom of its management than upon the record of its past earnings.

Accept the fact that the only certainty in your lives will be change—and you will be in a better position to assimilate it without mental indigestion and moral confusion.

The man of tomorrow may work only 2 hours a day. One cannot assume that the purpose of man is to work merely to keep himself alive. Work is a means to an end and not an end in itself. The problem of the future will be the problem of leisure, not the problem of labor. The answer lies in that this may be the first time that man will have the opportunity to do what Socrates did — contemplate and not have to slave. If cultural, religious and moral forces are inadequate man will seal his own doom. That is the big problem of the future — the problem of leisure.

If the leisure time to come is used well and with wisdom, then I think that man, for the first time, may come into an era where he will have opportunity for education, culture, contemplation and the better things of life. We need education before leisure. It is more important that we be educated to the proper use of leisure than to the proper use of labor, as labor has certain built-in regulations. Leisure, beyond sleeping or relaxing, if the remainder is not intelligently employed, could be a disaster rather than a boon to mankind.

The possibilities of the new art of television are as boundless as the imagination. But this much is certain: In the sphere of communication man will forever seek a medium of transmission in pace with his thoughts and desires. It is to the glory of man that he has never quailed before the apparently insurmountable obstacles of space and time. In the circumstances, it is inconceivable that he will not make the fullest possible use of a medium of communication that bridges the distance between himself and the objects of his interest.

The human being has been created with a mind that can encompass the whole world within the fraction of a second; yet, his physical senses lag woefully behind. With his feet, he can walk only a limited distance. With his hands, he can touch only what is within reach. His eyes can see at a limited range, and his ears are useful at a short distance only. When television has fulfilled its ultimate destiny, man's sense of physical limitation will be swept away, and his boundaries of sight and hearing will be the limits of the earth itself. With this may come a new horizon, a new philosophy, a new sense of freedom, and greatest of all perhaps, a finer and broader understanding between all the peoples of the world.

Television is on the way and moving steadily forward. Television fires the imagination, and I can foresee the day when we shall look around the earth from city to city, and nation to nation, as easily as we now listen to global broadcasts. Therefore, *Freedom to Look* is as important as *Freedom to Listen*, for a combination of these will be the radio of the future. This is no idle dream and no one need doubt that we shall have international television.

By pushing buttons, tomorrow's business executives will be able to watch the workings of their staffs. The factory manager will check up on operations in outlying plants, even those in distant cities, without stirring from his desk. And the president of a metropolitan department store, while dictating letters in his 9th-floor office, will find it possible to keep an eye on the progress of a dress sale in the bargain basement.

Radio, television, motion pictures and other means of mass-communications now are available to serve mankind everywhere. They cannot be stopped by guards at the borders. They can cross mountains and oceans and carry their message of truth, of light and of hope, to the smallest hamlet in the darkest spot on the globe. These modern tools of science can be used to influence men's minds in the right direction and to lift men's hearts toward higher ideals.

Television may well be one of the tools of science which will weld this planet into "One World." When international television comes, as it will, people throughout the world will see democracy and the American way of life in action instead of merely being told about it.

The marvels of today will be commonplace tomorrow. Fifty years from now our descendants will say that we were very slow in 1958. Their automobiles, locomotives and ships may be powered by atomic energy. Their systems of transportation will surpass in safety, speed and comfort anything we have today. Those who may wish to stay at home and see the world will be able to look around the globe by color television.

Color television is a major step forward in the science and art of seeing by radio. It will be revolutionary in its effect upon communications. Color greatly enhances the beauty and attractiveness of objects and scenes. It gives more information and intensifies our powers of memory and identification. It is a new dimension that will increase the public's enjoyment of news events, entertainment and education.

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Progress comes through pioneering effort and leadership. And it is here that we meet the human element. No one objects to another fellow doing the job of pioneering. No one objects to another fellow researching, developing, spending his money, and doing what he can to create new inventions and new services. It is only when he begins to translate his efforts into profits for his shareholders, or those who risked their money on his judgment, that he meets oppositon. Those who sat quietly and comfortably at home, while the pioneer was busy outdoors braving cold weather, forget the past, and see only the present. The success of the pioneer invites envy, breeds jealousy and stimulates conflict.

No man has a monopoly on brains. No organization has all the knowledge required in a continuously changing and developing art and industry.

The Liberal Arts should not shrug off advances in Science and Technology as too technical to understand. And engineers at their end, should not regard Music and Arts as outside their natural domain.

Science is not an end in itself but a means to achievement. Its triumphs will be hollow victories unless they are utilized to make better people, living fuller, nobler, more satisfying lives.

If we are to become the *masters* of science, not its *slaves*, we must learn to use its immense powers to good purpose. The machine itself has neither mind nor soul nor moral sense. Only man has been endowed with these God-like attributes. Every age has its destined duty—ours is to nurture an awareness of those divine attributes and a sense of responsibility in giving them expression.

Electronics, in the race to achieve new triumphs, is run on the big track of Time on which there is room for all who would compete. There is no *finish* line.

The eye is the most curious organ of the human machine. We almost always want to *see* things. We may not always want to *hear* things, but we certainly want to *see* them. Therefore, television has removed the blinders from man's eyes and has enabled him to look beyond the four walls of his own home, almost around the globe.

To me, it is always a treat to get away from the competitive struggles of the day and to find myself in the company of men of intellectual achievements, and to dream with them about the possibilities ahead. Such dreams open up new horizons and make one wish to live longer so he can do more. The challenge of tomorrow fascinates me much more than the achievement of yesterday.

The vitality of the human spirit that pulses with renewed vigor against aggression and slavery, against prejudice and persecution, against hypocrisy and censorship, is certain to triumph over the sinister forces of evil.

Go on and research, discover, and invent to your heart's content. Pitch your mental tents in the field of imagination. In this blessed country of ours, where man is free to think, to speak, to discover, to invent and to develop, the field of imagination and creation is wide enough for everyone. And when you are in this field, inhaling the fresh air of Liberty, basking in the sunshine of Freedom, and enjoying the priceless privileges of our blessed land, say to yourselves, what I have said to myself, repeatedly:
GOD BLESS AMERICA.

We are living in a world of unprecedented change and great peril. Our civilization, our morality, everything we cherish for ourselves and our children is today at stake in the world-wide contest between freedom and slavery. This is not merely rhetoric. The challenge is real and the danger is present. Not in centuries has mankind faced an historical crisis as basic, or as far-reaching in its possible consequences. Destiny has placed our beloved America in a position of leadership on the side of freedom. It is a position we must not surrender.

Let us not be stampeded by shadows and hobgoblins. The march of science cannot be stopped; nor, in the last analysis, would any of us stop it if we could. Of course it brings problems at the same time that it opens up opportunities. It cancels out some jobs while stimulating others and creating myriad new ones. It imposes upon us periods of necessary physical and psychological adjustment.

In this advanced era, it is generally recognized that honest differences must be settled by reason, understanding, negotiation and fair-dealing.

The pace of science is swift and its strides are tremendous. Yet, man himself has not changed. He is still subject to reason and persuasion. But these require that there be an open door to his mind and to his heart. The best evidence that this is true, can be seen from the fact that dictators fear the minds and thoughts of their own subjects more than they do the guns and fire of their imagined foes. It is the dictatorships and not the democracies of the world that have slammed the doors to the minds of their inhabitants. And they have erected iron curtains to guard even the doors. Science makes it possible to pierce the iron curtains and open the doors to the minds of men.

In studying the lives of scientists we find that their love of nature was generally linked with a devout spirit. Everywhere in science, whether in electronics or aerodynamics, in chemistry or physics, scientists throughout the ages have beheld the handiwork of the Supreme Architect of the Universe. Hans Christian Oersted, the Danish scientist who liberated a mighty force in discovering the relation between electricity and magnetism, exclaimed: "The Universe is a manifestation of an infinite reason, and the laws of Nature are the thoughts of God." Michael Faraday, the Columbus of the Electrical Age, watched the sunsets as one of his favorite pastimes, and one day as a rainbow arched the sky he said: "He hath set His testimony in the heavens."

David Sarnoff

PREDICTS THE NEW WORLD OF 1978

A HISTORIAN has said that "often do the spirits of great events stride on before the events, and in today already walks tomorrow." Never before was this insight truer or more meaningful than it is today. The tomorrows ahead of us will be crowded with great challenge and great opportunity. They will be crowded, too, with great dangers.

More than ever in the past, man will be called upon to discipline himself and the world he lives in, and remain true to ideals of human welfare and moral integrity. Already the human race has at its disposal the power to destroy in a moment what it would take many years to rebuild. And the precious lives that would be extinguished could never be rebuilt.

Wisdom and courage of the highest order are called for to guide this new-found power into constructive rather than destructive channels. And those of us who have had a role in generating that awesome power have also an obligation to do our utmost to make it a beneficent force.

I have always been more concerned with the future than the past. I shall ask you to join me in peering into the future.

However impressive the events that have filled the last fifty years, or even the last century, I am convinced that they will be eclipsed by the events of the next twenty years.

Let us consider twenty major developments likely to affect all of us within the next twenty years. I shall limit myself to capsule summaries. I have not attempted to list them in the order of their appearance or their relative importance.

I need hardly warn, of course, that there are many imponderables —especially with regard to the social and political prospects— that may retard some of my expectations. On the other hand, they may advance them. To a large extent this will depend on the

courage, character and competence of our leadership. But those are the hazards of prophecy.

I proceed to stick my neck out by making the following 20 predictions for the 20 years ahead.

NUCLEAR ENERGY

We will have learned to extract atomic fuel from relatively inexpensive materials, thus making this power both plentiful and economical. Nuclear energy will be brought to a practical state of peace-time usefulness, not only for industry but for planes, ships, trains and automobiles. Direct conversion of atomic energy into electricity—a principle already demonstrated experimentally by RCA—will be a fact. Atomic batteries, based on low-cost waste products from nuclear reactors and operating for many years without recharging, will supply energy for industry and for the home and will supply it abundantly.

SOLAR ENERGY

The energy of sun rays will be effectively harnessed and in world-wide use. It will prove of special value to tropical and semi-tropical parts of the globe where the sun's energy is immense but where under-developed nations cannot afford fully to utilize present-day fuels and power sources.

COMMUNICATIONS

Television, in full colors, will be completely global, so that man will be able not only to speak and hear all around this planet but to see the entire world in natural colors. Individuals will be able to hold private two-way conversations, and see each other as they talk, regardless of the distances separating them. Moreover, the beginnings will have been made in the automatic and instantaneous translation of languages, enabling people to understand one another at once across the barriers of Babel.

TRANSPORTATION

Jet-propulsion and rocket-type vehicles, using nuclear fuels, will travel at speeds as high as 5,000 miles an hour with greater safety and comfort than today's aircraft. The world's leading cities will be only hours apart, many of them virtually within commuting distance. Inexpensive personal planes, flivvers of the skies, will fill the air. Automatically piloted aircraft for passenger service will be far advanced; guided missiles will transport mail and other freight over vast distances, including oceans.

AUTOMATION

Already well launched, automation will reach a crescendo under the impact of cheap and abundant power. It will increase production, decrease costs, and make more goods and services available to more people. The transition will create problems of adjustment but ultimately it will free millions of people from arduous and hazardous work. It will increase employment, reduce hours of labor and increase leisure.

MATERIALS

Chemistry will make spectacular strides in providing ever new materials tailored to meet almost any specifications man can imagine. A tremendous array of new plastics, ceramics, lubricants and categories of substances that as yet have no name will become available for personal and industrial uses.

ELECTRONIC LIGHT

Electroluminescence or *cold light*, now emerging from the research laboratories, will bring into being startling new types of illumination. It will change the appearance of our factories, streets, stores, highways and homes. Providing light without heat and almost without shadow, its glow will be subject to easy control for volume and color nuances to suit any taste or decor. Being light without glare, it will eliminate many of the perils of night driving and flying. It will also give us brighter and bigger TV pictures, and ultimately replace the TV tube altogether with a thin, flat-surface screen that will be hung like a picture on the wall.

COMPUTERS

The era of electronic computers, already begun, will reach fruition. Recording and accounting will be taken over by robots, freeing for other work the great majority of the nine million Americans now engaged in clerical tasks. Business procedures, industrial operations and fiscal data will be gathered and analyzed automatically. New products will, for the most part, have their performance predicted by computers, removing the need for building actual working models. High-speed writing and reading will be as familiar as high-speed arithmetic is today.

FOOD

Striking developments in irrigation and flood control, more efficient use of solar energy, the electronic acceleration of germination and growth, as well as new chemical and biological discoveries will greatly expand mankind's food resources. At the same time, the oceans will be efficiently *farmed* for nutritive products. Thus all the food needed by all the people of the world will become available, despite the fact that the population will continue to grow. These developments will enable famine to be eliminated in all parts of the world.

HEALTH

The close ties now developing between biology, chemistry and physics, applying the new tools of electronics and atomics, will bring an avalanche of improvements in preventive medicine, diagnosis and treatment of human ills. Biochemistry will furnish disease-controlling and health-sustaining drugs at an accelerated rate, especially in meeting the physical problems of old age. Man's life span will be further extended, probably within hailing distance of the century mark.

THE HOME

The housewife's dream of an all-automatic home will be realized. The day's chores in the home will be pre-scheduled, with each of the tasks performed electronically. The temperature, humidity and velocity of the air in each part of the home will be automatically kept at the desired levels day and night, and the air will be purged of bacteria and other contaminating matter. Electronic appliances will do the cooking and the dishwashing, and

will dispose of waste, eliminating much tedious labor. Fortunately, we shall continue to do our own eating.

CLIMATE

Not only will the prediction of weather for months and even years ahead be perfected, but major steps will have been taken to make and control weather as desired. Ports now icebound will be unfrozen and icebergs rapidly melted. Progress will have been made in dissipating storms even of hurricane intensity, or in diverting them from a destructive course.

Thus far I have dealt mainly with technological progress. It is an area where we can tread with some assurance. The shape of things to come already can be discerned in the research laboratories at home and abroad.

I wish I had the same degree of assurance with respect to developments in the social and political areas, where the most unpredictable force of all—human conduct—tells the story. But social sciences are deeply affected by changes in physical environment which greatly influences human conduct.

So I venture to go on with the listing, perhaps in an overly optimistic spirit, yet with faith in the ultimate good sense of our race of men.

COMMUNISM

Within the next twenty years Soviet Communism will collapse under the weight of its economic fallacies, its political follies, and the pressures of a restive, discontented population. These pressures will increase with the rise and spread of education amongst their own people.

Practical ways and means will be found by the free world to pierce the Iron Curtain and bring home to the Russian people the facts and the truth. The Soviet empire will fall apart as one satellite after another attains its own liberation. The Communist hierarchy will destroy itself by internal struggles for power and will be displaced by a military dictatorship which in turn will give way to representative government.

PEOPLE'S CAPITALISM

The prestige of the Marxist solution of social problems will decline as its limitations and errors become increasingly apparent in a rapidly developing world of technology. It will be more generally realized that centralized state economy is incompatible with human freedom. As Socialism is stripped of its popular appeals, the dynamics of a people's capitalism within a democratic framework will be intensified.

LIVING STANDARDS

The equation of the technical developments already listed will usher in an era of relative economic abundance. Slowly but surely the waters of wretchedness now covering so much of the earth will recede, and levels of well-being without past parallel will be attained all over the world. The most pressing problems will not be the use of labor but the intelligent and beneficent use of leisure.

EDUCATION

As a by-product of economic progress and expanding leisure, man will enter upon a period of universal education. Not only will general levels of knowledge rise, but the intellectual climate will be favorable to development of special talents and individual genius. Highly-geared technology will put a premium on brains: ever more skilled scientists, engineers, designers, technicians, and others will be needed. This mounting demand for mental competence will tend to enlarge educational facilities and promote the arts and sciences giving man further fresh channels for expression.

ENTERTAINMENT

Every form of art and every type of entertainment will be readily accessible in the home. Talent — both live and recorded — will be available by television, radio, the phonograph and electronic photography. The opportunities for creative and interpretative talents will be greater than ever before. The range and variety of programs will embrace everything created by the human mind.

GOVERNMENT

Because of unprecedented access to information, public opinion will be a more decisive element in the political life of nations. Prevailing sentiment on any issue will be quickly and accurately registered by electronic means. Government and people will thus be brought into closer correlation, so that popular government and democratic processes will tend to become more and more effective, more and more efficient.

WAR

Universal communications and speedy transportation will shrink the world to a neighborhood. Technological developments in weapons of mass destruction will leave no doubt that the alternative is between survival or annihilation. All nations will find it imperative to develop and adopt practical means for disarmament based on effective inspection, control and enforcement. War as an instrument of international policy will be outlawed.

SCIENCE AND RELIGION

As a reaction against current cynicism and materialism, there will be an upsurge of spiritual vitality. The gradual elimination of physical hungers will deepen the more elemental hunger for faith and salvation, for age-old values beyond the material and temporal that gnaws at the heart of man.

Science begets humility. Its every discovery reveals more clearly the Divine design in nature, the remarkable harmony in all things, from the infinitesimal to the infinite, that surpasses mortal understanding. The physical processes and laws of the universe are logical, all-embracing and wholly dependable. They imply a Supreme Architect, and the beauty and symmetry of His handiwork inspire reverence.

It may be that the imperfection of man, too, is a part of that creative symphony. The seed of moral perfection has been planted in man, but it has been left to him to nurture it to full flower in the harsh soil of mortal existence. Thus man is given a positive role in carrying out a phase of the blueprint of the Supreme Architect.

But I must climb down from that lofty eminence. A man who has survived half a century of labor in any field will, I hope, be forgiven for an excursion to the heights where not only the past, but a bit of the future seem spread out before his eyes. The world, as I see it, that awaits us over the horizon of the next twenty years, is challenging—exciting—and promising. ◆

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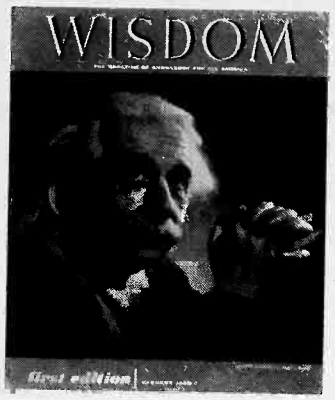
WISDOM

to your friends, relatives,
and business associates



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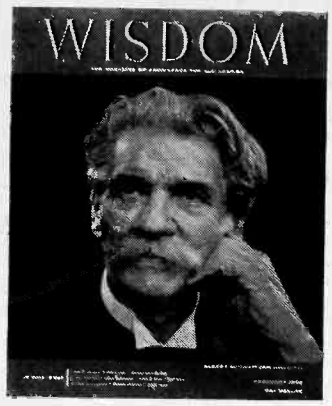

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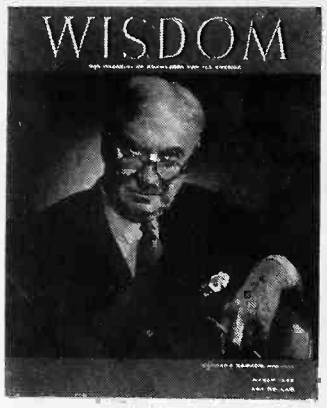

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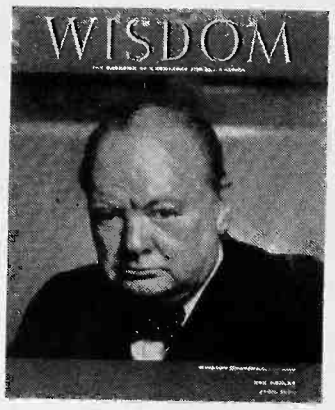

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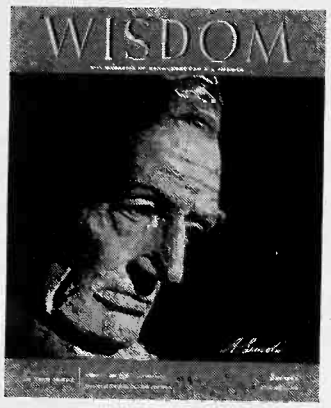

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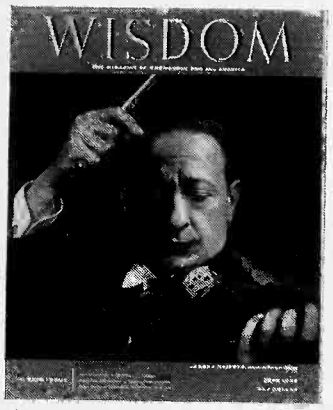

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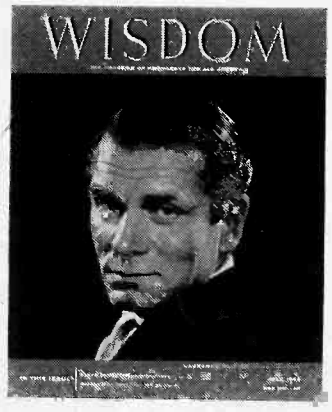

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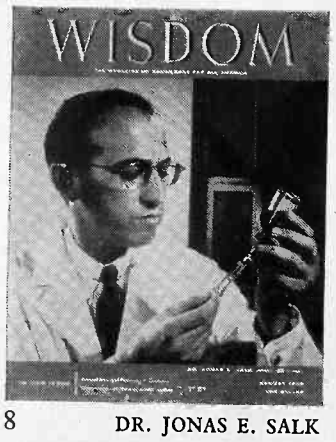

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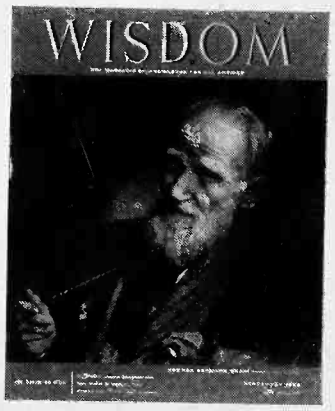

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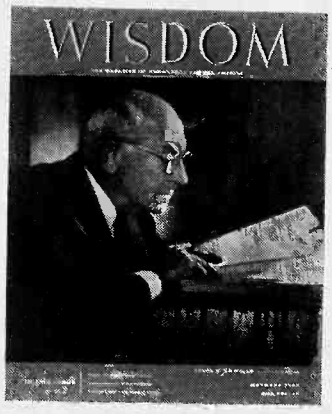

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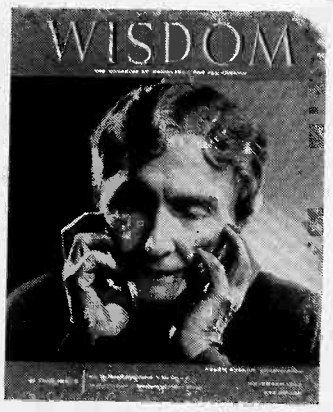

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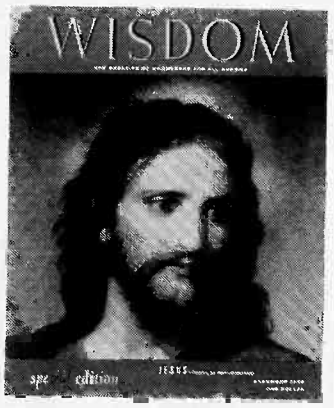

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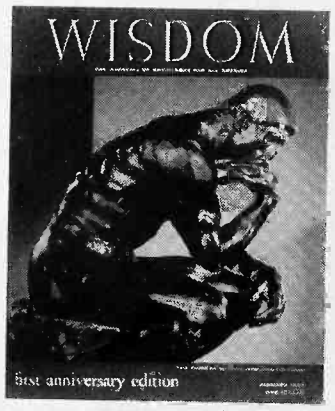

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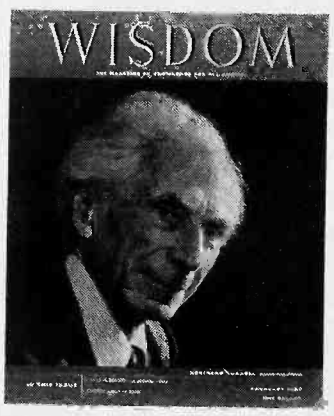

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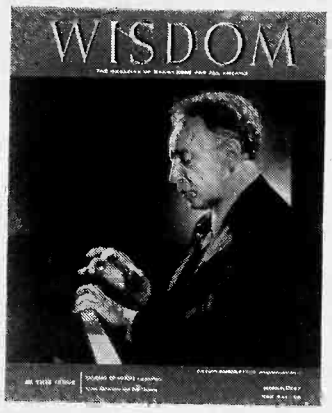

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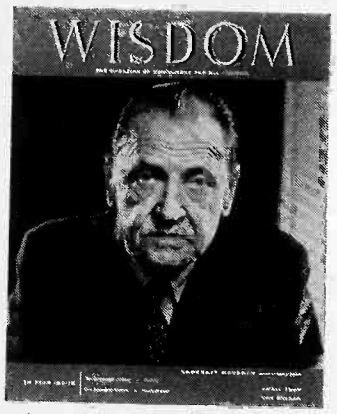

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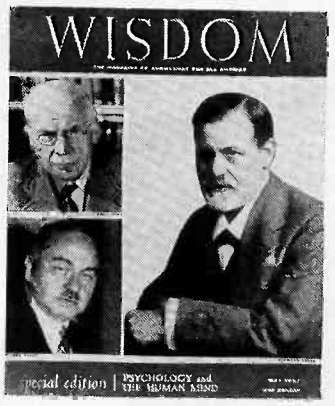

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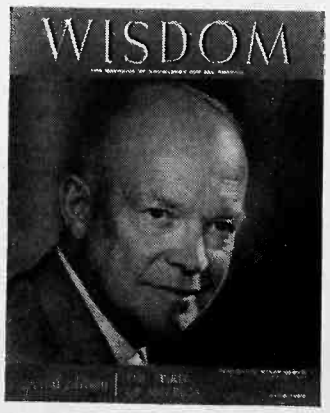

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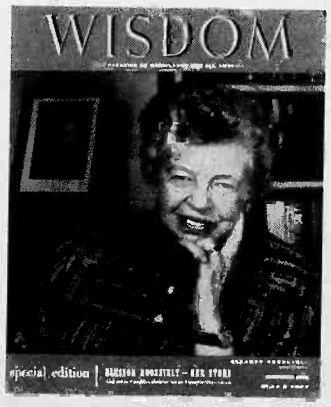

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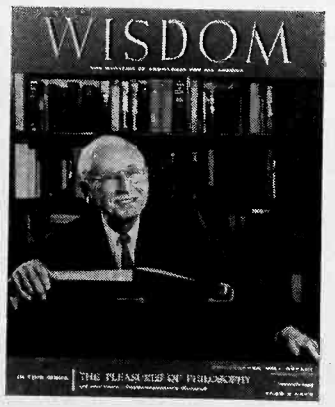

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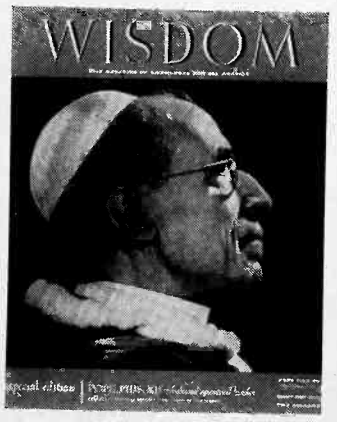

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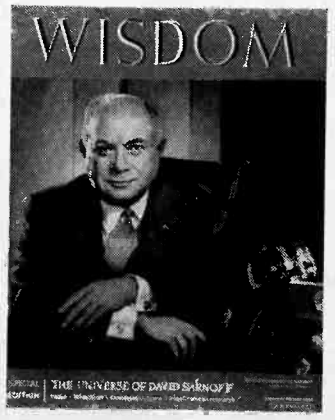

22 DAVID SARNOFF

what is WISDOM?

SINCE IT WAS FIRST PUBLISHED in January 1956, WISDOM has met the most critical of all tests — usefulness and dependability in the home, school, library, and office. It is the first magazine of its kind ever offered to the public. No expense has been spared to make it a truly magnificent magazine of timeless beauty and enduring quality. The finest paper, engravings, type-setting, printing, and binding are used.

WISDOM does not duplicate any other magazine. As the dictionary operates in the field of words, and the encyclopedia in the field of facts, WISDOM operates in the field of ideas. Its contents are of lasting value and importance. No popular magazine published for the general public has ever before attempted to tell the story of man's wisdom. WISDOM enables everyone, whatever the extent of his education, age, or means, to enjoy the fruits of human imagination, inspiration, and achievement since the dawn of history.

"*The half of knowledge is to know where to find knowledge.*" In WISDOM readers meet the Great Minds of all time — past and present — in every field of human thought and achievement. It is not limited in the nature of its subject matter. Its scope is world-wide. It reaches to all parts of the world for outstanding articles and pictures to bring readers a clearer, quicker, fuller understanding of Yesterday's age-old wisdom and of Today's knowledge and achievements — extracting the wisdom of the world that can be applied to everyday living. It enables you to acquire a liberal education. It stimulates mental growth.

WISDOM is written in clear, understandable language. It is superbly illustrated by the world's best photographers and artists. Every feature is carefully selected for general interest, edited for universal appeal, and presented in clear, interesting style. It is non-political, non-sectarian, non-controversial. The magazine throughout can be readily understood and thoroughly enjoyed by everyone. Dedicated to the advancement of knowledge, the improvement of public education and national welfare, the elevation of mental, moral, and social character, it is devoted to rendering an educational public service vital to America's well-being, for its editors firmly believe that education is our most important national resource.

WISDOM covers all fields of knowledge: Art, Biography, Books, Business, Education, Government, History, Humanities, Humor, Industry, Law, Literature, Medicine, Movies, Music, Nature, Philosophy, Psychology, Religion, Science, Sociology, Television, Theatre, Travel, World Affairs.

WISDOM contains *no advertising*. Every issue has permanent value and lasting interest. It can be read and treasured for years to come.

The physical make-up or format of WISDOM is a masterpiece of printing craftsmanship. It is characterized by simplicity, dignity, beauty. The page size is large — 10½ x 13¼ inches — the paper of high quality, the type large and easy to read, the photographs and illustrations etched by master engravers.

WISDOM has won the admiration and enthusiastic support of truly great men and women: Bernard Baruch, Albert Schweitzer, David Sarnoff, Cecil B. DeMille, Winston Churchill, Eleanor Roosevelt, Bishop Fulton J. Sheen, Dr. Norman Vincent Peale, Ralph J. Bunche, Conrad N. Hilton, Will Durant, Laurence Olivier, Artur Rubinstein, Herbert Hoover, George Jean Nathan, Helen Keller, Somerset Maugham, Admiral Richard E. Byrd, Bennett Cerf, General Omar N. Bradley, Jascha Heifetz, Dr. Jonas E. Salk, Richard J. Neutra, William Randolph Hearst, Jr., Dr. William C. Menninger, Dr. Karl A. Menninger. These are but a few of the world famous leaders who praised WISDOM. This unanimous acclaim from those most demanding of perfection stands as a noteworthy tribute to the WISDOM standard of excellence.

what is THE WISDOM SOCIETY?

WISDOM MAGAZINE is available only by membership in The Wisdom Society For The Advancement of Knowledge, Learning and Research in Education. The Society is a non-profit educational organization. It devotes its income wholly and solely to furthering its educational objectives, and is operated exclusively for educational purposes in the interests of public service — just as colleges and universities.

We are fully aware of the intellect and character of the men and women who read WISDOM. As a reader you are a person who is best able to appreciate the permanent value and immense benefits of WISDOM. You believe, as we do, that education can guide us through the challenging times ahead. And because we have faith in your ability to think and act wisely, we earnestly want you to share with us a common effort, and a common interest in the future of WISDOM, and to join the enviable company of those who have faith in WISDOM and are already members.

Therefore, we are happy to extend to you, as a reader of WISDOM, an exclusive invitation to become a Member of The Wisdom Society. Upon your acceptance of our invitation, we will send you a beautiful Membership Certificate of Honor. This will be inscribed with your name, and printed on fine paper ready for framing. It is something you will cherish and to which you will point with pride.

What does all this cost?

Only $15 for a full year's membership

And this of course includes a full year of WISDOM MAGAZINE

WISDOM MAGAZINE is available only to members of The Wisdom Society. Single copies are $2 — obtainable direct from The Society.

If you have a friend, relative or business associate whom you would like to sponsor for membership in The Wisdom Society, all you need do is send us the names and addresses, along with your check or money order for $15 for each person. Be sure to include your own name and address. We will then send each person not only a Membership Certificate of Honor carrying his or her name, but a beautiful card with your name announcing your gift membership.

If you would like the privilege of becoming a Lifetime Member of The Society, please consider this your invitation to do so. Perhaps you might like to sponsor a friend or relative as a Lifetime Member. If so, please send a check for $250 for each individual Lifetime Membership desired in The Wisdom Society. This amount assures you (or your giftee) membership in The Society for life, with no additional cost to you of any kind in the years to come.

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So you see how important it is that we receive your acceptance to our invitation at once. Simply fill in and return the Membership Application Form you will find on the following page, along with your check or money order, made payable to The Wisdom Society, as quickly as possible — today if you can — so that we can be sure you are included as a registered Member.

THE WISDOM SOCIETY
FOR THE ADVANCEMENT OF KNOWLEDGE, LEARNING AND RESEARCH IN EDUCATION

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ANNUAL MEMBERSHIP

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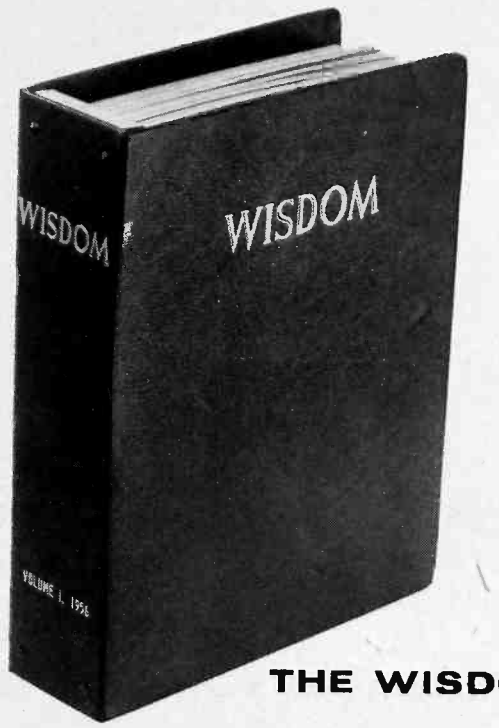

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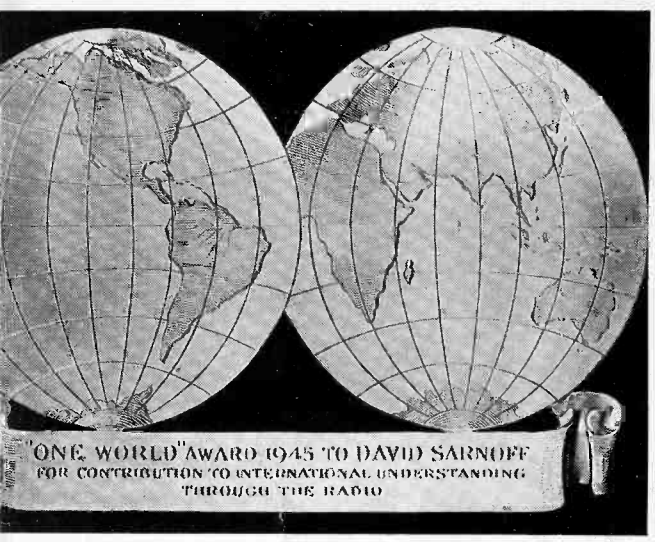

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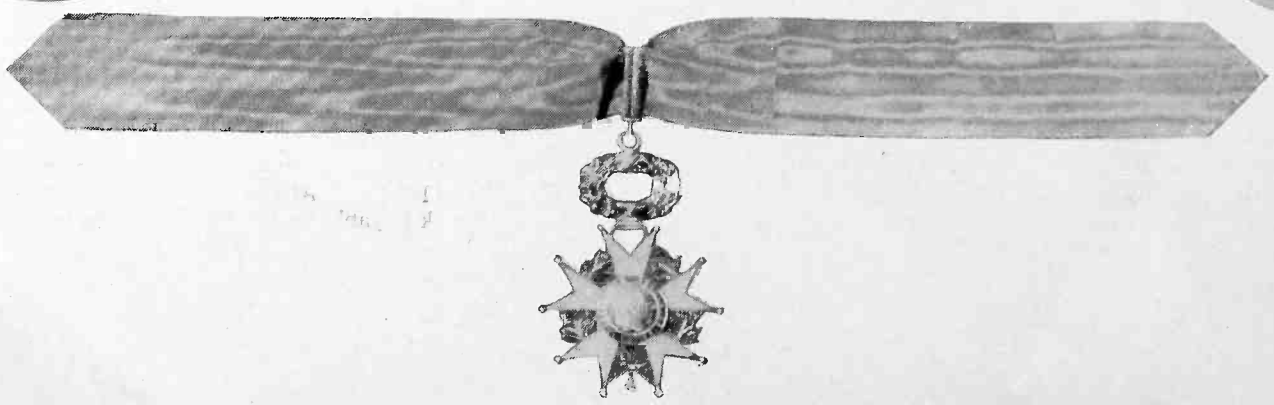

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