Magic Dials

The Story of Radio and Television by

Lowell Thomas · Illustrated by Anton Bruehl

Lee Furman · New York · 1939

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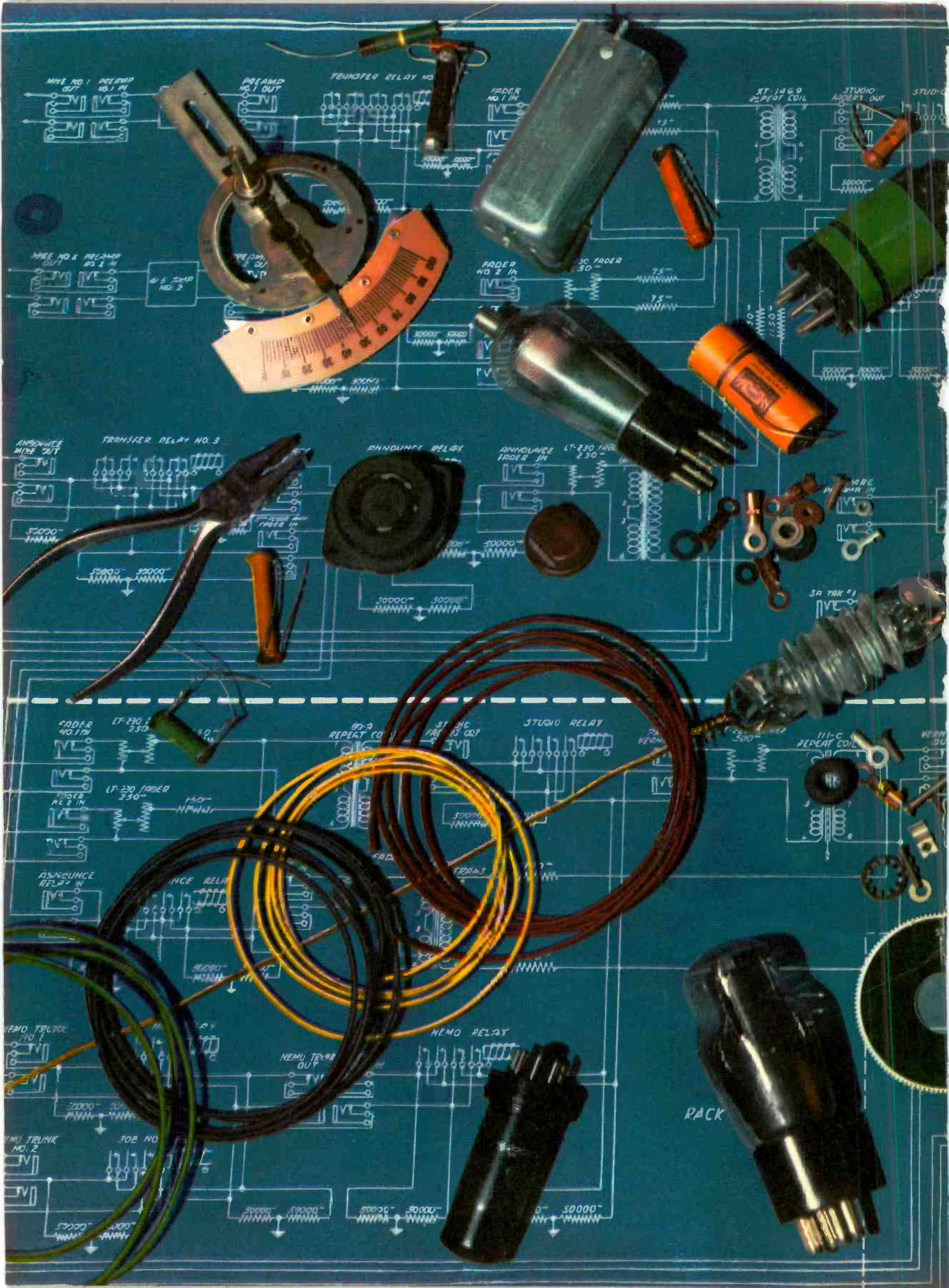
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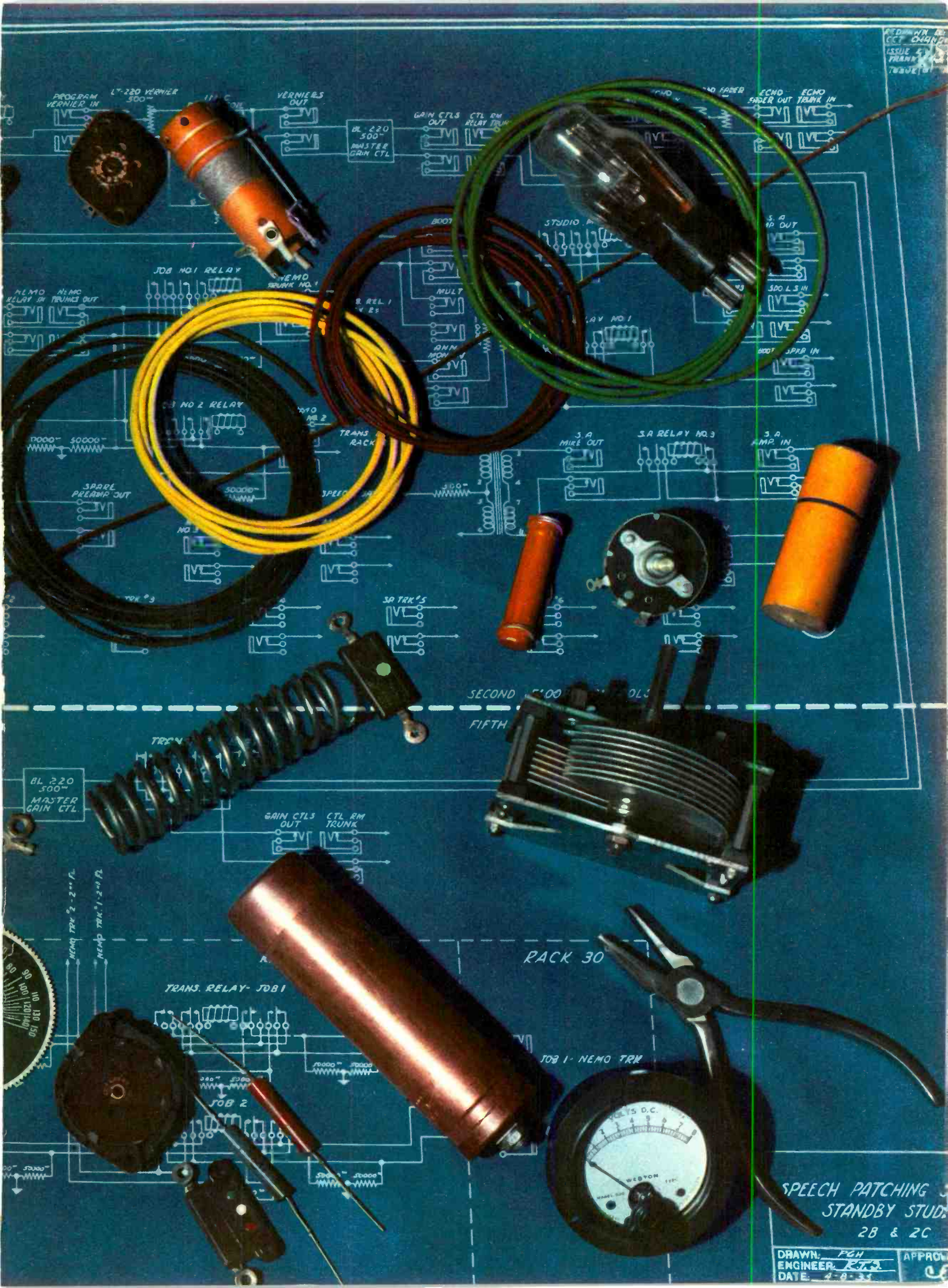
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DRAWN: PGH
ENGINEER: R.T.S.
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Magic Dials


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INTRODUCTION

THIS IS A STORY of powerful jinn, and of wizards waving magic wands and weaving strange and intricate enchantments. This is a tale of Cinderella and Jack and the Beanstalk and Aladdin and about all the other fairy-book people that ever were engendered in the human imagination.

This is a story combining the features of the maddest myths and legends—mingling magic carpets, seven league boots and slaves of the lamp with weird brews in beakers and test tubes, and uncanny filaments that generate the thunderbolts of Jove.

This is a romance at which Merlin would have sniffed "impossible", Cagliostro would have sneered "unbelievable", and which Sheherazade, that teller of one thousand and one fabrications of oriental imagery would have regarded as fantastic.

And yet it is all quite true, for this is the story of radio.

Or rather just a hint of the story of radio, a swift swoop over the vast field of an industry that has grown to tremendous proportions like Jack's beanstalk—almost over night.

Nor are those opening sentences about magic and wizardry over fanciful. The jinn, or genie, in tubes and transmitters make those of the Arabian nights seem inept and impotent. Chemists, electricians, engineers, technicians in laboratories, shops and draughting rooms, *do* wave metaphorical wands and weave indubitable enchantments almost as routine of their daily work.

As Berton Braley puts it, in Popular Science Monthly, under the title of

THE LADY LACKED IMAGINATION

In Burton's Arabian Nights
We're told about spirits and sprites
And powerful Jinn hid in lamps and in flasks
Who pulled off all manner of wonderful tasks
Accomplishing many a seven days wonder
Accompanied always by lightning and thunder.
We sniff at these legends and airily add
"What fanciful fancies Sheherazade had!"

And yet, while we snort at the stories,
The chemists in laboratories
Without any thunder or lightning whatever,
But merely pursuing their daily endeavor
Are busily bottling up powerful Jinn
Beside whom the old ones feel feeble and thin.
In flagons and test-tubes, in flasks and retorts,
They prison enchantments of various sorts,
The might of the magic these wizards invoke
Makes Sinbad a piker, Aladdin a joke!

Today's unromantic and drab?
Look into the chemical Lab.
Where Jinn they engender in test-tubes and vials
Have those of Sheherazade distanced by miles.
Without any magic save that in the bean,
They're hatching out rocs' eggs as simple routine.
Sheherazade's fancies are left in the lurch
By commonplace facts in the world of research.

The Cinderella motif is found in the amazing expansion of the amateur radio dabbler's "pumpkin" experiments of less than a generation ago not to a mere princely coach, but to a streamlined train of them—a business of communication representing billions of dollars and employing, directly and indirectly, millions of people.

We may, and do, accept all this as common place. We live so much with wonders that they seem no longer wonderful.

That is because we, most of us, look at results, and do not peer into the intricately engineered causes that produce those results.

It is the purpose of this book, in picture and in text, to give at least a glimpse into those causes. To look beyond the studio into the control room, and beyond the control room into the switchboard, and behind the switchboard into the complicated but ordered tangle of cables, and behind that into the thinking and planning and research and labor that created it all.

Nearly all of it has happened in twenty years. In 1919 Radio was chiefly wireless telegraphy—crackling through the ether in the dots and dashes of the Morse code. A system which was only a magnification of the signal fires man had used for centuries in his endeavors to leap the abysses of time. It had extended enormously the radius of instantaneous communication, but that communication was in a cipher for the initiated, and had to be translated by experts before it was intelligible to the general mind. A tremendous advance in the dissemination of news, yet actually nothing more than a vast amplification of cable and telegraph facilities.

Since experts and technicians had developed this method of wireless transmission, it would be logical to expect that such trained minds would be responsible for the beginnings of radio as we know it now—an instrument for tuning in on the universe by the flick of a knob or the click of a button. Logic, however, doesn't always shape events.

Experts *were* responsible for practically all transmitting apparatus, and for the basic discoveries and most of the inventions needed for the construction of receiving sets. And of course they designed receivers for their own experiments. But for many years, up to 1920, an overwhelming percentage of the receiving sets were fashioned by what condescending intellectuals call fourteen year old minds. Active, curious inquiring adolescent minds of boys of fourteen, sixteen, eighteen—and twelve. Boys who made radio sets out of soap boxes, bits of wire, nails, screws and pieces of crystal. Boys who powered their receiving sets with dry batteries out of flashlights, and who constructed short wave transmitters out of materials selected from junk piles.

Furthermore, since the technicians were chiefly concerned with what at that time was regarded as high-power transmission by long-wave, short wave experimentation was left mainly

to the amateurs, and the "hams" contribution to that department of radio-transmission was a very large factor in its progress.

By the time the professional experts and technicians of the "wireless" business waked up to the potentialities of this amateur scientific exploration, hundreds of the amateurs had themselves bourgeoned into professional exploitation of the new field—and some of them were several strides ahead of the "experienced" technicians of the older order. And the older order had to realize that their experience was a limitation instead of an asset, that progress in this novel trade was a matter of discovery, invention, experiment and speculation—that it was mostly foreground and very little background.

Once the technicians recognized this fact, however, the dominance of the amateur radio fans was over. They had opened up new country, but its development and consolidation was a job for Capital—capital which could experiment on a large scale, which could finance laboratories for research, and employ corps of engineers to cooperate in plans and operations.

Logic was back on the job, for it was logical and inevitable that anything as basically scientific as radio should need the co-ordinated facilities of great corporations for its wider development. Sometimes such an absorption of individualistic enterprise by Big Business means a slowing of progress, but that has not been true in radio. The great manufacturing and broadcasting companies which have dominated the radio business since 1921 have shown as much daring, imagination and enterprise as any individual, and, by the spending of huge sums in research and experimentation, have been able to accomplish results which no individual could possibly achieve. And which—incidentally—no state-controlled or operated institution has even remotely matched.

Twenty years from crystal sets to television!

Twenty years from the amateur catching a word or two through his ear phone to the family hearing—and seeing—a drama or a baseball game projected on the home television screen.

Twenty years of fantastic adventure among atoms, electrons and ions, of chemical enchantment and mechanical wizardry—

This is where you came in?

No, only a tag line to this script, as a reminder that when it comes to magic, you "ain't seen nothing yet."

CHAPTER ONE

Once Upon A Time . . .

THOUGH RADIO BROADCASTING is a "young man yet", "radio"—the actual sending of messages, without wire, through the ether, is on the downhill side of forty. For it was in 1896 that Guglielmo Marconi at the age of twenty-five set up his crude apparatus at Salisbury Plain, in England, and transmitted a Morse code message to a receiver two miles away.

But the theories, facts and inventions on which radio is based go back further than that. So far, indeed, that, metaphorically speaking, this lusty youth is really a centenarian with a long white beard. For the science of radio is founded on the science of electricity, and thus its beginnings spark from Franklin's kite, and its history flashes along lines laid by Volta, Faraday, Edison, Steinmetz and scores of other researchers, experimenters and inventors.

Out of the phenomena of electric waves, and the study of their behavior, sprang the induced currents which radio utilizes to girdle the planet with the sound vibrations of music and the human voice.

While Marconi was first to put these currents practically to work, it was J. C. Maxwell, in 1867, at the University of Edinburgh, who enunciated the original theory of etherial waves. It was, however, a theory in the realm of pure science, and made no stir in the great world. Nor were the few other scientists who understood the Maxwell theory aware of its enormous potential significance. Maxwell's thesis was filed away in the University archives while the ether waves surged on, with no argosies to ride them.

It is doubtful if Edison, eight years later engrossed with electrical experiments, had ever heard of the Maxwell theory. If he had, he might have done something about the peculiar spark which manifested itself from an electro-magnet he was then testing. It was an anarchic spark—a spark which conformed to no established laws of electricity. It was indifferent to wires and unaffected by earth currents. It would follow non-conductors as blithely as the best copper strands.

Transformer test. These transformers are used in superheterodyne receivers and accurate adjustment is necessary to provide proper operation.

He gave it a name, "Etheric Force", and the Scientific American commented "It is a new and distinct phase of force, an unstudied phase of electricity, which will rank Mr. Edison the most fortunate and eminent of scientific discoverers." But the rest of the world, lay and scientific, was not greatly impressed, nor, apparently, was the Sage of Menlo Park himself, since he took no patent on his discovery.

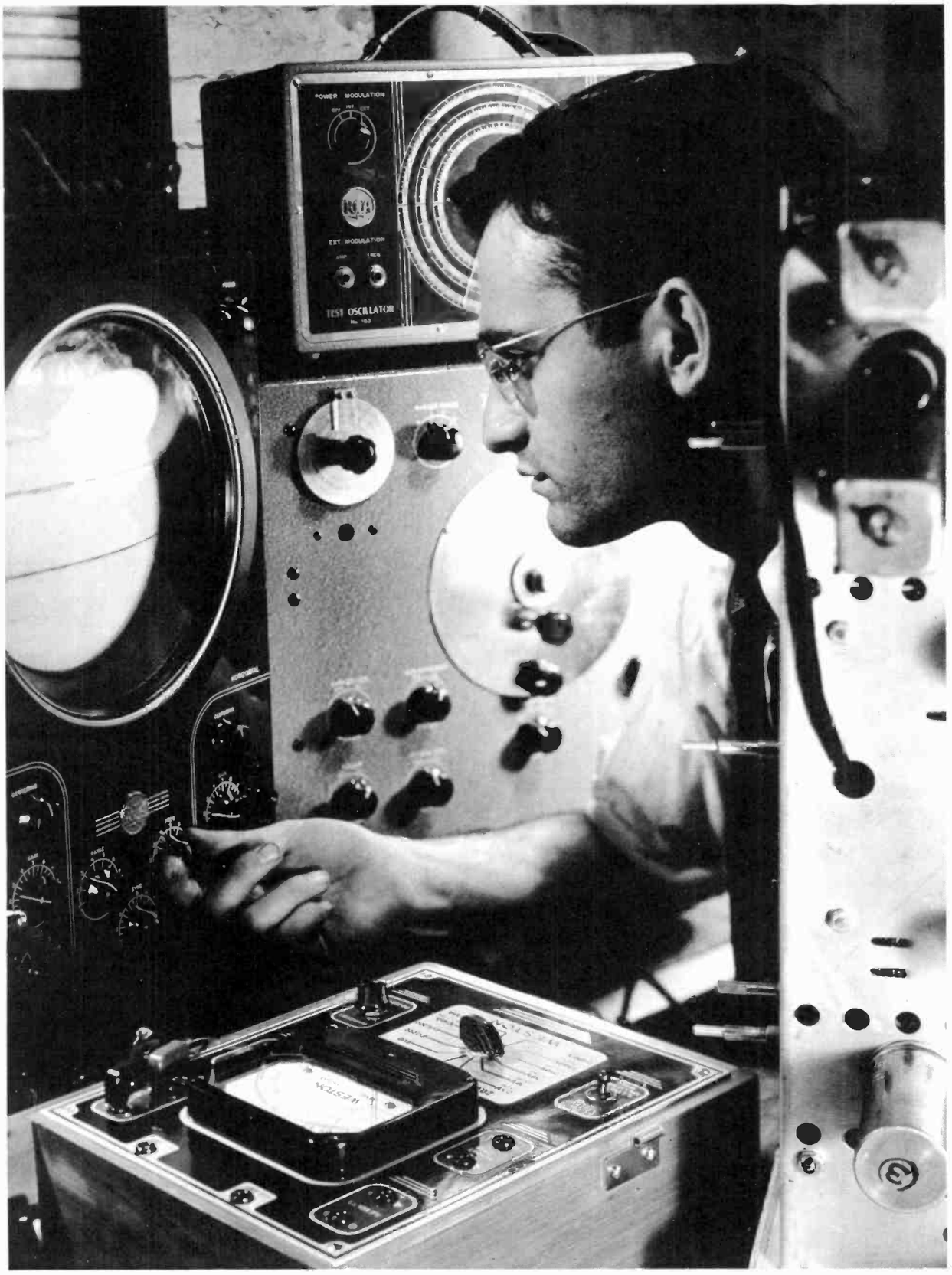
Again, in 1880, when he was working on his invention of the incandescent bulb, this Etheric Force intruded on his experiments. There were black deposits inside the glass, and a blue emanation from one of the legs of the carbon filament. He thought this phenomenon might be due to molecular bombardment, and he was curious enough to cover a lamp with tinfoil and connect it with a galvanometer and one of the terminals of the carbon filament. He found a current flowing between filament and foil. He had discovered, in other words, the principle of the vacuum tube. If he had not been working eighteen hours a day on perfecting his main idea of the incandescent light, he, instead of Lee De Forest, might have been the inventor of the radio tube. But he made no endeavors to pursue these investigations further.

It was again a "pure scientist", like Maxwell, who took the next step in radio development. Perhaps this is a good place to define the meaning of "pure science". It is science for science's sake, the study of natural forces undertaken purely to increase man's knowledge, and quite without concern as to the practical or commercial application of any discoveries it may achieve. Yet this type of research is the foundation of many of the most important of achievements in "practical" progress.

Professor Heinrich Hertz of Carlsruhe, Germany, was a pure scientist, celestial mathematician and a deep delver into electrical phenomena. In his laboratory he tested out the Maxwell theory by a series of experiments, and found that the ether would, as Maxwell had said, transmit electro-magnetic waves. When he shot an electrical spark across a gap certain oscillations occurred in the terminals. These oscillations set up waves in the surrounding ether—waves which would affect any conductor in the magnetic field. He further established the fact that these waves would, like the young man on the flying trapeze, fly through the air with the greatest of ease, even if walls and partitions intervened.

Through these demonstrations by the German professor, the radio vibrations came to be known then—and are still—as Hertzian waves. But being a pure scientist, Hertz made no practical application of his discovery.

Another Professor, a Frenchman, this time, Edouard Branly of Paris, made the next important advance. He noticed that a short glass tube filled with metal filings, ordinarily a highly resistant conductor of electricity, when bombarded with Hertzian waves became an



Testing television. Checking on receiver's efficiency by means of test oscillator and large cathode ray oscillograph.

excellent conductor. The Hertzian vibrations, even though very weak, caused the filings to cling together, or cohere, thus carrying current as efficiently as a solid wire. Branly called this tube a "coherer" because of this action of the metal particles, and this device, discovered in 1890, became the "detector" in the experimental radio receivers of the day.

In 1891 a number of scientists, individually, but almost simultaneously, tried to utilize the Hertzian waves for transmitting electrical signals. In England Sir William Preece and Sir Oliver Lodge experimented in their laboratories, as did Professor Branly in Paris. In Bologna, Italy, Professor Augusto Righi was making similar endeavors. None of them seem to have achieved any notable practical results.

But Professor Righi had a young student in his laboratories, a lad of twenty who was both efficient and enthusiastic. When Professor Righi's experiments got nowhere in particular, the youthful pupil went on from there. He invented and built transmitters and receivers and tried them out. After three or four years he succeeded in sending signals a distance of several hundred feet.

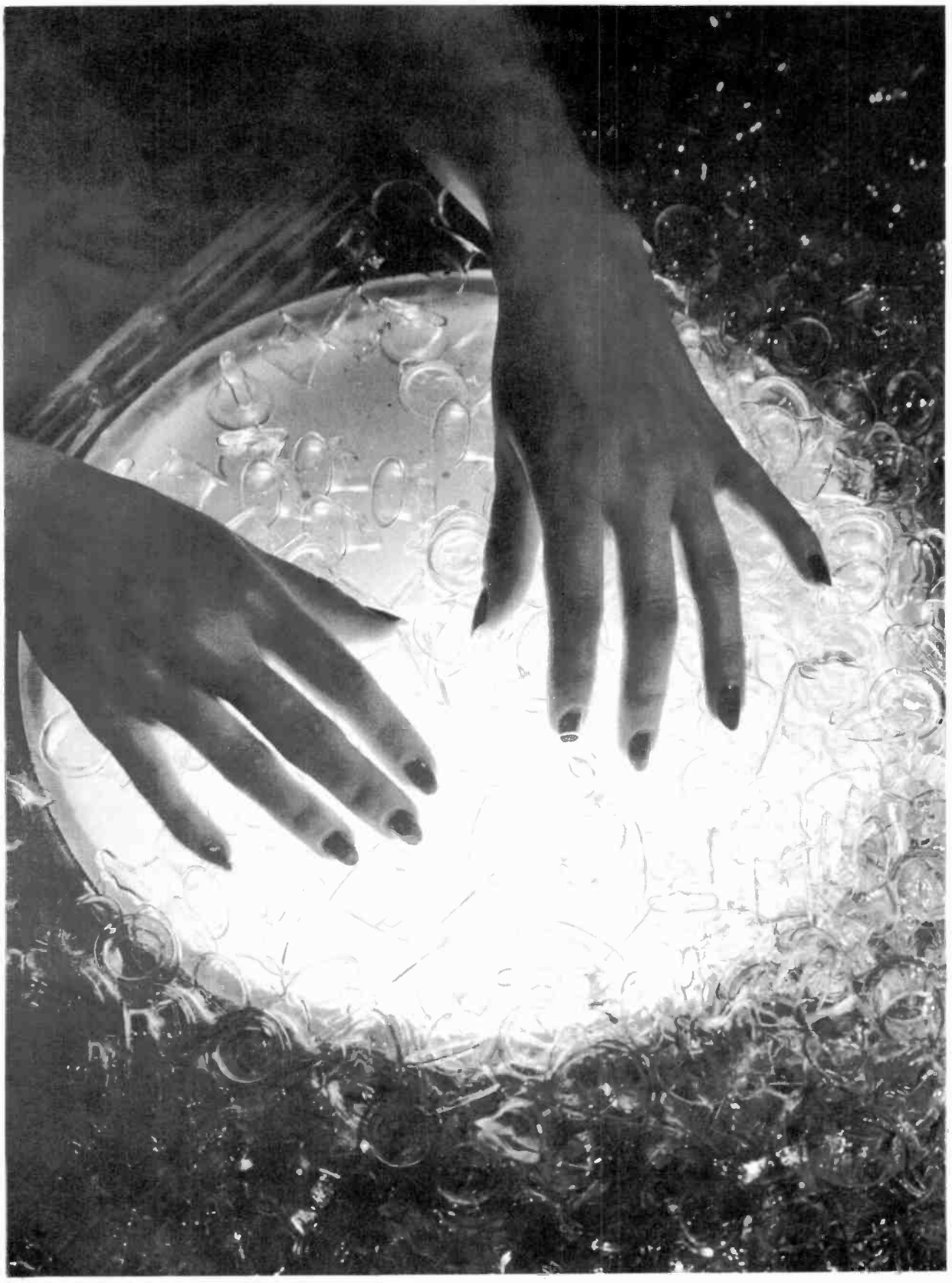
In 1896 this young man, whose name was Marconi, at the invitation of some far-seeing scientists in England, transferred his apparatus to Salisbury Plain, in Wiltshire, and there flung from his transmitter a message over the ether to his receiver two miles away. It wasn't far, as compared to the terrific leaps of Hertzian waves in 1939, but it was far enough to astound the believers and confound the unbelievers.

From then on the radio vibrations began going places. In 1897 Marconi was shooting his signals twenty-four miles. In 1898 a yacht race was reported to stations thirty miles away. In 1899 Marconi established regular service across the English Channel.

Early in 1901 radio extended its radius to 200 miles, and on Dec. 12th, 1901, the letter "S" —three "dots" in the Morse code, three short crackles from the Marconi's tall transmitter at Poldhu, Wales—jauntily jumped to a receiver at St. John's, Newfoundland. Radio had spanned the Atlantic. By 1902 it was vaulting from mainland to mainland. And it had also sprung from the somewhat intangible, unstable theoretical and experimental stage to the solid terrestrial mainland of commercial utility. A new, powerful and universal means of instantaneous communication, independent of cumbrous cables and complicated wires, was "at your service". By present standards it was crude, clumsy and inefficient, but it worked.

Henceforth radio was a matter, not of fundamental discoveries, but of progress and improvement.

In 1901 R. A. Fessenden outmoded the "coherer" with his invention of the electrolytic detector, which was more sensitive and accurate, and made it possible for operators of receiving



Not bubbles—but glass. The girl behind those perfect hands is testing radio tubes for imperfections in the glass.

sets to use head phones instead of reading signals from a telegraph instrument. Marconi outmoded the Fessenden device with his own magnetic detector, in 1902, and Professor Braun followed with a crystal detector which outmoded both of them. Dr. James Ambrose Fleming of England devised the Fleming valve in 1904, and in 1906 Lee De Forest came along with the vacuum grid tube, an invention as epochal as Marconi's original apparatus. The immediate effect of De Forest's tube, however, was not so much to advance radio transmission and reception, as to improve telephonic communication. The Bell company found in this tube a powerful booster for long distance lines, eliminating many clumsy and costly relays, and extending the range of long distance calls from about 1500 to 3500 miles.

Though these changes and improvements came rapidly, radio telegraph equipment was still heavy, noisy and even dangerous. At the St. Louis Fair in 1904 receivers looked like Rube Goldberg's mechanical fantasies, with coils, condensers, switches and odd gadgets and dofunnies in strange conglomeration. Transmitters were even more grotesque,—giant transformers that emitted an eye-searing and ear-rending spark, and various arcs and dancing lightnings which threatened to electrocute anybody within several feet of them.

If radio-telegraph outfits were big, broad, balky and clumsy, the few radio-telephone kits of that day were worse.

Nevertheless radio functioned, and its radius and efficiency increased. In 1908 most ships were wireless equipped, and in a few years *all* vessels were required to carry it. R. A. Fessenden, who had invented the electrolytic detector in 1901, created an alternator in 1906 which greatly increased the power and smoothness of transmission.

Then, in 1909, came the first broadcast of actual sound—not mere code messages—over the air. From the Eiffel tower in Paris a powerful transmitter (or what was called a powerful transmitter in those days) sent forth music from phonograph records, reception of which was reported by wireless stations 300 miles distant. This should have marked the real beginnings of radio broadcasting, but it didn't. Swift as has been the growth of radio, there are curious lags and halts in its gait.

For instance, Lee De Forest's tube was patented in 1906, yet it was not until 1913 that it began to crowd out the crystal detectors, and clear up to 1920 the "Hams" or amateur radio fans, were mostly using crystal sets.

The first spectacular evidence of radio progress was in May, 1919, when the Navy's N.C. boats made their flight to the Azores, and the voices of the radio operators on the flying ships were picked up, all along the Atlantic coast.

Though inventors and technicians were not, up to the early twenties, wide-awake to the

The "ham" explorer. A young amateur of 1919 actually gets reception. Crude magic, but it dazzles Dad, too.

possibilities of broadcasting to a large public, a young man named David Sarnoff had an idea. In *1916* he put his idea in a letter addressed to Edward J. Nally of the Marconi Co.

"I have in mind", Mr Sarnoff wrote, "a plan 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.

"It would seem to be entirely feasible. 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 problem of transmitting music has already been solved in principle and therefore all the receivers attuned to the transmitting wave length should be capable of receiving such music. 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 'Radio Music Box' can be supplied with amplifying tubes and a loudspeaking 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. There should be no difficulty in receiving music perfectly when transmitted within a radius of 25 to 50 miles.

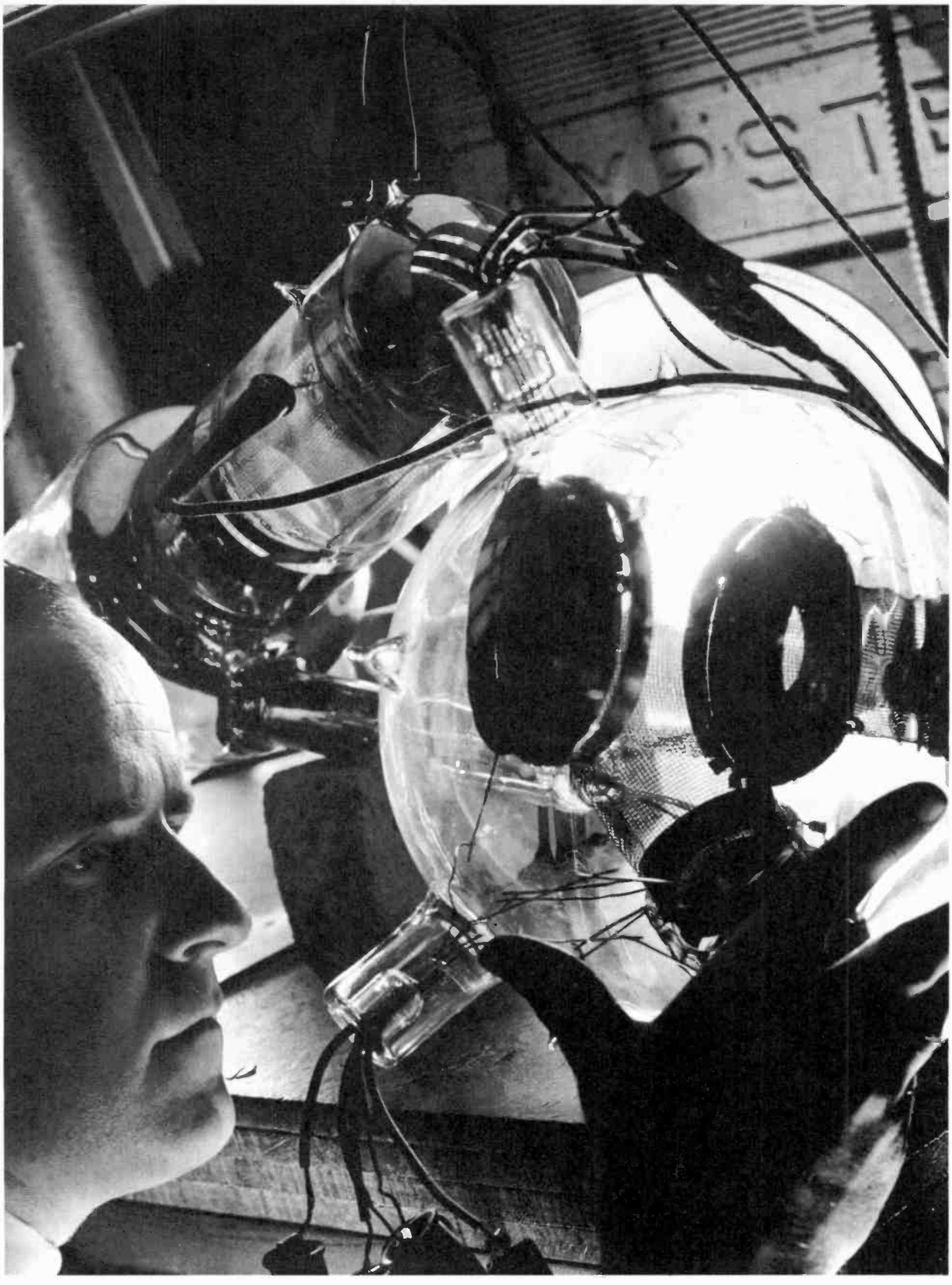
"The power of the transmitter can be made 5kw, if necessary, to cover even a short radius of 25 to 50 miles; thereby giving extra loud signals in the home if desired. The use of head telephones would be obviated by this method. The development of a small loop antenna to go with each 'Radio Music Box' would likewise solve the antennae problem.

"The same principle can be extended to numerous other fields as, for example, receiving lectures at home; also events of national importance can be simultaneously announced and received. Baseball scores can be transmitted 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.

"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.

"The manufacture of the 'Radio Music Box' including antennae, in large quantities, would make possible their sale at a moderate figure of perhaps $75.00 per outfit. The main revenue to be derived will be from the sale of 'Radio Music Boxes' which if manufactured in quantities of one hundred thousand or so could yield a handsome profit when sold at the price mentioned above.

"It is not possible to estimate the total amount of business obtainable with this plan but if



Dr. E. E. Flory examining experimental type of television tubes. These are comparatively simple, only about a million parts.

only one million families thought well of the idea it would, at the figure mentioned, mean a gross business of about $75,000,000, which should yield considerable revenue.

"This may be roughly divided as follows:

First year—100,000 music boxes...	$ 7,500,000
Second year—300,000.....	$22,500,000
Third year—600,000.....	$45,000,000
Total	$75,000,000"

Such was David Sarnoff's idea, and his estimates of sales. It was six years before that idea saw a practical realization by RCA, successor to Marconi.

But how uncannily accurate a prophet David Sarnoff was is demonstrated by the first three years of sales (1922, '23, '24) of sets by RCA.

1922.....	$11,000,000
1923.....	$22,500,000
1924.....	$50,000,000
Total.....	$83,000,000

He hit it "on the nose" for the second year, he was $3,500,000 short on the first, $5,000,000 short on the third, and $8,500,000 under the total. But that is pretty close prognosticating on an idea six years ahead of its time!

Broadcasting, as Mr. Sarnoff had visioned it, did not get its real start until Dr. Frank Conrad, of Westinghouse, in 1920, set up a 75 Watt transmitter in his garage. This was KDKA—the first regular radio broadcasting plant in the world. The professionals were on the job again, and the "ham" pioneer work was finished.

David Sarnoff, president of the Radio Corporation of America, examining a water-cooled transmitting tube.

CHAPTER TWO

Jack Plants a Bean

WITH THE ESTABLISHMENT of KDKA regular scheduled program broadcasting was on the air. It wasn't a type of program that anybody would listen to, today, but it was something special in those days.

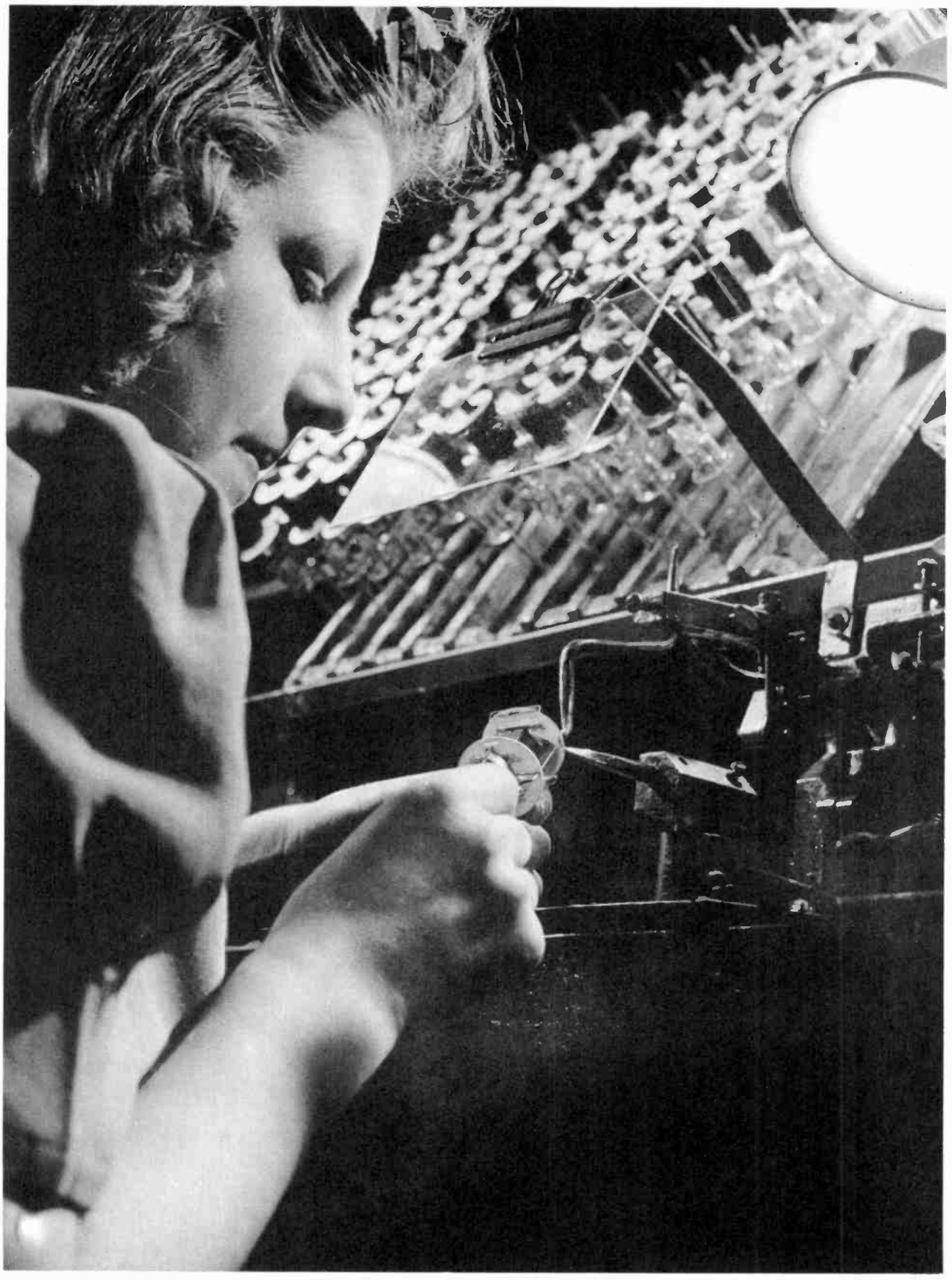
Follows a sample (as of early 1921)

7:55-8:05	Two test records on Edison phonograph
8:10-8:15	News read by operator
8:15-8:18	Stand by 3 minutes. All quiet.
8:20	Sacred selections on Edison phonograph
8:30	Stand by three minutes
8:35	Sacred selections on Edison phonograph
8:50	Stand by three minutes
8:55	Sacred selections on Edison phonograph
9:15	End of concert. Signing off.
9:50	Explain Arlington time signals
9:55-10	NAA time signals
10:05	Weather forecast
10:10	Signing off
10:25	Played on Edison record for Watton 2BZH (a local amateur)

In two hours and thirty minutes of broadcasting, twenty-four minutes of "standing by".

At that period in broadcasting history, listeners had to take practically Milton's poetical dictum that "they also serve who only stand and wait".

That was a Sunday night program, eighteen years ago. Today, in that same two hours and a



Assembling the mounts of beam power transmitting tubes. Parts are assembled on a jig which aligns and spaces them while they are spot-welded together.

half a Pittsburgh listener can catch the last five minutes of the Jack Teagarden orchestra, of Stan Lomax's Sport Talk, and bits of two plays; from eight to nine o'clock he has the choice of Charlie McCarthy, the American Forum, the NBC orchestra and a dance orchestra; from nine to ten his programs to choose are, the Merry Go Round, Haenschen's orchestra, Benay Venuta, a full length play, another play, Walter Winchell, Irene Rich, and the Ford Symphony orchestra. And from ten to ten twenty-five (when KDKA played that record for a local amateur) there's the Good Will Hour, another play, a dance orchestra, Cheerio, Orson Welles and H. V. Kaltenborn.

Anyhow, with KDKA begins the real story of what we mean when we say "radio" today. And also with the establishment of KDKA the pace of history and the pace of the radio industry starts to accelerate in a geometrical ratio. Nothing in human experience has traveled so far so fast, and we must supercharge the motor of this narrative to keep up with it. Even then the chances are that we'll be several megacycles behind what has happened between the time this book was written—only a month ago—and what the radio column in your newspaper and very likely the articles in your radio magazine will tell you as of now.

But we'll do our breathless best.

Dr. Frank Conrad of KDKA was an experienced technician, but an inexperienced broadcaster. "And that" to quote Lewis Carroll, "was scarcely strange because" there was almost no experience to be had. So the good doctor had to create his experience as he went along. The one and only method was that of trial and error—with trials galore and errors aplenty.

For example, the cement garage of Dr. Conrad's home, KDKA's original studio, was very "live" as sound engineers call it. The walls, floor and roof were reverberatory sounding boards that tossed echoes back and forth with the bouncing speed of a rubber ball in a handball court. Programs sounded to listeners as though they had been shouted down a well. This, in conjunction with the relatively inept microphones then in use, did not make for ear-happiness at the receiving end, especially when 99% of the set owners were still listening through ear phones.

Dr. Conrad thought a non-resilient fabric might deaden these distressing ululations, and thereupon went out and bought a tent, which he draped about the garage. It wasn't 100% acoustic treatment but it reduced the intrusive vibrations and made most of the echoes behave. When Westinghouse established its second studio on one of the factory roofs, a larger tent was installed. But the large tent wasn't as efficient as the small one.

When Westinghouse opened WJZ in Newark, (1921) its studio was tucked away in the women's cloakroom of the factory. Here, behind a sliding curtain, were installed a phonograph, a piano, a chair, a table, and the mike. Records were broadcast by placing the mike in front of

Loud speaker cone manufacture. Checking voice coil to make sure that it is within necessary close tolerances as to size and roundness.

the phonograph horn. Electrical pickups with direct connection to amplifiers was unheard of, and the combination of acoustical recording, mechanical pickup, mica diaphragms, tin horns and carbon microphones produced a variegation of distortions that would drive today's listener to a boiler factory for peace and quiet. People could get better and quicker news from their papers, and much clearer music from their own phonographs, but the wonder of hearing actual voices, even blurred and sputtering, and actual music bobbing along on the air, was so new and strange that set owners glued headphones to their ears for hours, ecstatic in spite of static. Listeners were a hardy race in those days.

But better mikes were coming along. By 1921 Westinghouse had created the "tomato can" which was what it resembled. This was the condenser type. What that means to a radio technician this author has not bothered to ascertain, for this is a non-technical treatise, and what condenser means, in a microphone, is not important. It was, however, a better mike—and that *is* important. Better, but not too good. For it was tricky and quirkish. When it was good it was very very good, and when it was bad it was a headache. It hissed, it clicked, it popped and it growled. On rainy days it evolved whole sets of extra weird noises and imposed them on the hisses and growls.

Nevertheless it was more satisfactory that what went before, and it swiftly improved. And its accompanying equipment—a pre-amplifier and power plant in a box the size of a large refrigerator, which had to be moved about the studio on a baggage truck—was soon reduced and simplified to easy portability.

This whole chapter—and several more—could be interestingly devoted to the early difficulties with equipment, along with the necessities that mothered one after another of the inventions which gradually solved these difficulties. But a hint has been given, and now we return you to Studio KDKA.

To this first studio was relayed the first outside pick-up in radio history, as the Sunday Services of the Calvary Baptist Church of Pittsburgh were broadcast to KDKA's listeners, Jan. 2, 1922.

Thirteen days later KDKA broadcast a pick-up of a speech by Secretary of Commerce Herbert Hoover—the first speech to be thus aired.

Another first for KDKA—the initial broadcasting of a fight, the Ray-Dundee mill on April 11.

Followed the Davis cup matches on August 4th, and on August 5th a National League baseball game was put on the air. All "firsts" for the first station.

With these lead-offs by KDKA, other stations—for they were multiplying—began to hit

Loud-speaker response meter. Mr. R. Hackley operating semi-automatic device for checking response of loud-speaker. Charting roll in the lower right corner.

their stride and the pace of the whole procession quickened. It *had* to move fast to make the amazing record which has been registered. For remember that a baby born on the date of the first broadcast of KDKA would still have to wait a year before he or she could vote.

Let's note only a few of the high spots hit in that parade of "Firsts".

1922—First pick-up with a portable outfit. It weighed 560 pounds and had to be put on a truck. Today's regular pick-up set weights sixty pounds, and a successful pick-up of New York's Easter Parade was transmitted in 1938, from a set installed in a top-hat and fed by batteries carried in a belt about the announcer's waist.

Oct. 6, 1922—Sir Thomas Lipton in New York talks to Gordon Selfridge in London (WOR).

Nov. 11, 1922—"Aida" the first broadcast of grand opera.

Jan. 4, 1923—WNAC (Boston) and WEAF (N.Y.) hooked up. First "network".

Feb. 4, 1923—Roxy and His Gang—first stage performance broadcast from the Capitol theatre.

Nov. 6, 1923—Coolidge's message to both houses of congress broadcast—first broadcast from the national Capitol.

1923—First Trans-Pacific "jump", Whiteman's orchestra is heard in Japan.

Feb. 8, 1924—J. A. Carty, chief engineer of the American Telephone and Telegraph Company conducted the first transcontinental broadcast, The Roll of the Cities. From New York, Carty radioed the metropolitan studios from San Francisco to Havana, and the cities answered "Here". ("What was so remarkable about that?" asked an English listener. "Of course the cities would answer 'Here'. Where could they be but where they were?")

March 14, 1925—Savoy Hotel orchestra makes first Trans-Atlantic musical broadcast from London.

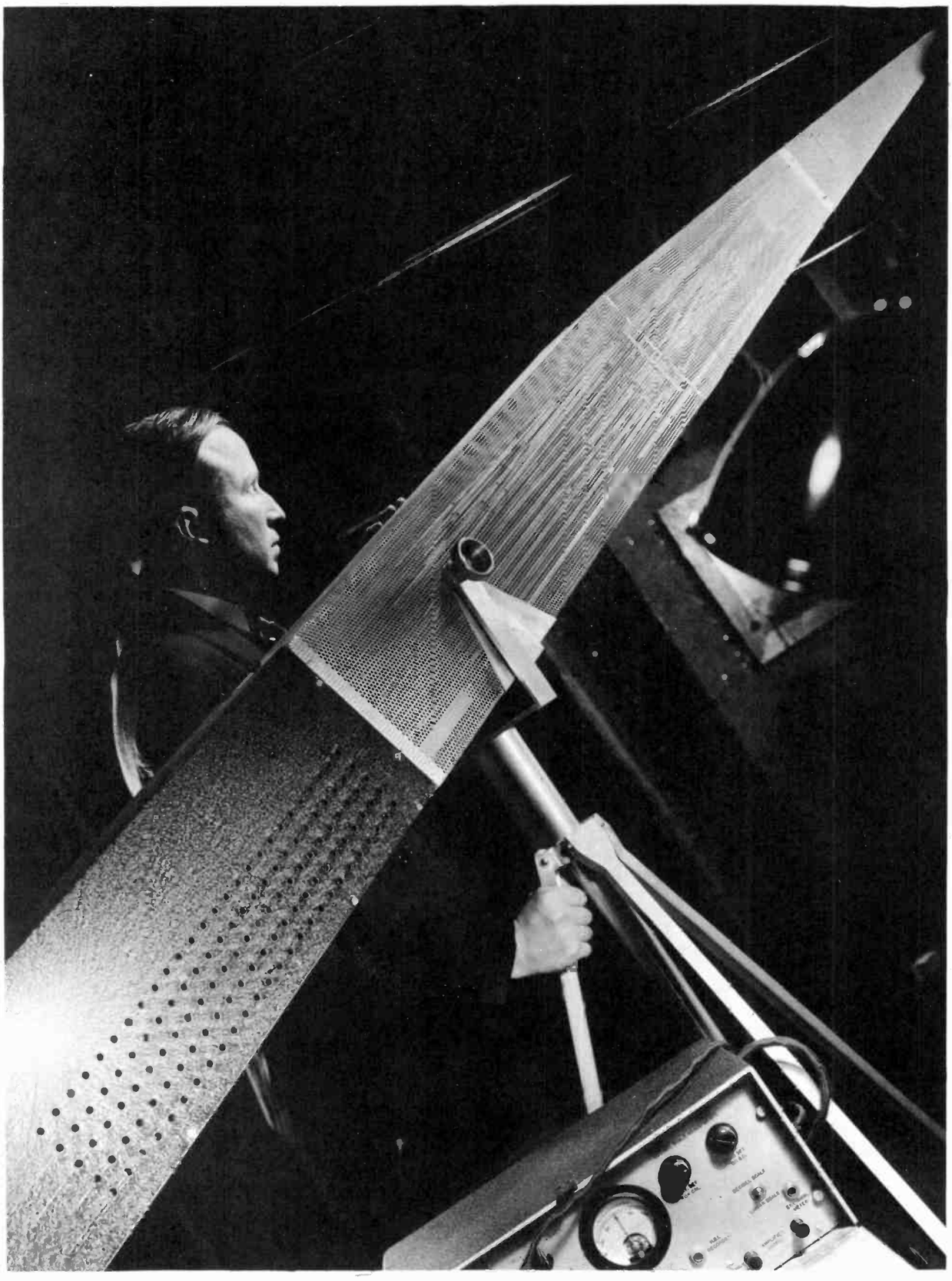
(This, quoting Chief Engineer O. B. Hanson, of NBC, "was epochal, but scarcely audible. At a conservative estimate, what we got in New York was 1% Savoy music, 1% interference, and 98% static.") Nevertheless it was a First.

May, 1925—First short wave pick-up—a small-boat regatta on the Hudson.

July 11, 1925—First sponsored network program.

Lopez Orchestra, sponsored by Gimbel Bros.

Jones and Hare—courtesy of Happiness Candy Stores



Dr. H. F. Olson with ultra directional microphone. This device picks up only the sound that is within a 30 degree angle directly in front of it.

The Everready Quartette, presented by the National Carbon Co.

The Gold Dust Twins

The Fisher Orchestra—offered by Astor House Coffee.

This First differs from the others in that it represented in itself no technical nor scientific advance in radio, though it was made possible by great improvements in radio facilities and equipment. Nor was commercial broadcasting new—individual stations had been selling time for several years. (The First "sponsor" was the Queensborough Corporation, which endeavored to sell real estate over WEAF, Sept. 7, 1922).

But this commercial network program was tremendously important, because it brought large-scale advertising into radio for the first time, and thus tapped a rich mine of revenue by which broadcasting could be financed with a scope and compass beyond the imagination of the most sanguine of early radio men. It was important, too, because it meant that radio could be free. For, by 1925, it had become evident that broadcasting could not live—as it had been precariously living—by the sale of sets to listeners.

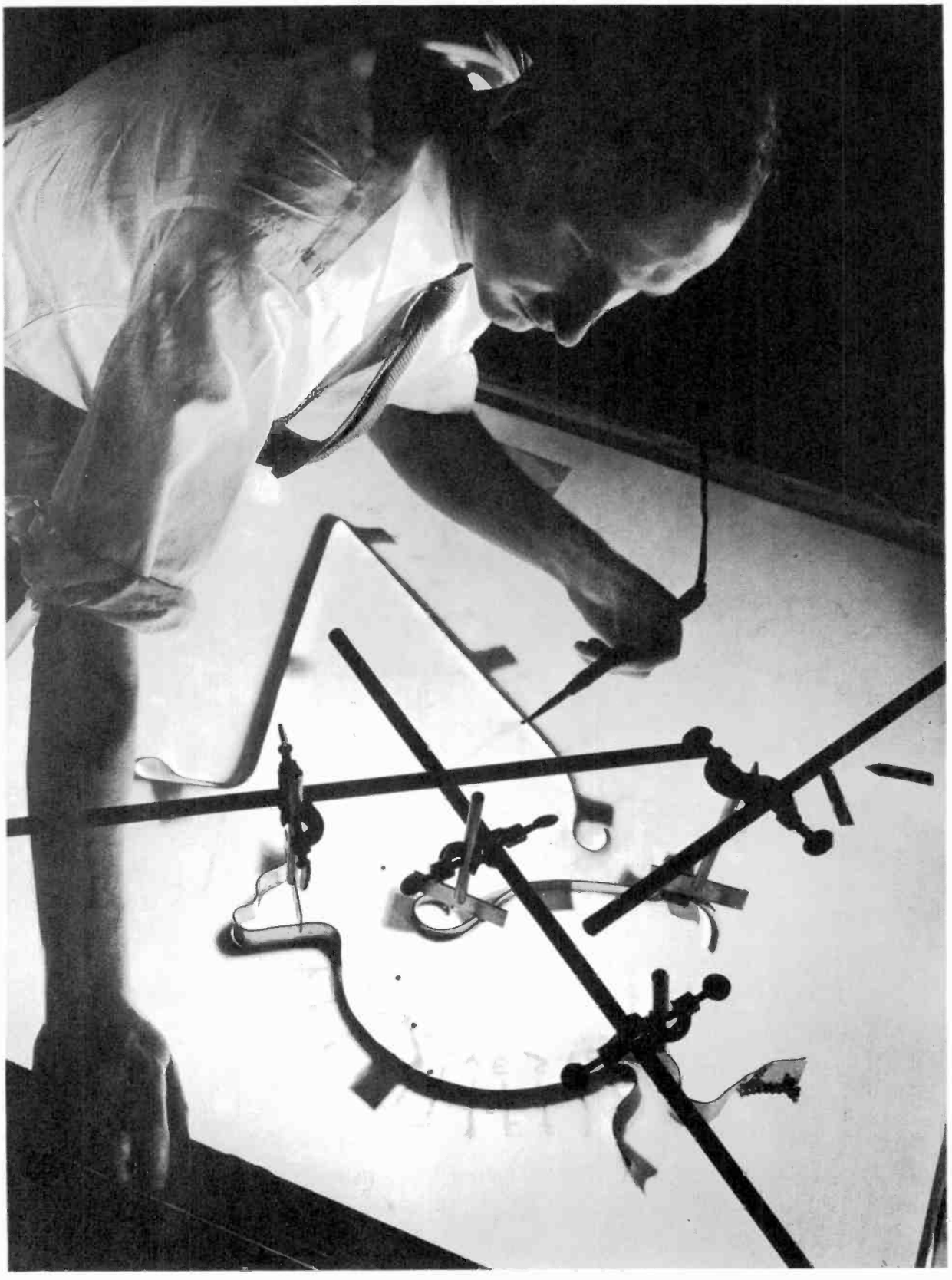
The alternative was government ownership of broadcasting, as in England, Germany, Italy and other countries. And government ownership, even in the most democratic of lands, means pressures and restrictions imcompatible with freedom.

With private industry and business as customers for time, the economic threat of government ownership was liquidated. Broadcasting could develop without restrictions save those of prudence and good taste, without bureaucracy, without political control.

Commercially sponsored broadcasts were to give American radio independence—and to afford a market for talent, in every field, that would offer the listeners a variety of entertainment and education unequaled anywhere else in the world.

This initial sponsored network program, therefore, though of no special significance at the time, was epochal—if you can talk of epochs in a business that compresses periods, eras, epochs and eons into less than twenty years.

For the next three or four years the broadcasters do not appear to have registered any remarkable Firsts. The emphasis seemed to be on doing, in bigger and better fashion, what had been done before. There was vast improvement in equipment and in quality of entertainment, a huge extension in networks, there was growth unprecedented, there were mergings, submergings and emergings of radio companies by hundreds and almost by thousands—things were happening with a rapidity that confused those who were in the middle of it, and dazed those outside of it, and some of this we shall chronicle later; but the next First of novel interest was the broad-



These are electron chasers. Dr. J. Rajchman is using these queer appliances to learn which way electrons go and why.

casting of the U.S. Army manoeuvers in 1935, from tanks, planes, balloons, trucks and trenches.

There were, actually, plenty of other Firsts registered during these years. First which would have been, a few years earlier, of first importance. But by now the world was so used to the form of enchantment called radio that it would mumble "Just some more wizardry. Ho hum, it's a dull life. No news in the papers."

It did sit up and take notice, however, when in 1938, Admiral Leahy of the U.S. Navy conducted the first world tour by radio, talking from New York to the Navy's officers stationed all round the world, Honolulu, Manila, Shanghai, Paris and London, Cairo, Rio, Samoa and Sydney. And it sat up a little more tensely when—as though across the desk from the Admiral —officers answered from these cities, and from battleships, cruisers, destroyers and submarines on or under the high seas, and planes and blimps above them.

Then, April 30th, 1939; First regularly scheduled television program broadcast from the New York World's Fair, with President Franklin D. Roosevelt as the speaker—First Gentleman of the Land and First Televised President in the history of the world.

But Television, as Kipling once wrote, and as other writers have been parroting ever since, is Another Story—

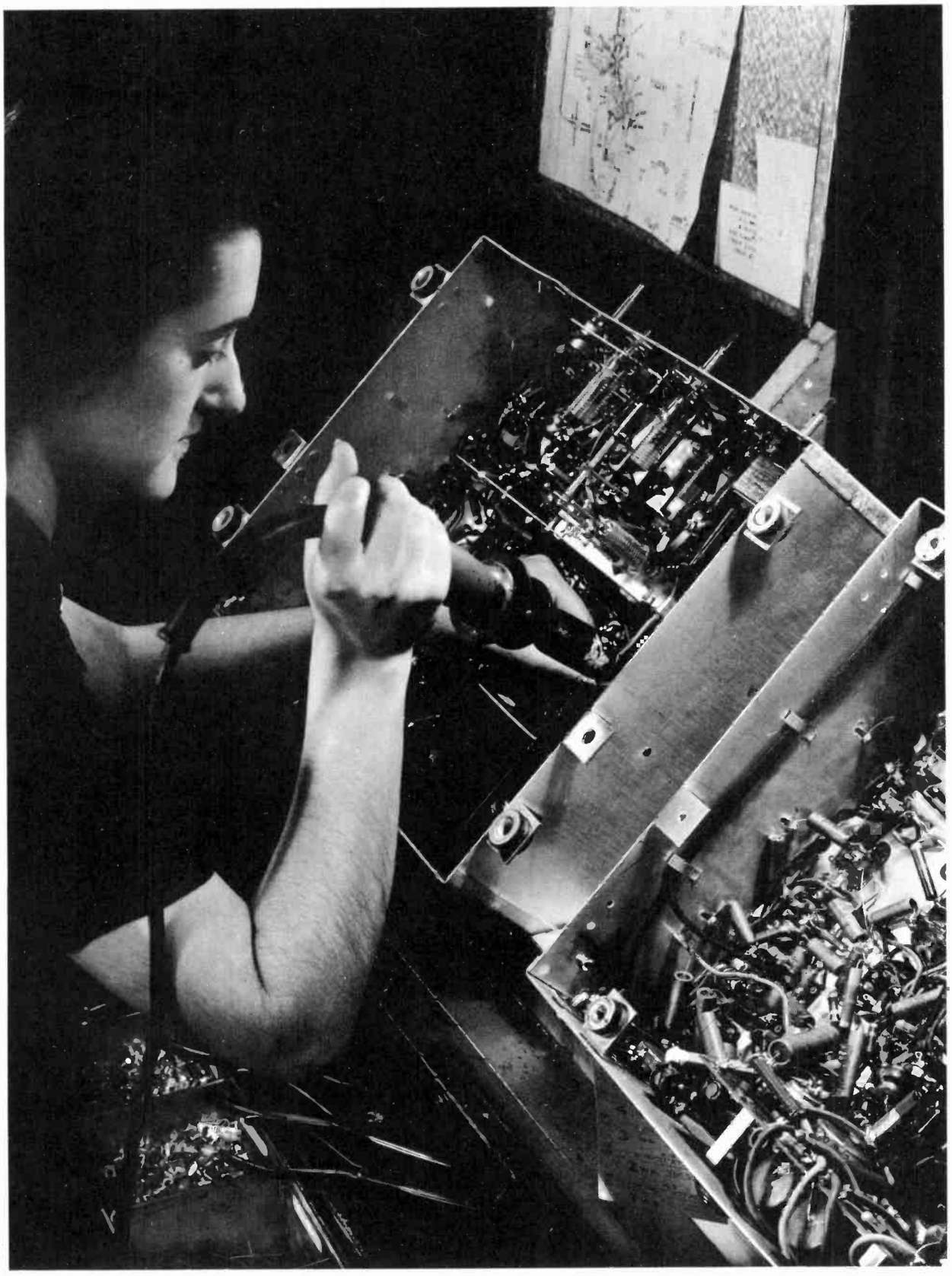
—And another chapter.

CHAPTER THREE

Magic Megacycles

CHRONOLOGICALLY, Television should be the last chapter in this book. For it is the latest thing in radio, and therefore about the latest thing in the world, though, strangely enough, not the newest. Of which more when we get around to it (or "anon" if you prefer).

But the idea is to give a sort of skeletonized summary of radio progress, to be filled in, more



Television tinkering. Bottom view of chassis used in television receiver having a 5 inch picture tube. Shows operator on production line soldering connection. Not a simple job.

or less, later with the blood and tissue that make it vital. And with such a scheme, television isn't out of sequence here.

Beside which it is the most spectacular and exciting phase of radio at present, and everybody knows that the sooner you can introduce excitement into a story, the better.

While the experiments of "hams" with receiving sets and short-wave transmitters had much to do with the earlier days of sound radio development, as our introduction explained, television, as also introductorially stated, has been entirely the job of seasoned—though often young—professionals; chemists, engineers, technological experts, backed by research departments of large organizations. There have been some free-lance inventors in the field, and a few shoestring operators, but television, whose basic principles are not extremely difficult to explain, is in its operation such a tangle of complex technological problems, and, up to now, so terrifically expensive, that the free-lancers have had to find heavy-money artillery to support their attack, and the shoestringers have either tied themselves to big capital's purse strings, or lost string and all.

When the Radio Corporation of America, through NBC, presented its first public television broadcast at the World's Fair, it had spent more than five million dollars during the years of preparation for that event. The only individual who could afford that sort of gamble—with no winnings likely for years—would be a multi-millionaire, and multi-millionaires are seldom inventors.

However, whether it pays or not, television is here.

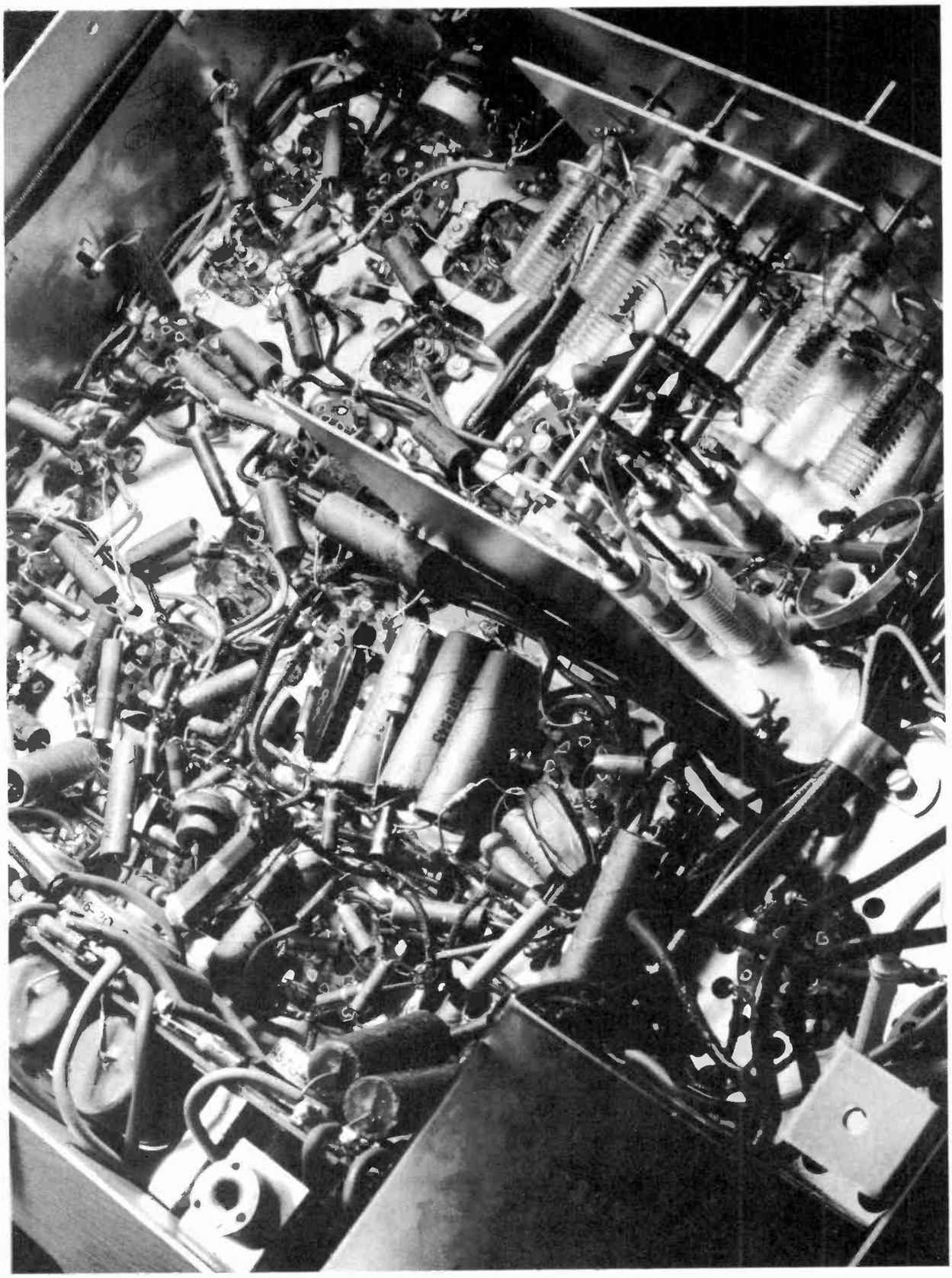
To learn how it came to be here requires a further casting back than was necessary to reach the origins of radio.

When Baron Jöns Jacob Berzelius, a Swedish pharmacist, discovered the element, selenium, in 1817, it was just another element to the scientists, and of no interest whatever to the man in the street.

It remained just another element for fifty-six years. Then a telegraph operator named May, employed at the Valentia Trans-Atlantic Cable Station in Southwestern Ireland, noticed that a resistor made of selenium seemed to convey current better when the sun shone on it. Other investigators found that it was the light, and not the heat, of the sun that made this change in the conductivity of selenium.

May's discovery was to lead, after many years, to the modern photo-electric cell, which converts light waves into electrical vibrations. The photo-electric cell is the heart of television.

Here is a swift chronological survey of some, not all, of the most important events in the development of television. It will be noted that several of these events also are part of radio



Video chassis of television receiver. Some idea of the complexity of television equipment may be gained from this photograph.

history. This is quite natural, since both are based upon the same principles of electrical vibrations.

1878—Sir William Crookes invented the Crookes tube, and demonstrated cathode rays.

1883—Edison discovered the "Edison effect". An electric current was made to pass through space from a burning filament to an adjacent metallic plate.

1884—Paul Nipkow patented the television scanning disc.

1888—Photoelectric cells were built and demonstrated.

1906—Lee de Forest invented the three-element vacuum tube with a filament, plate, and grid.

1923—Vladimir K. Zworykin (at that time with Westinghouse; since 1929 with RCA) filed patent application on the first form of modern television tube, later to be developed into his Iconoscope—the "eye" of RCA's television equipment.

1925—C. F. Jenkins in Washington, D.C., demonstrated apparatus which showed far-off, moving objects, or "shadowgraphs".

1926—J. L. Baird, in England, demonstrated television transmission of half-tone pictures.

1926—Philo Farnsworth, 19 year old sophomore at Brigham Young University, patents first electronic television device.

1927—Television transmission over wire circuit between New York and Washington demonstrated by Bell Telephone Laboratories.

1928—First television drama, "The Queen's Messenger", broadcast from WGY's studios, Schenectady, New York.

1929—Vladimir K. Zworykin, of RCA, demonstrated a non-mechanical receiver using a special cathode ray tube called "Kinescope".

1930—First showing of television in a theatre. The program was broadcast from the RCA experimental station, 711 Fifth Avenue, to RKO Proctor's Theatre, 58th Street, New York City.

1931—RCA installed experimental television facilities and studio in the Empire State Building tower, New York City, and commenced field tests in metropolitan area.

1932—Electronic Scanning invented.

1935—New type of wire line, the coaxial cable, capable of transmitting television signals, announced by Bell Telephone Laboratories.

The dance as expressed in this graceful ballet of Tamara Toumanova finds a new audience through television.

1936—June 29th, RCA all-electronic television field tests began, with broadcasts of 343-line pictures, from Empire State Building tower.

1938—September 15th, NBC conducted first television sidewalk interviews with passers-by in Rockefeller Plaza, New York City. Transmission picked up by NBC-RCA telemobile unit, relayed to Empire State Building and then broadcast to the metropolitan area.

1939—January 27th, RCA and NBC gave first demonstration of all-electronic television before Federal officials and press in Washington.

April 30th, 1939—Regular television program schedule inaugurated by RCA-NBC.

That is a sketchy and somewhat inexact summary of television history. Even more than radio, television is a group production. Many inventions of men working apart contributed to it, many inventions of men working together brought it to its present state. Columbia and Mutual, as well as NBC, have made great progress along their own lines, and manufacturers also have done their part.

Nor should the impression remain that America leads, or has led, the world's development in this field. As a matter of record, pictures were televised with rough but recognizable legibility in Europe as early as 1880! Equipment and knowledge were lacking, however, for making this anything but a laboratory experiment.

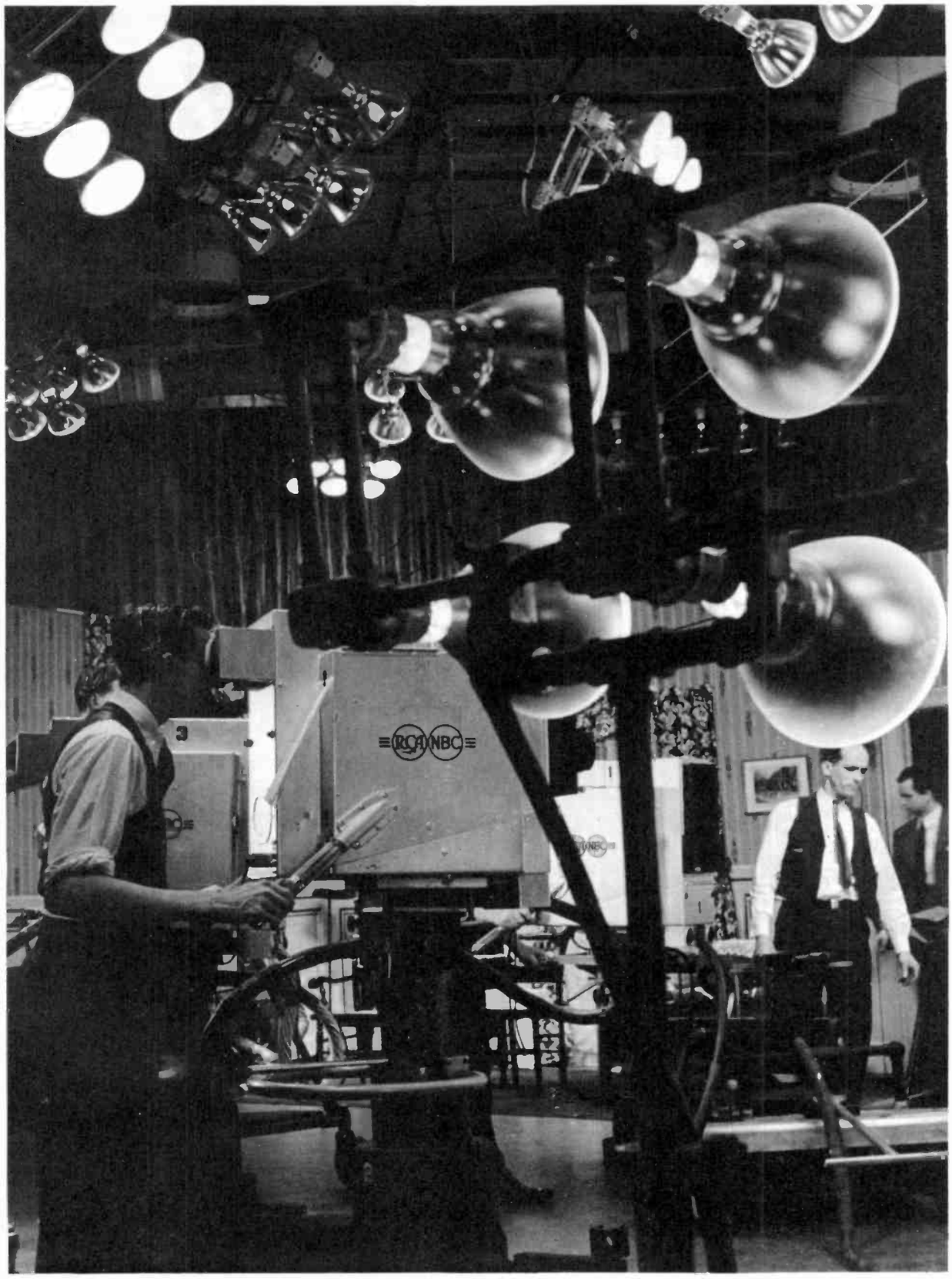
The British Broadcasting Company has been televising to about 3,000 set owners for two years but it is using the American electronic screening method.

The French have had considerable success, and the Germans, according to Dr. Peter Goldmark of Columbia, were, as early as 1937, showing television dramas on a screen 8 feet wide.

After that swift skimming of television history, let's see how the thing works.

Since RCA television is the first in this country to reach the stage of general broadcasting, we may best describe their method as shown in the studios of the National Broadcasting Company.

On the studio stage, under glaring lights—for television, at present, requires concentrated illumination—a group of actors are performing. Upon them are focussed several television cameras—each mounted on a specially devised truck. They look very much like regular cameras, but aren't. Behind the television camera lens is a vacuum tube, known as the Iconoscope, which serves a purpose similar to the "mike" in sound broadcasting, but in this case it picks up the scene instead of the sound. Regular mikes are used to broadcast the sound.



Lights! And plenty of them. Illumination must be brilliant for television studios.

Within the Iconoscope is a light-sensitive plate, somewhat resembling that used in the regular photographic camera. But the light from the television lens, instead of causing the chemical change which produces pictures on a camera plate, sets up faint electric currents in the plate, varying in strength according to the intensity of the light. Actually this "mosaic," as the plate is called, is made up of several hundred thousand infinitesimal light sensitive globules, each insulated from the others, and each in fact, a tiny photoelectric cell. As light rays strike these globules they become electrically charged—and those charges remain there until removed by "scanning."

This scanning—or reading of the picture on the mosaic screen—is done by what is known as an electron beam, a sort of invisible needle point of electronic energy that moves, at incredible speed, back and forth across the plate in 441 horizontal lines. (The earliest television pictures used but sixty lines. Felix the Cat, the first television actor, was thus televised in 1930 by Dr. E. F. Alexanderson.) The number of lines was rapidly increased to 120, 180, 240, 343 and finally to the present 441. The reason for increasing the number of lines is simple. Actually the picture that appears on the receiving screen is a series of dots of light of different intensities. The more scanning lines, the more dots, and the more dots the clearer and more detailed the image.

The scanning beam that "reads" these lines is contained in the Iconoscope. If you want to know why and how this beam can pick up the electrical impulses from the plate, convert them into high frequency waves and hand them over to the amplifier to be routed to the transmitter antennae you can obtain a slight inkling by doing some homework on the theory of electrons. If you're real bright and study hard you should have a vague idea of the principles in four or five years.

That scanning beam is a rapid reader. It reads from left to right at the rate of two miles a second, from right to left at 20 miles per second.

Describing *what* a television camera *does* is relatively easy. Even explaining, in the simple and general way in which we hope we have managed, *how* it does it is no monumental task. But to elucidate *what it is* and *how it is made*—that stops us.

For the heart of that camera, the Iconoscope, is an infinitely delicate, sensitive and complicated apparatus containing thousands of parts, no one of which anybody but a technician can actually understand.

And the rest of the mechanical, electrical, electronical and supernatural organs that constitute the camera's circulatory, glandular and nerve system are, to the uninitiated, such a heterogeneous mass, mess and maze of wires, bulbs, filaments, connections, bushings, cams,

NBC television antenna array on the Empire State Building. The ring-like antenna at the top is for sound; the torpedo-shaped radiators below launch picture "signals" on the air in all directions.

gears, sprockets, nick nacks and flotsam and jetsom, that there isn't anything to be said about it except:

"Look at the illustrations—they'll give you some idea, though even then you won't understand it."

If you did, it would only be a start, for all the other apparatus used in television is of the same type or more so. How they make it work isn't nearly so astonishing as how they ever made it at all.

But let's get back to our "scanning". The beam has just "read" the picture by collecting the electrical charges on the mosaic screen inside the camera. Now, what happens.

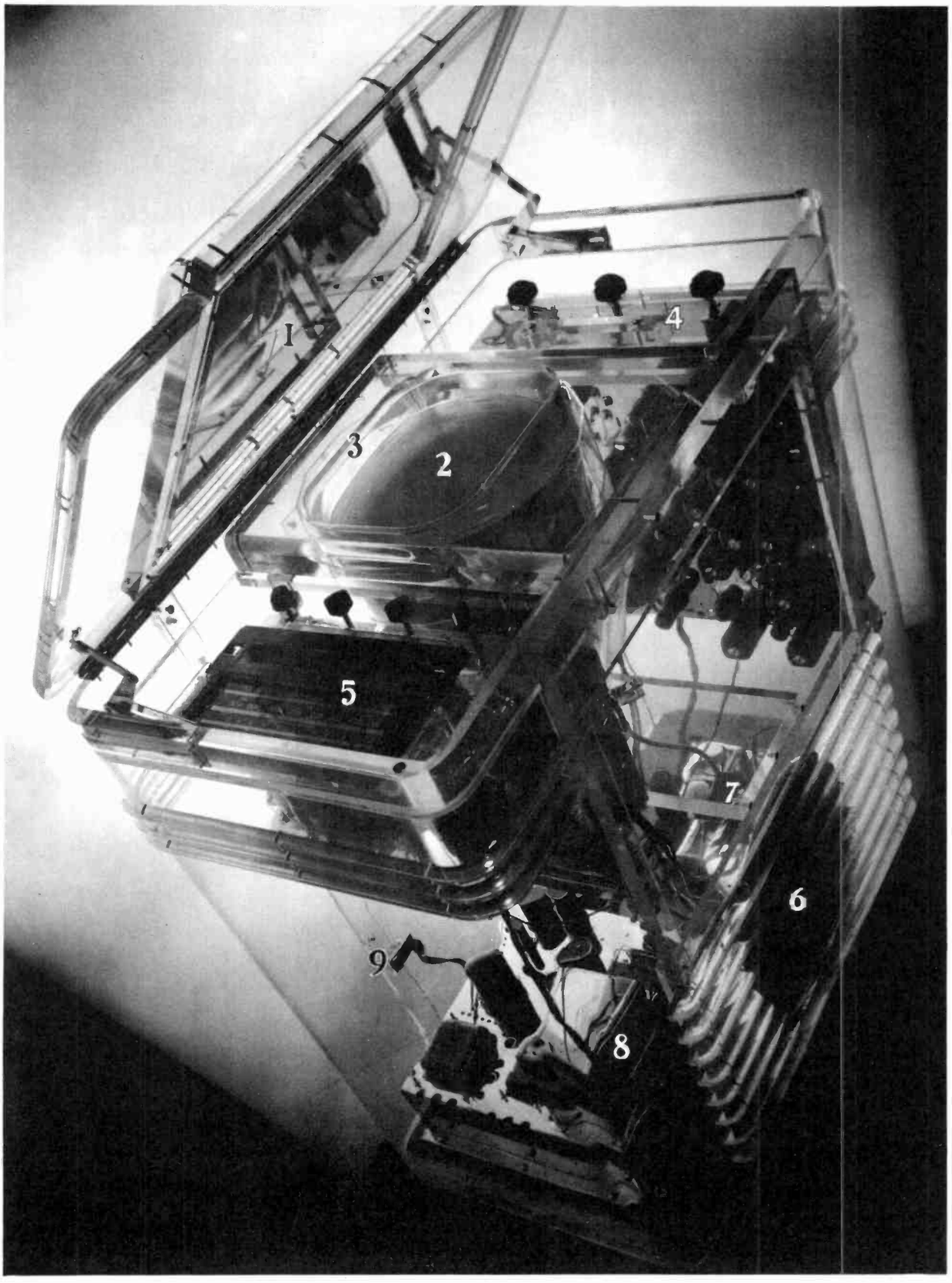
Very simple, very ve-ry simple.

The charges picked up by the scanning beam are amplified, "modulated" or controlled, and sent by cable to the transmitter on the Empire State tower. There, by a technical abracadabra which your narrator never will be able to understand, they are synchronized in some way with radio waves, whose speed is the same, but whose rate of vibration is infinitely slower—and shot into the ether, to be picked up by the television receiver. The tube that picks up these television waves and changes them back from electrical vibrations to light, is known as a Kinescope, and was invented by Dr. Zworykin, who also invented the Iconoscope. The amplifiers in the television receiver boost the incoming vibrations to a higher intensity. These vibrations are then shot by an electron gun (it shoots a stream of electrons) against a fluorescent screen, which by the reverse process from scanning, converts the electrical charges into light. This is reflected on a mirror, and in the mirror you see—and from the radio loudspeaker you hear—the performance that is going on in the NBC studio.

Some idea of the speed at which television scanning and transmission must be done may be gained by comparing it to telephotoing. In ordinary wirephoto practice a still picture is sent in ten minutes, at the rate of 300 impulses per second. In Television there are six million impulses per second, a pace twenty thousand times as rapid.

Because existing telephone or telegraphic circuits can convey not more than 30,000 impulses per second, television engineers had to invent a means of carrying two hundred times as many vibrations. The solution was the Bell Company's production of the coaxial cable. Up to this writing that cable is the most efficient means of wire transmission for television. It is, however, very heavy, not portable except by specially devised equipment, and costs approximately a dollar a foot. Thus the coaxial cable which has been laid by the Bell Co. between New York and Philadelphia is a half-million dollar speculation in a far-off future.

All of television's equipment, at the moment, is similarly expensive. You can buy a nice

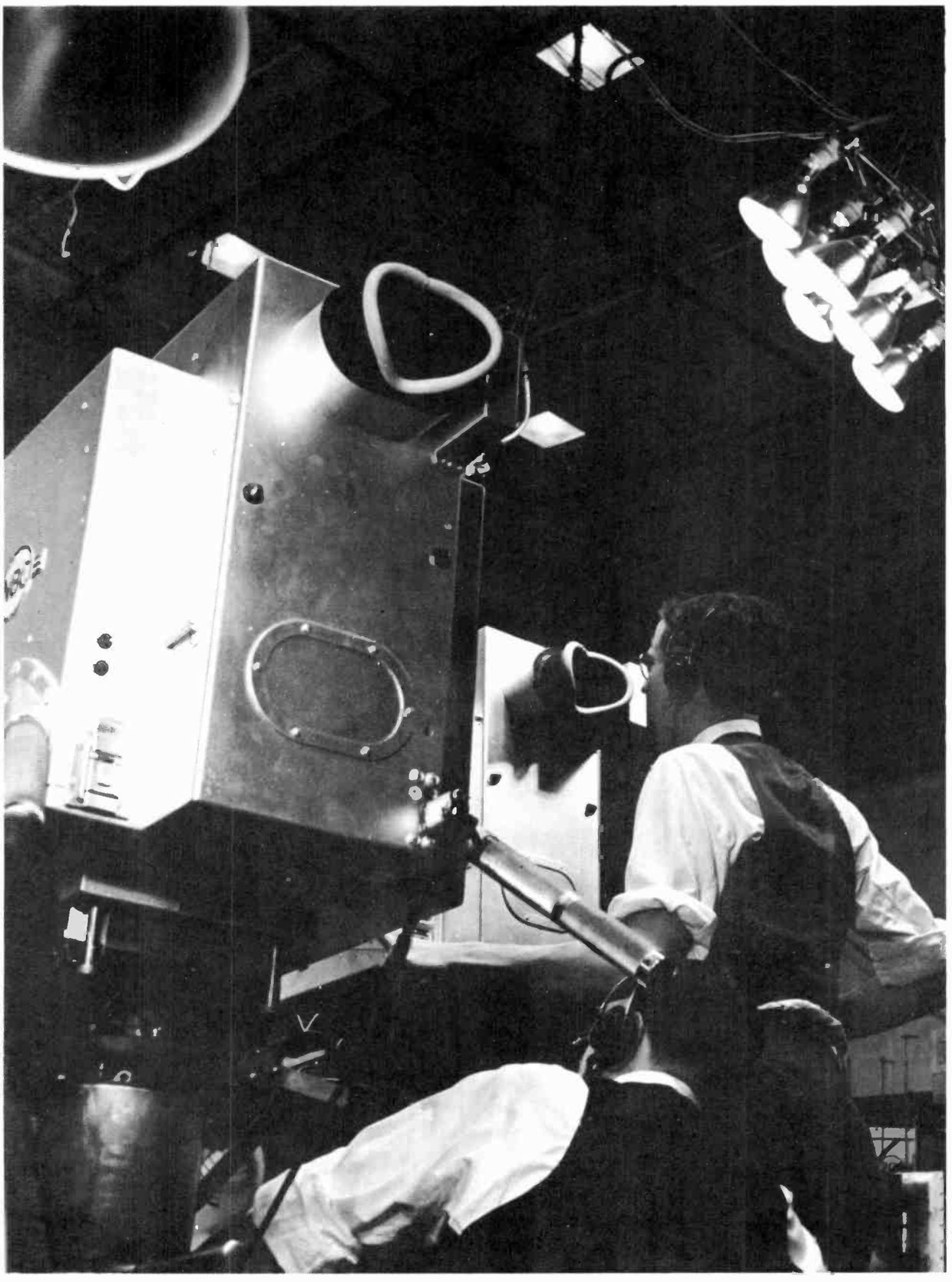


Inside stuff on a television receiver. (1) Mirror on underside of lid to reflect image; (2) Kinescope picture tube; (3) Frame for picture tube; (4) Television receiving chassis; (5) Radio broadcast receiving chassis; (6) Loudspeaker; (7) and (8) Power supply chassis; (9) Interlocking safety switch to throw off all power when back of cabinet is opened.

home transmitter for $60,000, and when you have acquired the Iconoscope camera, built your antenna, and secured such other accessories as are necessary for broadcasting, you won't have expended much more than $300,000. Unless you want to make outdoor "pick-ups" in which case you'll need two pick-up trucks at $75,000 each.

Assuming you have three hundred thousand dollars and want to spend it to televise to your friends, you are likely to encounter a slight difficulty in putting your broadcasts on the air. The Federal Communications Commission may not allot you a channel. There are not very many channels available and the F.C.C. is likely to be niggardly about handing them over. Without going into explanations as to what is meant by a kilocycle, it requires a "band" of 6,000 of them for a single television transmission. Now the entire sound broadcast band used by the U.S. radio stations is only about one thousand kilocycles wide. One television station, therefore, occupies six times as much of the ether as is used by all the sound broadcasters in the United States. At present, there are only seven television channels available, under F.C.C. rules, and the applicants for these are plentiful—and powerful. As yet no permanent assignments of these channels have been made. NBC and CBS have been granted experimental use of two, and the Don Lee Studio in Los Angeles has a similar arrangement for a third. These are the only stations now regularly broadcasting, even experimentally. The General Electric Company has recently been licensed to build a transmitter at Schenectady, N. Y., which will soon be in operation. What the fight for channels will be when real competition sets in may be imagined.

There is another basic and inexorable limitation on television, which does not apply to radio. Radio waves follow the earth's curvature and can, therefore, whip clear around the planet. The high-frequency waves of television will not act similarly. In a sense they will "bend", but high-frequency waves are absorbed by the earth's surface at a rate that weakens the original power enormously. A television transmitter, even one as powerful as that on the Empire State tower, placed fifty feet from the ground could not televise more than four or five miles. But by placing it very high, its vibrations can be "showered down" over a large area and the weakening effect of the "ground wave" may thus be overcome. Roughly speaking, however, the practical limitation of a television transmitter is the horizon. The higher the tower, the greater the horizon. The NBC engineers find that at present the distance within which dependable transmission and reception can be secured is about forty miles. Nevertheless it is quite possible that a televised broadcast might be picked up even 150 miles away—provided the receiver were also very high above sea level. Over the ocean, too, it is possible to televise further than over land, since salt water does not absorb high-frequency waves as easily as earth.



Behind the television image. Three Iconoscope cameras operate simultaneously in picking up a live talent show. Push buttons in the associated control room make one picture out of the three camera shots.

But, to repeat, the NBC transmitter on the Empire State and the Columbia antenna on the Chrysler building have a practical radius of between forty and fifty miles.

As it looks now, network broadcasting of television is much further away than the horizon. It can be done only by spacing sending stations fifty miles apart and transmitting programs from one to the other by coaxial cable at a dollar a foot, or relaying them, through the ether—a process at present about as costly as coaxial cable.

The most competent prophets will not prognosticate commercial network television as likely within five years—and most of them say ten.

And yet, sound broadcasting has confounded all the prophets, and television may do the same. As the typewriter clicks out these words somebody in a laboratory may have created a method of wire transmission that will carry programs from station to station cheaply. Or some corps of technicians may be discovering a way of making television ride on waves that *will* bend.

In the light of radio history, anything can happen.

From the technical standpoint television is already a success. That it will be—whatever the experts say—a commercial success sooner or later, and probably, sooner, we can safely believe.

Already eight companies are making receiving apparatus (at prices from $200 to $1000). Four are building transmitters, and eleven hold hundreds of patents under which television operates. They are doing this in the expectation of eventual profit—they are business men, not televisionaries.

Meantime, while the television operators ride gallantly toward their port of eventual profit on waves of red ink, we can sit at a console cabinet and watch and hear a drama or a baseball game projected for us by slaves of the lamp—invisible electrons making the incredible visible.

AUTHOR'S NOTE: Like radio, television is rapidly developing its own special vocabulary. It will probably be regarded, very soon, as an evidence of mental stagnation not to know most of the television terms. The following, therefore, is a glossary of some television technology:

AUDIO (Latin, "I hear")—Pertaining to the transmission of sound.

BLIZZARD HEAD—A blonde actress, to studio technicians who have to worry about proper lighting for her hair to avoid flares.

BROAD—A general illumination unit used in lighting the sets. (No! no! *not* a "dame".)

BUSINESS—Anything in television for which a technical designation is lacking or forgotten by the speaker.

CATHODE-RAY TUBE—Vacuum tube containing the screen on which the picture is reproduced in the receiver.

CONTRAST CONTROL—A knob on the receiver for adjusting the range of brightness between highlights and shadows in a picture.

COAXIAL CABLE—Special telephone cable suitable for conveying television signals.

FOCUSING CONTROL—A knob on the receiver for bringing the picture into sharpest definition.

Tamara Toumanova, celebrated ballerina, has a moment's respite during rehearsal of a television sequence.

FRAMING CONTROL—A knob or knobs on the receiver for centering and adjusting the height and width of pictures.

FRAME—One complete picture. Thirty of these are shown in one second on a television screen.

GHOST—An unwanted image appearing in a television picture as a result of signal reflection.

GOBO—A light-deflecting fin used to direct light in the studio and protect the camera lens from glare.

HOT LIGHT—A concentrated light used in the studio for emphasizing features and bringing out contours.

ICONOSCOPE—A type of television camera tube developed and used by RCA. Television engineers call it "IKE" for short.

IMAGE DISSECTOR—A type of camera tube developed by Farnsworth.

INTERLACING—A technique of dividing each picture into two sets of lines to eliminate flicker.

KINESCOPE—A receiving cathode-ray tube developed by RCA.

LINE—A single line across a picture, containing highlights, shadow, and half-tones; 441 lines make a complete picture.

LIVE TALENT—Participants in a program picked up directly in the studio, as distinguished from film presentations.

PANNING—A horizontal sweep of the camera. (From "panorama".)

SAWTOOTH—A wave of electric current or voltage employed in scanning.

SCANNING—The action of the electron beam in exploring (in the camera tube) or reproducing (in the cathode-ray tube) the half tones in a picture.

SCOOPS—Multiple lighting units in the studio.

SPOT—The visible spot of light formed by the impact of the electron beam on the screen as it scans the picture.

TELECAST—A television broadcast.

TELECINE TRANSMISSION—A movie program.

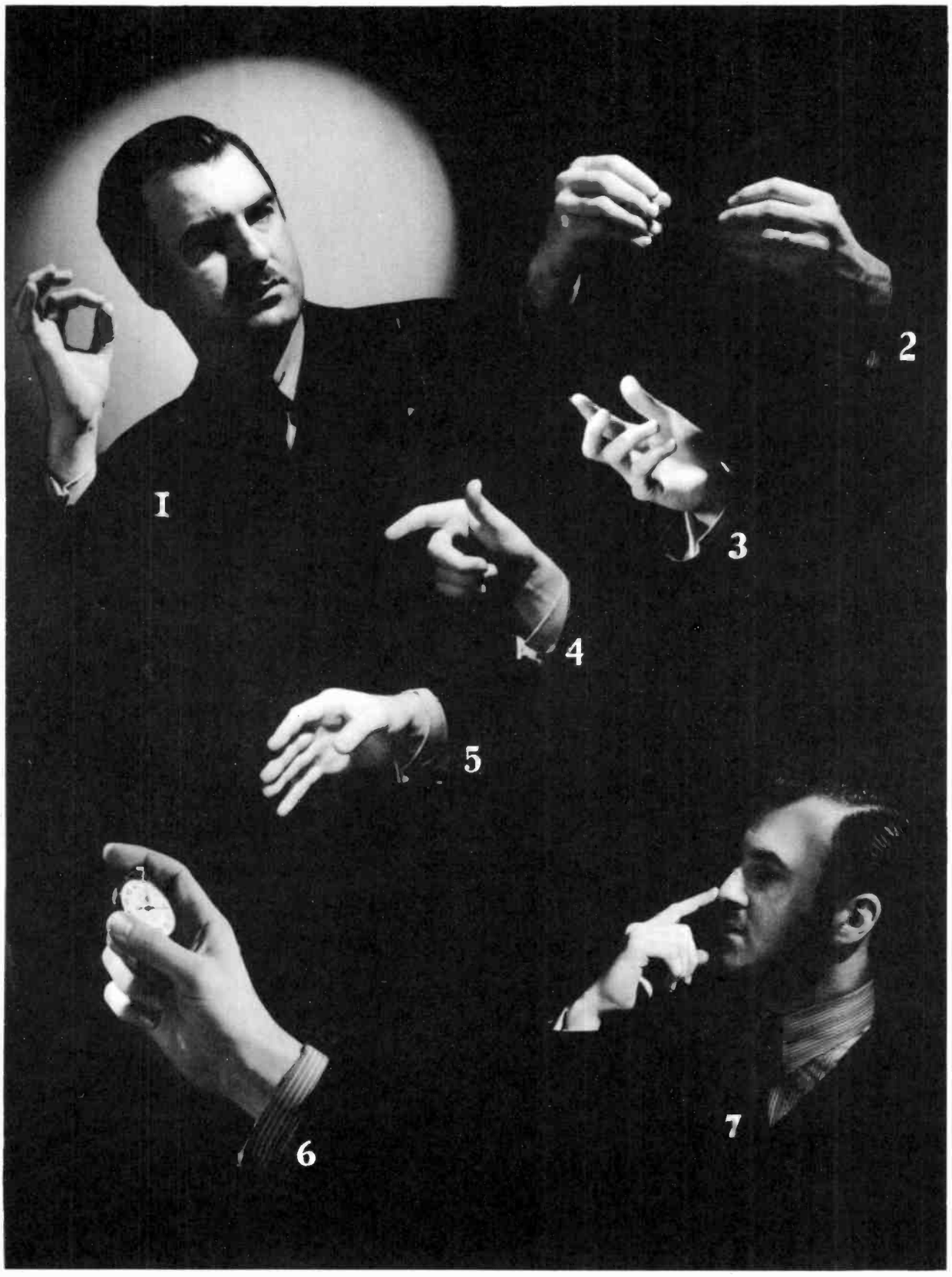
TILTING—A vertical sweep of the camera.

SYNCHRONIZATION—The process of maintaining synchronism between the scanning motions of the electron beams in the camera tube and the cathode-ray tube in the receiver.

VIDEO (Latin, "I see")—Pertaining to the transmission of transient visual images (cf. "audio").

WINDSHIELD—A perforated metal cover which fits over the microphone and protects it from drafts caused by the powerful air conditioning system used to remove heat caused by the lights in the studio.

WOMP—A sudden surge in the signal strength resulting in a flare-up of light in the picture.



W. L. Marshall demonstrates the program director's hand signals (1) O.K.—everything is all right (2) too fast; drag it out (3) bring up the level; louder (4) turning motion of the hand—faster (5) come closer to the microphone (6) the stop watch, the tyrant over the program director (7) on the nose, exactly on time.

CHAPTER FOUR

Cabalistic Kilowatts

WHILE WE ARE ON THIS SUBJECT of technology, and now that we have explained how television works, (or have we?) we might as well get the matter of how radio works also disposed of.

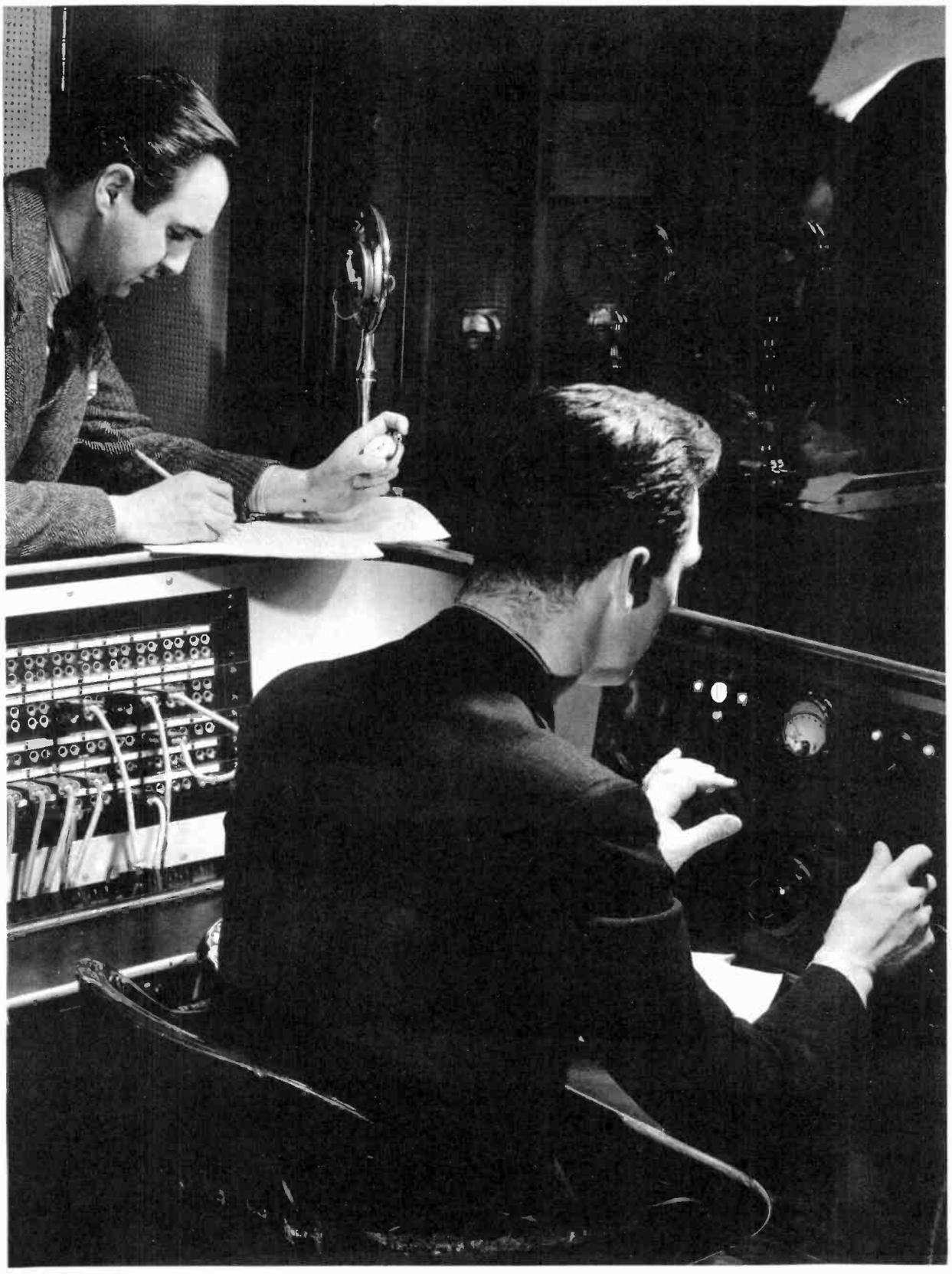
There has been much listing of discoverers and their discoveries, experimenters and their experiments, inventors and their inventions. But in attempting to describe how broadcasting is done today it probably will not be necessary or even desirable to name inventors or their inventions by name. It may not even be wise to explain how some of the main mechanical and electrical instruments of broadcasting function—*what* they do rather than *how* they do it should be our chief interest. As may have been said before in these pages, the whole thing is a mess of magic anyhow, in charge of a talismanic group of thaumaturgists (go to the dictionary for *that* one, we had to) and who are we to understand their sorceries?

We can endeavor, though, to show how speech and music go from the speaker or musician to the ears of the estimated 32,000,000 listeners.

There are, broadly speaking, two kinds of broadcasting, "pick-up" and studio. A pick-up is exactly that—a speech, or a sporting event, a dance orchestra, a concert "picked up" by a microphone on the spot (outside the studio) and transmitted by radio waves to the station, whence it goes simultaneously by wire to the other stations on the network, and from the station transmitter to the listeners within the station's own radius.

Some of these "pickups"—or "nemos" in radio argot, especially those of events which do not occur regularly—are made with portable apparatus, which is light and compact enough, today, to be carried easily by one man. Others, regularly scheduled baseball games, operas, concerts, conventions, etc., are picked up by more powerful and elaborate equipment installed for the occasion. Some of these installations are permanent, and where that is the case their broadcasts often go to the station by wire instead of via the ether.

For some happenings, particularly those where it is desirable to cover several different



Production Director (left) timing the script during rehearsal.

phases of the activities as they occur, a number of announcers with light outfits may be stationed hither and thither, or roam about for spot news. When this is done, their broadcasts are made, not to the station, but to a pick-up truck or mobile unit which relays them.

Radio's roving reporters who pack their light field outfits on their backs generally use short-waves for transmission. Why short waves are better for short distances, and also for trans-Oceanic jumps, is a technical subject that we won't stop to explain here.

Another small mystery about this short wave pick-up is how these choppy little vibrations, fifteen to fifty feet in length, are synchronized, translated, superimposed, put in rhythm or however you want to describe it, with the station's regular wave length of say 1500 feet. It's like harmonizing a jig with a stately minuet, or the staccato yammer of a riveting machine with the slow thud of a pile driver. But it's done. Somewhere in the station's bewildering maze of wires, tubes, switches, batteries, generators and transformers, these short waves are automatically and instantaneously stretched into long ones, which carry the original message—unaltered—on the station's regular carrier wave, to the listeners' receivers.

The meaning of "studio broadcasting" is obvious. It denotes all programs put on the air directly from the station studios. Practically all of the "big name" commercial programs, such as Jack Benny, Fred Allen, Bergen and McCarthy, Bing Crosby, Whiteman, Goodman, etc., are studio broadcasts. So are the daily serials, commercial and sustaining, and such programs as the NBC Symphony Orchestra under Toscanini.

Absolutely all broadcasting is either pickup or studio—or a combination. "Short wave", "police calls" and "network broadcasts" can be included under these two heads.

Strictly speaking, police calls do not emanate from a "studio", but the radio room in a police headquarters is to all intents and purposes a studio, with permanent equipment.

Short wave is merely pick-up broadcasting on a shorter wave length than the standard station waves. "Network broadcasting" is simply a hook-up of several stations by telephone wire so that a program can be broadcast, for example, simultaneously by Hollywood and New York.

Eliminating technical words so far as practicable, what happens in a radio studio when a program goes on the air is simple enough—though it is accomplished by about the most complicated apparatus ever evolved by the brains of men.

The diaphragm of the microphone, hit by the sound, vibrates in tune with the sound waves, which have various rates of vibration according to the kind of sound. Behind that diaphragm is a contrivance which changes those sound vibrations into electrical currents. But these currents are weak, and if they are to travel far must be "boosted" in power. Hence they go through a wire to an amplifier. From the amplifier they are sent, again by wire, to the transmitter station,

Edward Everett Horton runs through his script in a rehearsal of the Rudy Vallee Hour.

which is generally several miles out in the country. The transmitter is equipped with two kinds of "senders", an oscillator and a modulator. The oscillator generates what is known as the carrier wave, and its power is described in kilowatts. What's a kilowatt? One thousand watts, or the amount of current needed, for instance, to light up 20 ordinary incandescent bulbs. An oscillator is also described in terms of "frequencies". By which is meant the rate of electrical vibration, which in turn determines the wave length. Frequencies are rated in kilocycles and a kilocycle is 1000 vibrations per second. The numbers on your radio receiver's dial represent the number of kilocycles used in broadcasting by the different stations. Practically all the stations on the broadcast band will be found between the numbers 55 and 160 on your dial. For convenience in dialing, however, one zero is dropped. So a station which you tune in at 55 operates on 550 kilocycles per second (550,000 vibrations) while the one you dial at 100 operates at 1000 kilocycles (1,000,000 vibrations). Hence when you tune in a station at number 55 you are on a frequency of 550 kilocycles. No one else within that station's field may use that particular channel and, to avoid station interference, the F.C.C. allows no other station to use a frequency within ten kilocycles of that channel.

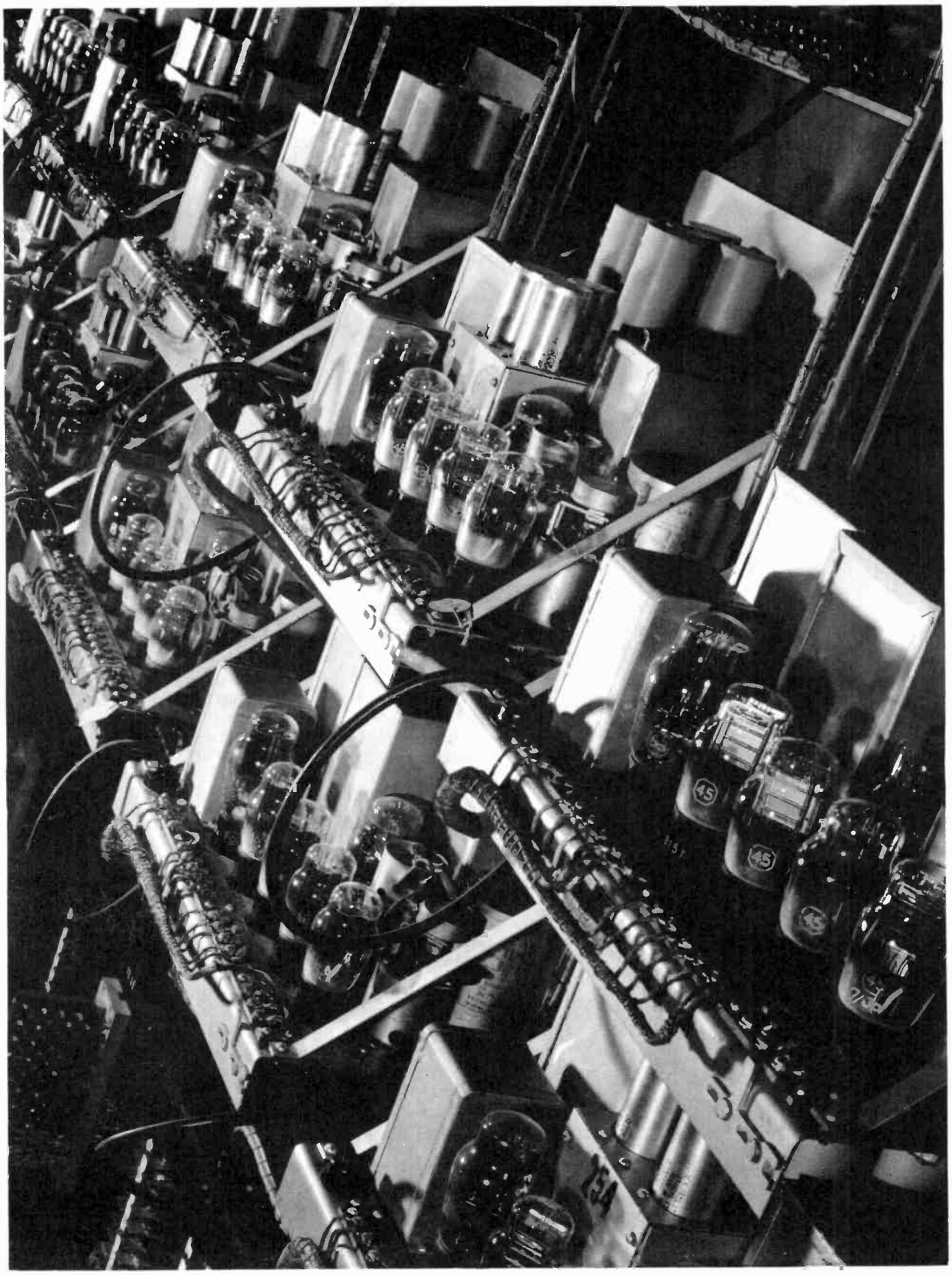
But, though the wave you tune in on is the wave sent out by the oscillator, that oscillator wave produces no sound in the receiving set. The modulator does that. In some cabalistic way, which is probably perfectly obvious to the technician, the modulator "carves" the sound into the oscillating, or carrier wave. When the carrier wave, thus modulated and controlled, reaches the receiver, the combination is amplified in your set, translated from electric energy into sound, and you hear the program.

Such are the main steps in a studio broadcast—mike to amplifier to transmitter to receiver. Of course the studio control room handles the program on its way, and the main control board operators watch all the programs going out, and there are a hundred other intricate pieces of apparatus spotted along the path of the radio waves, but the route is still mike to amplifier to transmitter to receiver.

The second step in the broadcast route—the amplifier—is an instrument of inconceivable potency. The vibrations set up by sound waves in the microphone are weak, mere electrical whispers. These must be magnified tremendously before they can be transmitted.

When the carbon microphone was in use, the usual amplification was fifty billion times. Meaning that this comparatively small instrument, the amplifier, so multiplied the power of the human voice that it went on the air with twenty-five times the decibels (sound units) that would be produced if the two billion people in the world all yelled in unison.

That was considerable amplification.



Amplifiers. A few of the several hundred in a station which magnify voices and music trillions of times.

But when the condenser microphone was adopted, this amplification wasn't enough. It was an infinitesimal iota of the decibels required. Today's amplifiers boost the sound of the human voice, or the music of an orchestra, not by mere billions, but by trillions and quadrillions of times. They toss the human voice into the realm of astral mathematics, producing electrical reverberations of incomprehensible might.

To paraphrase Ralph Waldo Emerson, it is not only "the shot heard 'round the world", it is the shout heard 'round the *universe.*

The whole route this "shout" follows is traversed at the rate of 186,000 miles per second. Well, not quite that—wires and weather may slow it up considerably, but it never gets below 100,000 miles per second, which is once around the earth in a watch tick.

With "pick up" broadcasts the process requires one or two more steps. For instance, where an announcer is using a portable outfit and relaying to a truck or mobile unit, then the steps would be mike—to—transmitter—to—truck amplifier—to truck transmitter—to station—to —transmission tower—to—receiver. These extra steps slow things down a bit, say by a hundred thousandth of a second.

While a portable field outfit can be carried, literally, in a hat, the station equipment for broadcasting couldn't be packed into the "topper" of Gargantua, Goliath, Paul Bunyon or any of the other giants of legendary fame. Radio magicians need elaborate apparatus for their effects and illusions. And here enters a paradox, a queer contradiction. Radio is "wireless" telephony—but a radio station uses more wire than a telephone exchange. A single control board requires several hundred miles of it; the main control boards at the New York studios of NBC, CBS or WOR, for example, contain fifteen to twenty thousand miles of wire each, in what looks like an inextricable tangle, but is actually an orderly array to those who operate it.

This assemblage of equipment is what engineers find necessary to handle the broadcast traffic that flows into radio receivers.

In addition to the miles of wire in each station, the leased telephone wires over which broadcasts are sent from station to station of the networks add thousands, tens of thousands, more miles of strands and cables to Radio's "wireless" plant. Beside which there are several hundred thousand more miles of wire necessary to light, power and air condition the 763 stations that make up the broadcasting industry. When "wireless" telephony expanded into radio broadcasting, the wire manufacturers were gloomily apprehensive about the future of their business, but today radio is one of their chief customers. It wasn't logic, but as hereinbefore suggested, logic frequently goes haywire when applied to radio.

Sealing together bulb sections of a big air-cooled transmitting tube. The craftsman skillfully fashions the bulb when the glass becomes plastic at yellow heat.

As for the other operating equipment necessary to a single station, a few NBC statistics, taken once over lightly, are interesting and typical of any big broadcasting plant.

There are ten 750 kilowatt generators, and fifty tons of storage batteries. Their current is handled by eight switchboards. In the air-conditioning system—which was installed chiefly to make "inside weather" that was propitious for broadcasting, and only secondarily for the comfort of audiences and personnel—there are fifty-four blowers, four 300-horsepower compressors, and four dehumidifier tanks with a total capacity of 174,000 gallons per hour. The plant circulates 224,000 cubic feet of air per minute, and changes the air in the whole building every ten minutes. To do this requires twenty one million pounds of steam and four million kilowatt hours of electricity annually.

At the Master Control desk, through which every program is routed—22,000 of these each year—there are 1500 keys, 2200 lamps, and 2500 relays.

The speech equipment consists of 300 amplifiers, 120 dial monitoring stations, 175 loud speakers and 2000 vacuum tubes.

And in addition to the Master Control desk there are twenty eight control rooms serving the individual studios.

At the transmitting towers, which, though several miles away, are nevertheless station apparatus, are more and bigger generators, still more miles of wire, and one thousand and one other containers and distributors of what medieval-magicians would call "cantraps and conjurations", but radio magicians call by technical names.

In other words, radio is no prestidigitator's art, but a "presentation" based on intricate, elaborate, powerful and very expensive appliances.

Radio transmission has reached a point of power and accuracy that is well nigh perfect. As the waves leave the transmitter tower they are carrying an almost exact "electrical transcription" of the sounds that went into the microphone. But once they plunge into the temperamental ether, many natural manifestations play hob with them. The ether is not ever exactly placid. There are forty-four thousand thunderstorms daily in various parts of the world, and they all roll around through the ether, setting up static. There is fog and rain and sleet and snow —atmospheric conditions, it is true, but causing electric reactions that affect the ether's conductivity. There is the sun, whom, for novelty's sake we will call Old Sôl. When he shines real hard, he too creates disturbing vibrations in the ether which affect radio waves. The moon, on the other hand, has no influence in the ether.

There is an etherial "ceiling"—a band full of helium—very high in the stratosphere. Radio waves apparently cannot rise beyond it. This ceiling by day is about sixty miles high. At night it

Master control desk. Part of the intricate equipment by which broadcasts are switched over a network.


NBC

rises to a hundred or more. It is higher in winter than in summer. The higher radio waves can travel the less interference they encounter. This "ceiling", discovered by Sir Oliver Heavyside, explains why reception is better at night, and better in cold than in hot weather.

Other things, uncontrollable by the best engineers, interfere with perfect reception. Tall buildings refract and distort the waves. The skyscraper areas are not only full of steel, but the spaces between buildings generate wave-lengths of their own which tune in on and interfere with regular station lengths—and the F.C.C. can't do anything about it.

Radio engineers might well march up and down, like pickets, in front of the weather bureau, carrying placards, "Weather is Unfair to Radio" "Up with the Ceiling" "Down with Static", "We Demand a Closed Shop Against Non Union Waves."

All factors considered, the wonder is not that we have occasional static in our radio sets, and at times queer bobbles and quavers out of the loud-speaker, but that we have anything else. The fact that 95% of the time we can turn on our fourteen dollar or four hundred dollar set, and listen to the voices and music of all the world, distinct, clear, full-toned and natural, is a triumph for the living and a monument for the dead scientists and craftsmen who thought this necromancy out and made it work.

AUTHOR'S NOTE: Since we appended a glossary of television argot to the preceding chapter, it's only fair to add a little radio vernacular to this one. Here are a few samples:

DOWN IN THE MUD: Low volume; (That's old stuff today—they simply say LOW LEVEL, but we like the old one better.)

FRYING: Noise caused by poor equipment.

LEAK: Interference by wireless telegraphy.

CLINKERS: Noise on long distance network wires.

NEMO: Outside pickup.

STANDBYS: Programs to be used in place of regular program; also applied to musicians, usually pianists or organists, who fill in gaps in programs.

DEADSPOT OR WHITE SPACE: Unscheduled silence.

COLD AS ICE, OR WOODEN LIP: Voice lacking expression.

LEVEL: Test of voice for tone and volume.

FUZZY: Voice lacking clarity.

WOOFER: Breathy singer.

86: No good.

WEAVER: Performer who keeps changing his distance from the mike.

CARBON CATS: Musicians who steal musical ideas.

SHAKING THE SCRIPT: Proof-reading for errors.

WHACKY WILLIES: Whistlers and stampers in an audience.

SNEAK IT IN: Command to orchestra leader or sound man to increase volume gradually.

ONE AND ONE: One verse and chorus of a number.

DEAD HEAD: Unresponsive member of an audience.

GOING UP THE GOLDEN STAIRS: Auditioning for a sponsor.

Ray Kinney and his orchestra do a "nemo" from the Hotel Lexington.

CHAPTER FIVE

Aerial Heralds

SO MUCH FOR THE TECHNICAL END of broadcasting—how programs get out of the station and into the receiver.

But what kinds of programs are they? How are they planned, how built, how produced?

Broadly, they can be grouped under two heads, News and Entertainment.

News is the conveying of what happens, the transmission of facts as they occur. Entertainment is—in the definition of Webster—"a diversion; a public performance, as drama, opera or the like". Under this head of Entertainment may be classed music, plays, educational programs, "variety", and even religious broadcasts. For "entertainment" is not merely that which amuses, but that which stimulates thought and emotion.

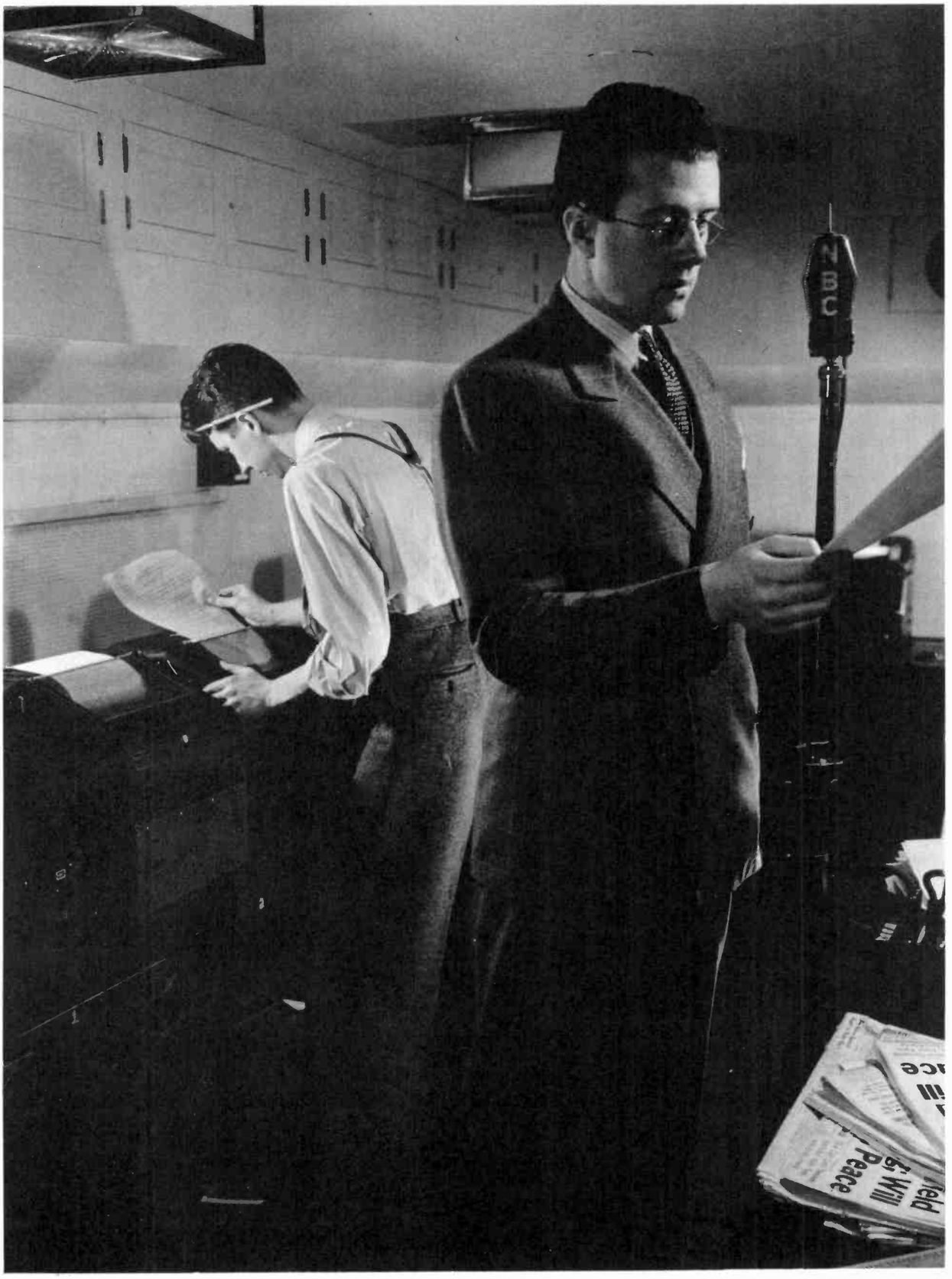
But let us first examine how the radio brings the news to our loudspeakers. We shall have to scan the subject almost as swiftly as the electron beam scans the television plate, but we can get a quick flash on how it's done.

You hear two kinds of news broadcasts over your radio—news bulletins and on-the-scene broadcasts.

The bulletins you hear several times a day—regular as clockwork. They are brief, simple accounts of what is happening in the world. They are read by an announcer, and they usually last from five to fifteen minutes.

Occasionally, in the case of some tremendous news—such as floods, hurricanes, fires and explosions, you hear these brief news bulletins outside their scheduled time. They may be inserted right in the midst of some regular program.

These bulletins come to the network headquarters and to radio stations from the Associated Press, the United Press, and the International News Service, who employ their own correspondents. At the rewrite desk in each of these news bureaus, news bulletins are rephrased into radio style, a more casual and informal style than the newspapers use. It takes about 800 words of copy to make up a 5-minute news bulletin.



Lathrop Mack, night news editor, reads a late press bulletin on the tense European situation in a hastily arranged newscast over nationwide networks. A battery of news tickers supplies the material.

Now how do the news services get these bulletins over to the radio stations they supply? They employ the electric teletype, which is an electric typewriter connected by wire with all the various radio stations.

In each radio station, there is a brown cabinet, equipped with a roll of yellow paper. This is the other end of the typewriter.

On this teletype receiver the news messages appear simultaneously at every radio station.

But such news bulletins are not the only way radio brings the news to you. There is the second way—the on-the-scene news. You have probably heard many on-the-scene broadcasts. You have listened to football games and baseball games in progress, heard the cheering, the singing. These are on-the-scene broadcasts.

To bring such broadcasts to you, radio has a very complicated task before it. The big stations usually devote a whole department to this work.

There are two kinds of special features to deal with. The first are things we can count upon to happen. The other kind are the surprises.

Such big world events as coronations, inaugurations, conventions, openings of Congress, and elections, are in the first category. Take a national convention for instance. Preparations for "covering" it begin six months before it starts. The head of the network's news department will contact the National Committee, sit in on their conferences, hear what they plan to do, see the site of the convention, and go over it, taking down notes on the architectural plans of the building, etc., so that he can show to his engineers what equipment will be needed.

In the meantime, he must also contact prominent men, and news commentators for broadcast comments. He must go over blue-prints with the engineers for the building and setting-up of equipment. He must train a special staff of announcers and technical men for their jobs.

By the time the convention opens the radio scene is set. There is a complete control-booth right in the convention hall, where the chief announcer and the engineer sit. There are microphones all over—some to pick up the band, some to catch the words of the speakers on the platform—some for announcers in various places.

There are even microphones to catch the voting from each delegation on the floor. This battery of microphones is connected to a specially designed panel board.

To catch the little odds and ends of gossip and convention color, the "walking transmitter" is used. This is a sort of little broadcasting station in itself, worn or carried by an announcer.

How complete such "coverage" may be was demonstrated at the inauguration of President Roosevelt in January, 1937. For this event, one network as an instance, set up one complete master-control booth under the East steps of the Capitol in Washington, a cue transmitter on

Forty-five seconds left of the last minute. Lowell Thomas gets a visual warning from program director Charles Warburton, that his quarter hour on the air is nearing an end. Hugh James, standing at the control console, is ready with the closing announcement.

top of the Washington Monument, a blimp equipped with a short-wave transmitter, employed 2 commentators who could speak French and Spanish, used 18 announcers and 20 engineers, and 30 microphones.

Now as to the "surprises"—the news events which happen with incredible swiftness—toward which a nation's attention is turned inside of a few hours with full force!

Such events include hurricanes, shipwrecks, fires, floods, and all sorts of strange unpredictable occurrences.

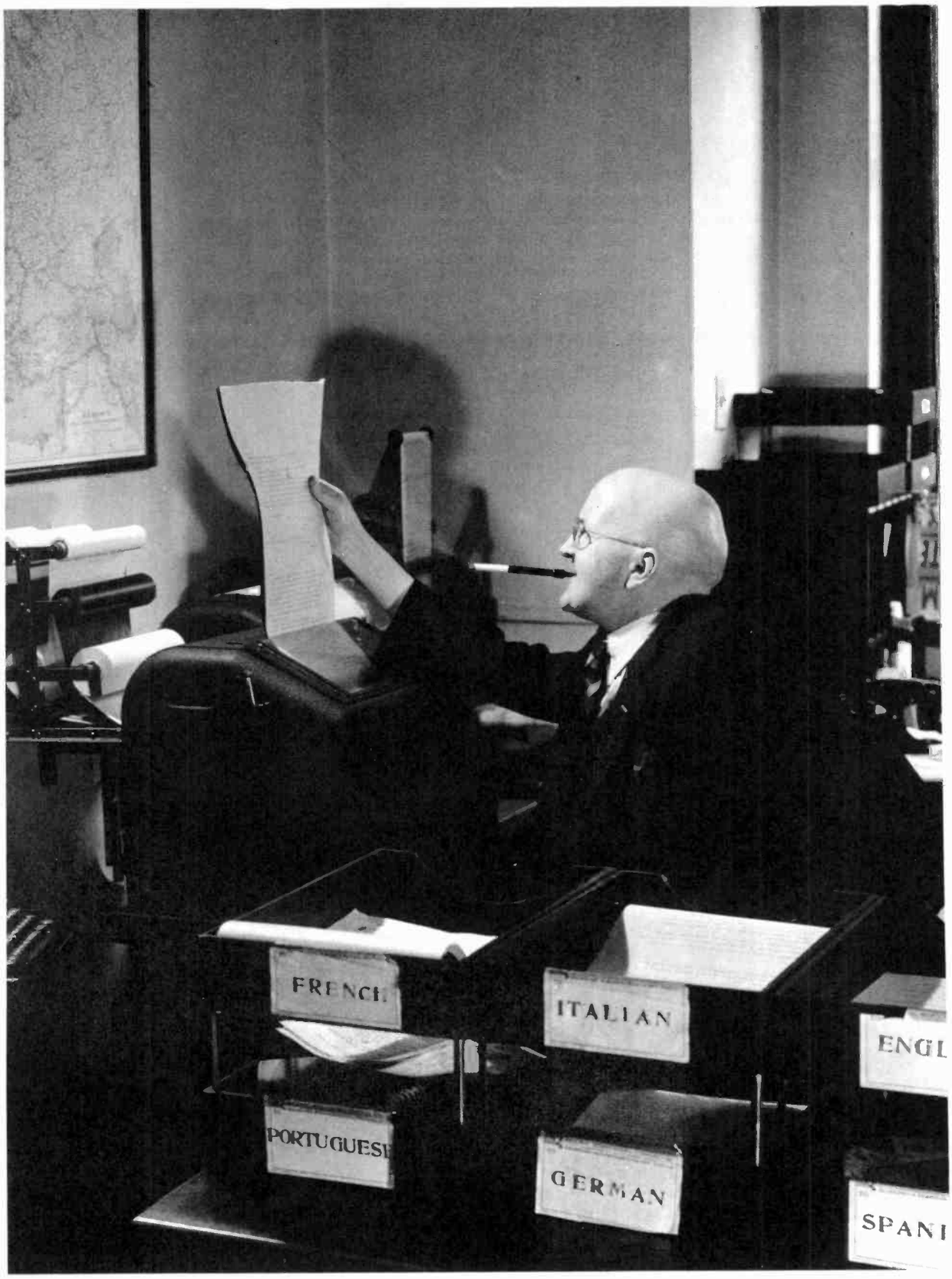
The main item in these cases is speed—just as speed is of prime importance in handling a story for a newspaper. But it is a hundred times harder to get broadcasting equipment and facilities and announcers and engineers quickly to a remote place in some distant part of the country and have everything working well enough to get a clear broadcast, than it is to send out reporters. So the speed of radio staffs in these times is positively feverish.

When the Hindenburg burned and blew up at Lakehurst, N. J., all the action happened in minutes, even seconds. Newsmen were caught napping, because the crossing of the big dirigible had become routine. News services covered the landings by telephone, radio news editors had withdrawn their special equipment from the airport.

Yet the story of an eyewitness to the disaster was on the air within a few minutes. He was Herbert Morrison, a Chicago announcer who had been making a recording of the landing, a record that normally would not have been used for several days. But tragedy made that record news. It was lifted from the recording machine and played over NBC's two networks. This broke NBC's ten year rule against recorded programs, but no rules can stand against a story like that.

The sinking of the submarine Squalus was another tragedy that disrupted all regular schedules in NBC's news department. A. A. Schechter, NBC's news director, had to assemble a large special staff almost instantaneously. The Portsmouth scene must be covered from several points. From Boston and New York, engineers and announcers were sped. A master control unit was set up in the navy yard. Two engineers and an announcer, with a short wave unit, were placed on the destroyer Brooklyn, anchored near where the Squalus sank. A third short wave unit was placed on a small launch, which cruised directly over the sunken submarine.

From the scene of operations off the coast, navy officers at Portsmouth got their reports by radio from the Brooklyn. Those reports, official releases, were read to several score of news reporters and the radio crew at headquarters. An announcer repeated the official report from headquarters, there came a pause, and then: "We take you now to NBC's observers aboard the destroyer Brooklyn." By short wave the latest report on activities at sea came through the



Hudson Hawley, news editor of the NBC International Division, scans a press association story for its interest to one or more of the six language groups addressed over short-wave stations X3XAL and W3XL.

master control unit, from where it was relayed by special wires direct to Radio City in New York, for rebroadcast to network stations. In the same way, the small launch unit sent its latest report—descriptions of the rescue chamber breaking water alongside the salvage vessels, carrying crew members, those fortunate enough to have escaped death, to the surface.

There were many obstacles to overcome. For instance, the NBC control unit in Portsmouth headquarters had no direct communication with the small launch. The crew aboard could hear "cues" for their signal to broadcast, but there was no means of picking up their own broadcast signals at headquarters. Here's the way that difficulty was solved. The boat shortwaved its information to Boston, an engineer relayed the message by direct telephone wire to Radio City, where a technical director relayed it again by direct wire back to Portsmouth—a circuit of hundreds of miles between two units only 16 miles apart.

NBC's biggest recent news beat was scored in the Munich crisis. Sometimes such beats are luck—but not this one. NBC's foreign representative, Max Jordan, waited outside the meeting hall in Munich. His broadcasting headquarters were close by. His line was open, his equipment ready. The final statement from that conference, signed by Mussolini, Hitler, Daladier and Chamberlain, was obtained by him the moment the conference concluded. Jordan didn't wait to read it, he jumped to his microphone, read the full text, and added his comments, thus beating news cables and other radio newsmen by forty-six minutes.

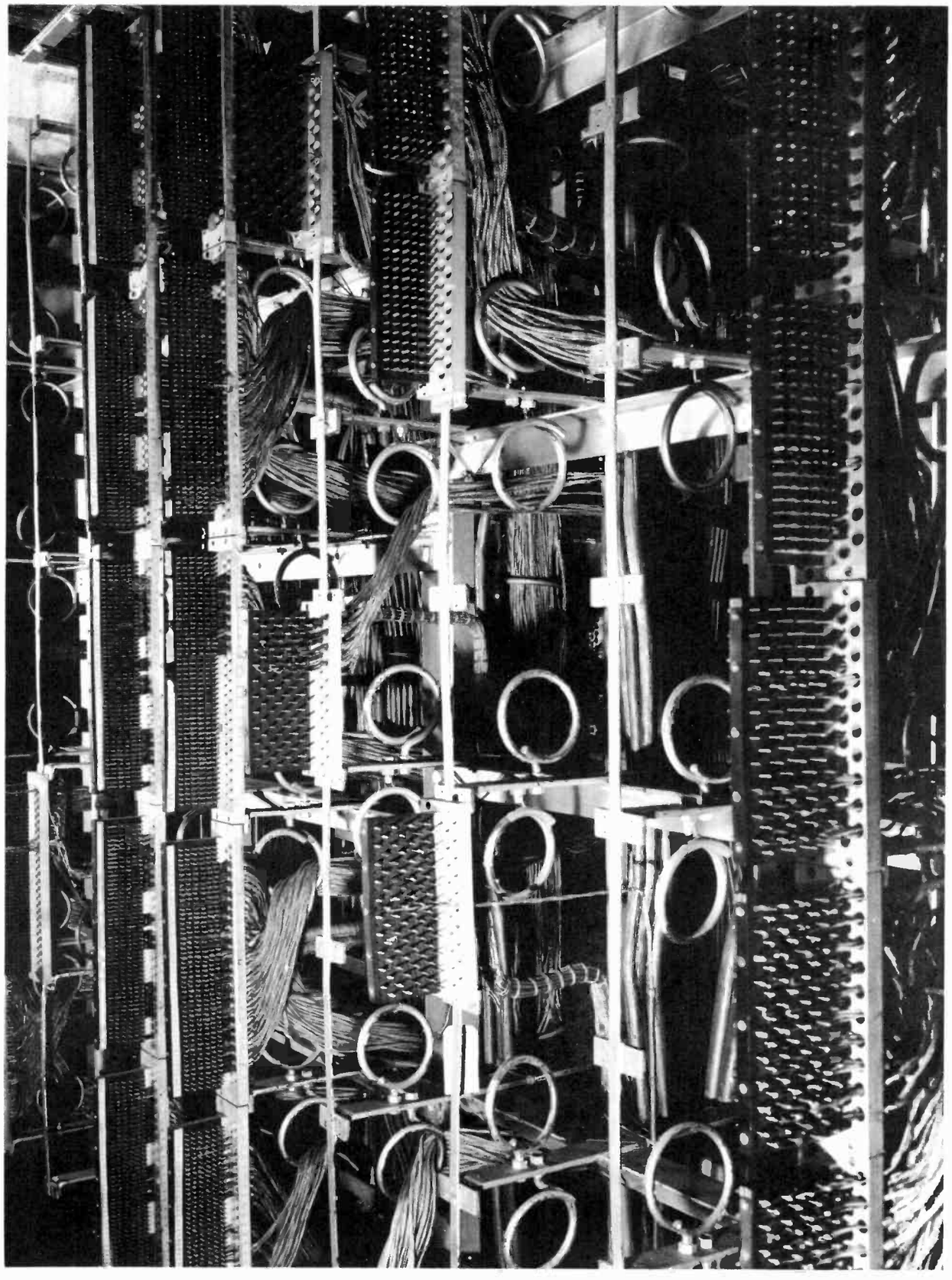
The "flash" comes from the news service bulletin (ground-work of all radio news). When the radio station's news man feels a story is "hot", he starts contacting the place in question, or the nearest spot to that place to which he can telephone.

Big news is usually bad news—tragic news. And it seldom is scheduled—disaster breaks suddenly.

Sometimes for one reason or another, it is impossible to reach the scene of the action. The newsman has to invent curious round-about ways of getting there.

Paul White of CBS cites the instance of the Florida hurricane. The minute White heard about the hurricane, he called the Telephone Company to see whether lines were available to Miami. They were not, so White told them to let him know the moment one came through. He wanted, of course, to speak to the CBS station at Miami, WQAM.

But in the meantime another problem arose. He could have a telephone line through to Miami eventually, but how was WQAM to know that a program was wanted immediately? When the line came through, WQAM would have to scout around then, instead of having the talent and the information and the equipment all set up.



Main distributing frame. A small section of the frame from which radiate the thousands of miles of wire used in broadcasting.

It was impossible to reach Miami by telephone and airplanes were grounded because of the gale.

So what White did was to send a cable to London. London shot the cable down to Johannesburg, South Africa. Johannesburg relayed it to Rio de Janeiro, which shot it to Havana, Cuba. And the message was short-waved via tropical radio to Miami. When the line came through, the broadcast was ready!

Sometimes the short-wave microphone catches news while it is in action. There was the time that Paul Douglas was sent out in an airplane with short-wave equipment to cover the search for the debris of the dirigible Akron upon the storm-tossed Atlantic. While flying toward the Jersey Coast—it was a disagreeable, rainy, blowy day—they saw the blimp J-3 blow up right beneath their plane. It was on its way to aid the survivors of the Akron.

Douglas immediately ordered the pilot to fly to Atlantic City, where he rushed over to the local station there, and scooped the country on the news of the J-3's crash.

Radio on-the-scene is now regularly brought from Europe and even more distant places.

The mechanics of elaborate "pick-ups" that carry two way conversations back and forth across the oceans, are well depicted in Paul Wing's "Take It Away, Sam."

While the names are fictional, the facts are factual. We quote:

"Then came a long telephone conversation with the supervisor of engineers, who called to give Sam instructions for the announcer on a 'nemo job',—a remote pickup, away from the studios. In this case, the Transcontinental microphone was to be set up on the pier of an incoming liner which was bringing a famous British statesman to this country on a diplomatic mission of great importance. Sir Cedric Branscombe was to broadcast to the American people from the pier, directly on disembarking from his ship. But the broadcast wasn't quite so simple as just that. For the fifteen-minute program was to be opened by the Premier of Great Britain, broadcasting by short wave, from London—and simultaneously, by long wave, speaking to the radio listeners of the British Isles. He was to introduce Sir Cedric to the American radio audience. Sir Cedric would then explain his mission and would be welcomed to America by a representative of the State Department. This gentleman, in turn, was to return the program to London, where it would be closed by a few remarks from the Premier.

"The voices of all three men, and of the British and American announcers, would be short-waved across the Atlantic and long-waved to listeners in their own countries simultaneously.

"That meant that the voices from London, when picked up by Transcontinental's short wave receiver, far out on Long Island, would be converted into long wave and broadcast directly from there to the listeners of Transcontinental's New York station, WTRA. But, at the

Through the looking glass. The announcer is seen through the Studio Control Room window—reading his script into the microphone while the engineer contacts the Master Control Room by phone.

same time, they would be carried by telephone wire to the Transcontinental studios in New York City and, from there, still by wire, to every one of the stations on the Transcontinental's great network—from the Atlantic to the Pacific and from Canada to the Gulf.

"But—

"The London voices also must be heard on the steamship pier in New York, so that the New York announcer would know when to give Sir Cedric the signal to begin speaking. To take care of this, a special telephone connection (called a "feed back") was to be made between the New York studios and the pier, where it would terminate in two pairs of headphones—one to be worn by the New York announcer; and the other, by the engineer who would accompany him to the pier.

"And that was not all:

"The New York announcer's voice and Sir Cedric's, which would travel by wire to the New York studios, and thence to all the stations on the network,—and to the Long Island transmitter of WTRA—when they reached this last point, must be converted into short wave, sent across the Atlantic to the British receiver, reconverted into long wave, and broadcast to British listeners.

"The supervisor of engineers gave Sam complete instructions for the switches. From London to the New York pier—and back to London again. These instructions included the 'cues', and the last words that were to be spoken by each person participating in the broadcast.

"Near the beginning of the program, when the British Premier spoke the words, '. . . and so, I commend His Majesty's representative, Sir Cedric Branscombe, to your American hospitality,' on the word 'hospitality' the New York announcer must signal Sir Cedric to start speaking. When he finished, he would be greeted by the State Department representative, who must end his remarks with the words, '. . . who, once again, will speak to you from London.' The instant the engineers in New York, Long Island and London heard these words, they would switch the circuits so that the voice of the British Premier would be heard again."

These international broadcasts are complicated by other than technical difficulties. Radio has to be impartial. If it has a broadcast from the democracies, it must have another from the totalitarian countries.

It must balance Chamberlain with Hitler, Daladier with Mussolini.

Being impartial in these tense days takes a bit of doing, but the broadcasters manage it.

Heigho, Everybody, this is ——? No prizes for the correct answer, but they hire a keeper for you if you don't know Rudy Vallee.

CHAPTER SIX

Fantasies and Illusions

NOW LET'S MAKE an equally swift survey of how entertainment programs are built.

A radio program comes out of your loud-speaker in a brilliant pageant of sound. It is natural, alive, and it always comes out on time. It seems effortless, but a lot of effort has gone to produce it. Dozens of people have worked day and night, reams of paper have been used up, tons of energy have been consumed.

Here are a few of the things which must happen before a radio program is created.

Like any other work of art, it must start with an idea. Radio ideas originate anywhere. In the case of a sustaining program, an idea may originate with a member of the Program Department. Or it may come to radio from the outside world.

Radio ideas have been furnished by famous explorers, by experts on pirate lore, by world war spies, by sea captains. Even a murderer out of prison has contributed the story of his life for a radio program.

Advertising agencies who sell radio programs to sponsors also think up ideas. Many of them have their Idea Men.

Sometimes a radio idea is sold directly to the sponsor by an unknown person. That is what happened in the case of Myrt and Marge. Myrtle Vail, an unknown Chicago housewife, sold her radio idea a few days after she had thought it up, to P. K. Wrigley, and got a five year contract.

Major Bowes was in a position to carry out the idea for his amateur hour at once. He thought it up when he was manager of Station WHN, in response to all the young people with talent who were applying for a job in radio. That same week the first amateur hour was on the air. Hobby Lobby and Information Please were ideas of professional "Idea Men".

So much for ideas. They are slippery things, and one never knows where they will shoot up, either from president or from office boy.

But before an idea can become a radio program, it must have some kind of official okay. In

A few minutes to go. The Vallee musicians relax, tune up or go over the score before the warning "one minute to go" brings them to attention.

the case of a sustaining program idea, it must be approved by the Program Department. In the case of a commercial program, it must be approved not only by the advertising agency building the program, but by the sponsor as well.

Once an idea is accepted, it is usually sent to a radio script writer, who fixes it up in some sort of dramatic form of broadcast length. If it is an idea which will stretch out over separate broadcasts, he will begin writing up various episodes. He will also write a "continuity".

A continuity consists of the different announcements of numbers and personalities which you hear so casually on the air. The announcer does not make up a word of what he says so glibly. Every radio program must have a continuity of some kind, even though the continuity may consist of nothing more or less than "This is the Whosis Broadcasting System".

While the radio script or the continuity is being written, the idea man or the producer considers the matter of music. Will music be necessary on this program? Will it be important or will it be just background music? Will it require an orchestra to play it, or can an organ or a piano be used?

If only an organ or a piano is to be used, the problem is simple. An organist or pianist is hired. When there is only a musical theme heard at the beginning or the end of a program, the services of an organist to play it are usually called upon.

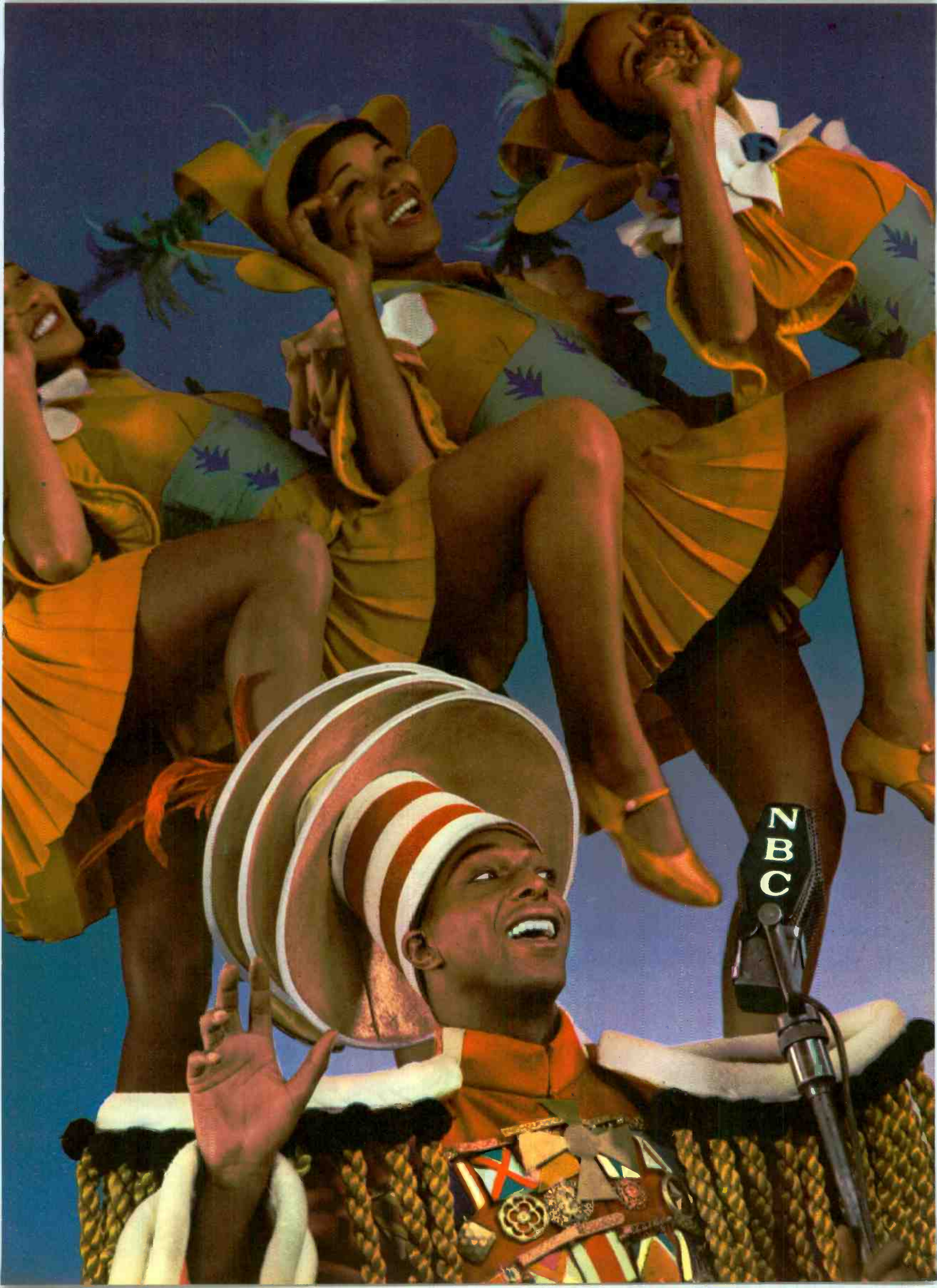
But supposing an orchestra and a conductor are needed. The conductor is hired first. He then may be assigned an orchestra of so many men according to the cost of the program. Or he may be permitted to select his own orchestra. It all depends upon the arrangements of the agency or program department running the show.

The conductor and the production director of the program select the music. It is then up to the conductor to see that the music is obtained the way he wants it. He contacts the station music library to buy any printed music he needs. He sees that certain numbers are assigned to certain arrangers. He checks with the library to see that the music is put properly into the orchestra men's folders, and that it is delivered to the studio in time for rehearsal. He studies his scores.

While all these things are happening to the conductor, the radio script is all finished, and it is being sent to the production director.

The director then casts the script. He casts not by holding auditions, but usually by selecting the actors out of a large card-file of names he has on hand. These cards are very explicit about the abilities of the actors. They tell whether the voice is dark or light, whether it has a giggle in it. They tell how many different kinds of roles an actor can perform. Some actors are very versatile. The best radio actors are.

Maurice Ellis and chorus from The Hot Mikado turn on the heat for the Magic Key of RCA.


NBC

For instance, one actress can not only be featured in a juvenile role, but she can be a little girl of 4 or 5. Another actress can do old women, young girls, middle-aged maids, hired help, a parrot, a pig, and a crying baby.

Some programs that sound as though they had hundreds of different actors on tap, may really use only a handful of tremendously versatile people.

The radio script, at the same time that it is being cast by the director, is also sent to the Sound-Effects department. Radio sound effects are called upon to do many things. They can create the weather, tell the time, set the stage. They give pace to the action, denote transition from scene to scene and give perspective. At their best, sound effects supply a kind of new dimension that brings fresh impact and realism to dramatic presentations on the air.

Sound effects are, mainly, of three kinds: Vocal, manual, and recorded.

Vocal effects are seldom used except in animal imitations. If you need the mating call of the Giant Panda, for instance, you have to hire a Giant Panda imitator. There aren't many of these, so radio doesn't use that mating call much.

Manual effects are rapidly being replaced by recordings. But for the slam of doors, shots, walking, eating and hoofbeats, recordings won't do.

To get the sound effect of a door slamming the sound effects man has a very clever method —he slams a door. A regular door mounted in a heavy frame. Again, for windows opening and closing, he uses a window.

Horses' hoof beats are made by the clomping of half-coconut shells on damp sand, on the sound effect man's chest, or on a marble table top, depending on what kind of hoof-beats are required.

If the script calls for water lapping, or some one swimming, the sound effects man sloshes water around in a canvas tank. If he wants the effect of water running out of a tap, he lets water out of a tank with a tap.

He can make shots by slapping a leather chair with a stick, but most studios now use a special type of blank pistol. He can make the listener believe a bomb has exploded by putting a dozen bb shot in a basket ball bladder and jerking it suddenly upward about three inches from the mike. How that would convey the idea of an explosion we wouldn't know, but the sound effects man says it makes a swell one.

Auto horn effects are made with auto horns, and bells and buzzers are simulated with bells and buzzers. Crackling of flames is done by crunching cellophane, marching men by a mechanism consisting of a bundle of sticks thumped in rhythm on a table. Metallic crashes are made

Thunder to order. The sound effects man beats it out on the drum.

with a box of scrap iron, splintering of wood by smashing berry boxes. Thunder can be made with a regular stage thunder-machine, or by a record.

The more spectacular effects such as moving automobiles, trains, aeroplanes and racing motorboats—once stunts that the sound effects man had to invent apparatus for (isn't that a nice sentence to end a preposition with?) now are produced by sound records, with which the sound effects man is equipped when the script calls for them.

The Sound Effects department sometimes spends as many as five days working to build one sound effect for a broadcast. That closes the subject of sound effects. (Sound of closing door.)

When all these different departments and people are ready—the director with the radio script cast and rehearsed—they all meet together in one large studio for rehearsal.

Of course they have all met before. They have probably had innumerable conferences, and the director may have suggested to the conductor of the music that something might be changed.

When they finally come together, however, one man definitely takes charge. He is the Production Director, sometimes known as the Agency Producer, in the case of a sponsored show, or even the Productioneer. But from this point he runs the show.

He puts together all the pieces as though radio entertainment were a jig-saw puzzle. He cuts out a musical number here, and may even ask the conductor to find another number more appropriate for the balance of the show at the last minute. He slashes words out of the script, he works with the director on the tempo of the dramatic portions.

He sits in the control-booth a part of the time and listens to the show as it comes over the air. While the different parts are going on, he notes down flaws, and then he goes out and tells the people it must be changed.

A radio rehearsal is usually held the day before the broadcast—generally quite early in the morning. It often runs all day. The doors of playhouses and studios where a rehearsal is in progress are guarded from visitors.

A radio rehearsal continues the next day—the day of the broadcast. Again it starts early in the morning. The actors and musicians work right up to air-time, unless there is a necessity to make a change to evening dress. In that case they are perhaps allowed an hour to get freshened up. Broadcasters wear evening clothes only for shows which are held in the evening.

"Dress rehearsal" on a radio show means the last three or four hours before air-time. It is during dress rehearsal that timing of numbers and acts becomes split-second. Little things are shaved off here and there, other things built up, until the whole business goes like clock-work. By dress-rehearsal time, the production director is permanently installed in the control-booth with a stop-watch constantly in his hands. He directs the show from there over what is known as

Sound and fury. Putting shots, thunder, hoof beats, fizzing drinks, sirens, speeding trains and cars on the record for a radio thriller.

a "talk-back microphone" in the control booth, and his voice is heard in the entire theatre or studio.

By air-time everything is as perfect and ready as when you hear it on your loud-speaker.

Of course, all radio programs that you hear on the air are not as elaborate to get together as this imaginary one we have been following. Programs which would fit into the type we have mentioned would be such shows as "Kraft Music Hall", "The Circle", "Chase and Sanborn Program", "Kate Smith and Company", "Town Hall Tonight" and in general all the big night-time variety shows.

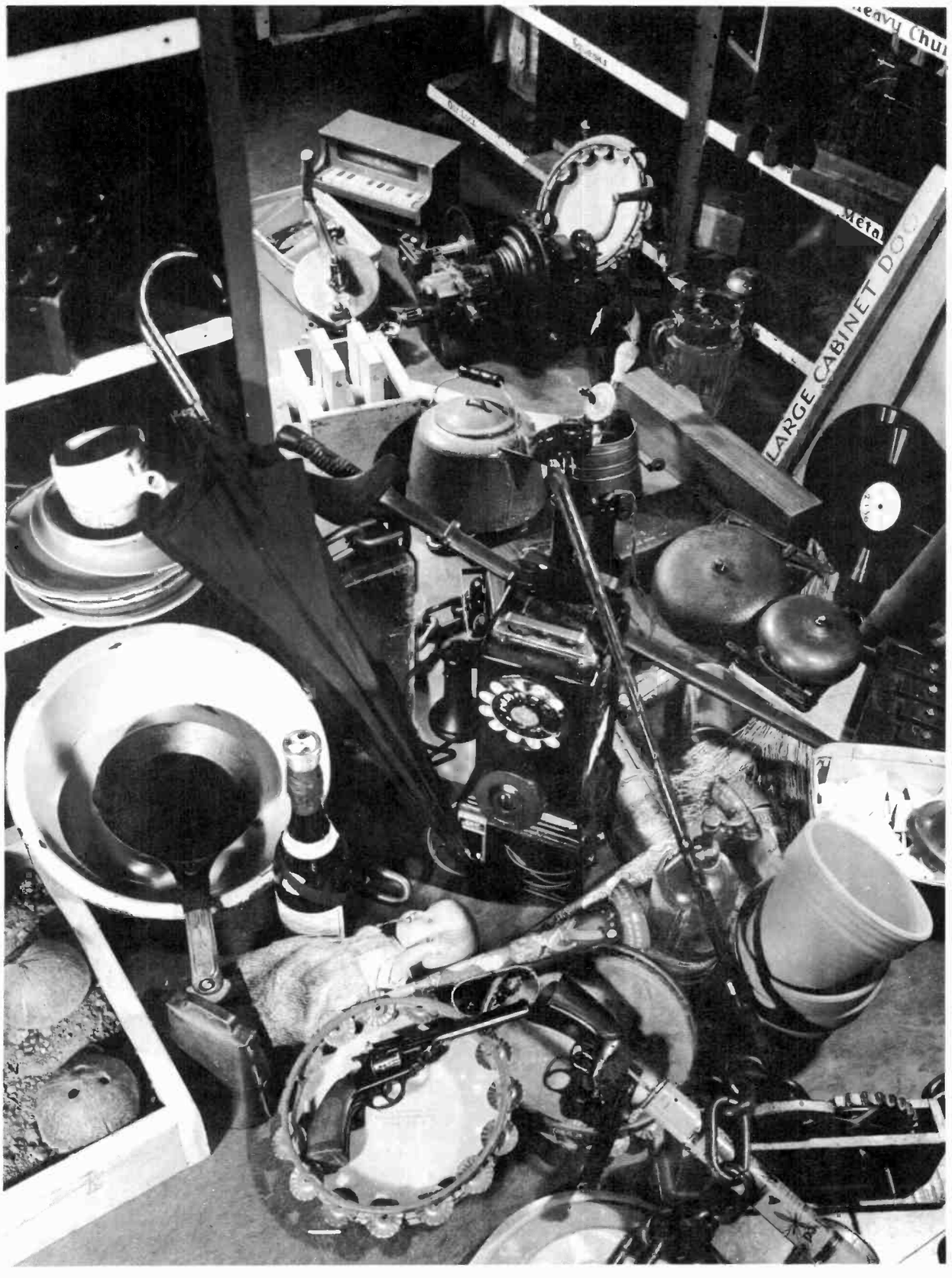
Many others, however, are more on the spur of the moment. They may be created in a few hours. Major Bowes Amateur Hour, for instance, is not rehearsed. The only previous work done on the show is the auditioning of amateurs in order to find the people to be used each Thursday.

"Information Please", "Professor Quiz" and "Vox Pop" are spontaneous shows. So are nearly all the quiz programs. But even they are subject to the red hand of the studio clock.

CHAPTER SEVEN

Gangway for Cinderella

SNIFFING AT THE "CINDERELLA COMPLEX" in American literature is one of the favorite sniffs of literary critics. The Cinderella slant is false, they aver. In life things don't happen that way. And they continue to sniff despite the fact that life constantly and regularly confounds and confutes their contention. They can find a true Cinderella story somewhere in the columns of their daily paper, any day. The only explanation of the critics' stubborn refusal to believe in Cinderella is that they don't read anything in the papers but other literary reviews.



What's that noise? A conglomeration of sound effects apparatus from the Sound Effects Storeroom. Shelves (in the background) are labeled with such intriguing titles as "squeaks" "rattles" "whistles" "wails" "crashes" and "explosions."

If they did, they might, in time, realize that this is a Cinderella country; that pumpkins do grow into coaches between morning and midnight, and that mice change into snorting chargers in an equally brief period. They might find plenty of statistical evidence that the route from rags to riches is often short, and that seven league boots take mincing steps in comparison to the giant strides registered by American business and industry in some of its enterprises.

Of this there is no more convincing, though romantic evidence, than radio. In business history many individual ventures have leaped from nothing to millions in a few years—even, in certain instances, within a few months. But in expanding from nothing in 1920 to one of the major industries of the United States in 1939, radio has set a record which, the figures show, is unequaled and without precedent. To borrow words from those other Cinderella fellas, the movie makers, "it's terrific, it's stupendous, it's colossal".

You can't speak of the statistics of this growth as "cold figures". They glow, they shimmer, they coruscate, perhaps from the meteoric speed at which they have traveled.

In 1920 there were no statistics on radio—or none that mattered. The number of home-made sets was a thing of conjecture, the number of manufactured sets was estimated at possibly ten thousand. The investment represented by receivers was not worth recording, the capital directly devoted to manufacturing was negligible, the amount put into broadcasting was practically nil.

The business couldn't be dignified by dubbing it a "shoe-string" industry. It might better be likened to a very small and feeble caterpillar spinning an exceedingly weak thread into a tiny cocoon.

But you can't call what has been hatched out of that cocoon a mere butterfly. It's more like an eagle—or to carry the simile a bit further, even if we warp it slightly—a multi-motored, 'round the world American Clipper.

In 1920—nothing, except a pocket full of dreams.

In 1938—(1939 figures not yet available) forty million radio receiving sets in use, bringing the total investment by the public in home and auto sets over the period of 18 years, to three billion dollars.

In 1920—sets sold?—A generous guess would be 5000.

In 1938—Six million, with a value of $350,000,000. (Our statistician further estimates that this means sales at the rate of 28 sets per minute.)

In 1920—number of people directly employed in all phases of manufacturing and broadcasting—? Let's be liberal and say 5000.

Radio receiver chassis assembly line. Girls soldering wires and small parts in position.

In 1938—number employed in radio:

Manufacturing	91,000	
Wholesale	25,000	
Retailing	56,000	
Broadcasting	50,000	(this includes talent)
Salesmen and Repairmen	150,000	
Total	372,000	

These are the people directly employed in the radio business itself. How many men and women in steel and wire manufacturing, glass factories, rubber products, fabric and plastic plants, insulation manufacturing, building, lumber, advertising and hundreds of other occupations, owe the existence of their jobs to radio can't exactly be determined.

Here we might digress for a moment in order to point out that the other two Big Cinderellas of business, movies and the automobile industry, starting from scratch, both required nearly forty years to reach their present size. In the automotive field it took twenty-nine years for production to rise from four thousand cars in 1900 to four million in 1929. To increase the total of fifteen or twenty thousand cars in use in 1900 to the thirty million on the road today, took thirty-nine years.

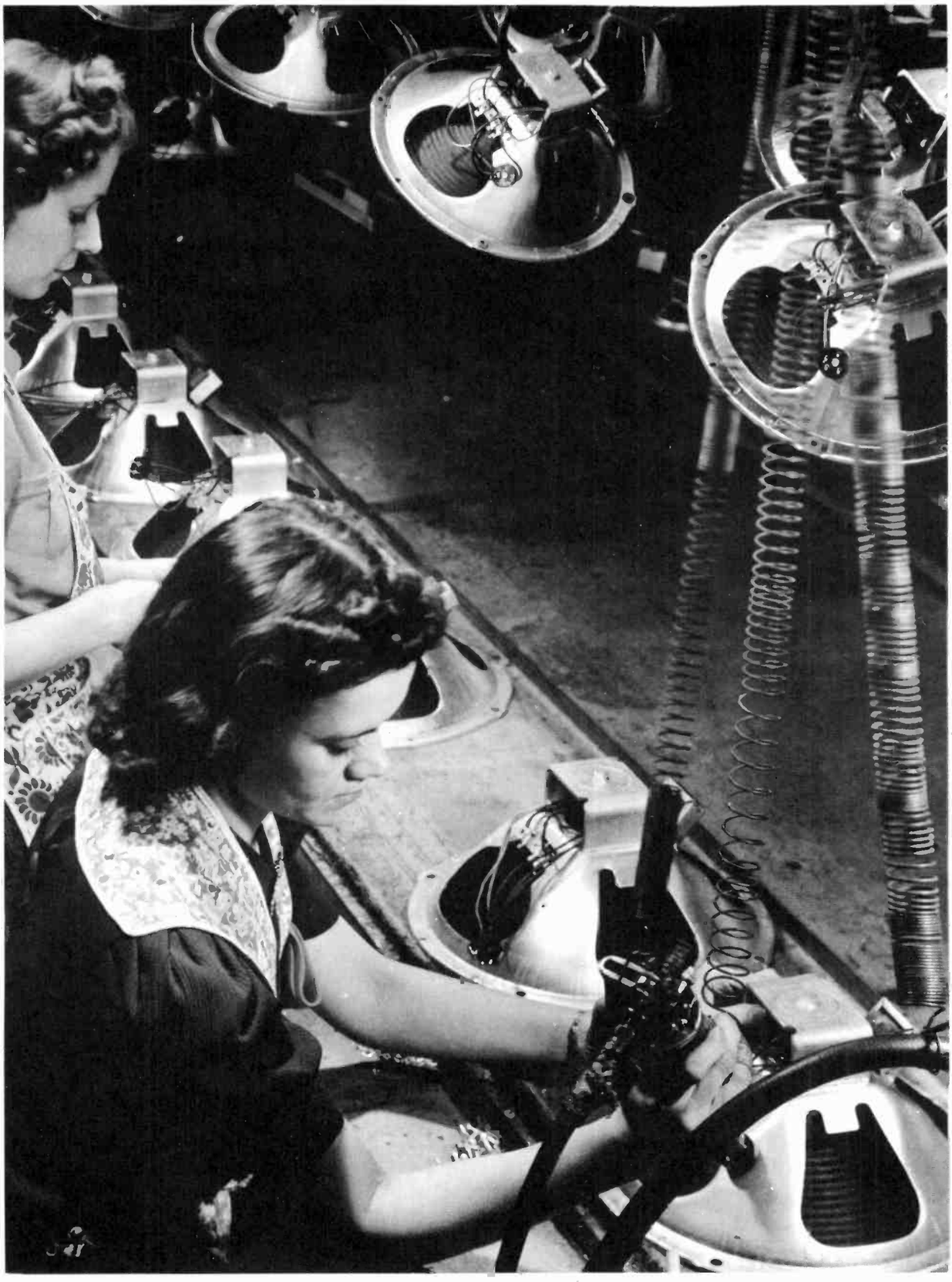
Radio, however, multiplied ten thousand sets into more than forty million in considerably less than half that period.

When we "break down" some of these radio-set statistics, they are even more amazing. Actually, the first year for which definite figures are obtainable is 1922, when 60,000 homes had radio sets, and sales were 100,000. Thus in sixteen years 60,000 had become 28,000,000, and 100,000 had become 6,000,000. (The forty million sets heretofore noted include auto radios, first sold in any quantity in 1931—100,000. Auto radios sold in 1937—biggest year—1,750,000.)

The closer you get to these figures, the taller they grow. For it happens that 1938 wasn't the biggest year in the radio industry. That was 1936, when 8,248,000 home sets and 1,412,000 auto sets were sold. Our period of most remarkable expansion, therefore, contracts to only fourteen years (1922–36) in which annual sales, in radio terminology, multiplied their kilocycles from one hundred thousand to ten million.

Well, that, in general, is the set up on receiving sets.

Now let's glance very briefly at the transmitters—or rather at the number of transmitting stations. Figures on the total number of individual transmitters would be difficult to find, since it would include every amateur sender, every portable, every sound truck.



Assembling loud speakers. Part of the job of making your radio set.

1920—number of regular broadcasting stations in U.S.—1. (KDKA, Pittsburgh)

1938—U.S. Broadcasting stations—763.

Thus while sales of radio sets multiplied about 1600 times since 1920, stations didn't do quite so well. However, the fact is that stations multiplied at a much faster rate than that between 1920 and 1924. From 1 to about 1400. It proved too rapid—a toadstool growth that had to be thinned down by the Federal Communications Commission, as will be explained in another chapter.

In "round numbers" these 763 broadcasting stations represent in plant and operating investment at least a billion dollars, and probably much more.

There are 995 manufacturers of receivers and parts, tubes, amplifiers and transmitters, with an annual turnover of $400,000,000, and an investment that also must be rated in ten figures.

What was a pocketful of dreams in 1900 is now a pocket full of billions.

Let's count 'em, and not too lavishly, either.

Investment in radio sets	$3,000,000,000
Broadcasting companies.	$1,000,000,000
Manufacturers	$1,500,000,000
Retailers	$ 500,000,000
Total	$6,000,000,000

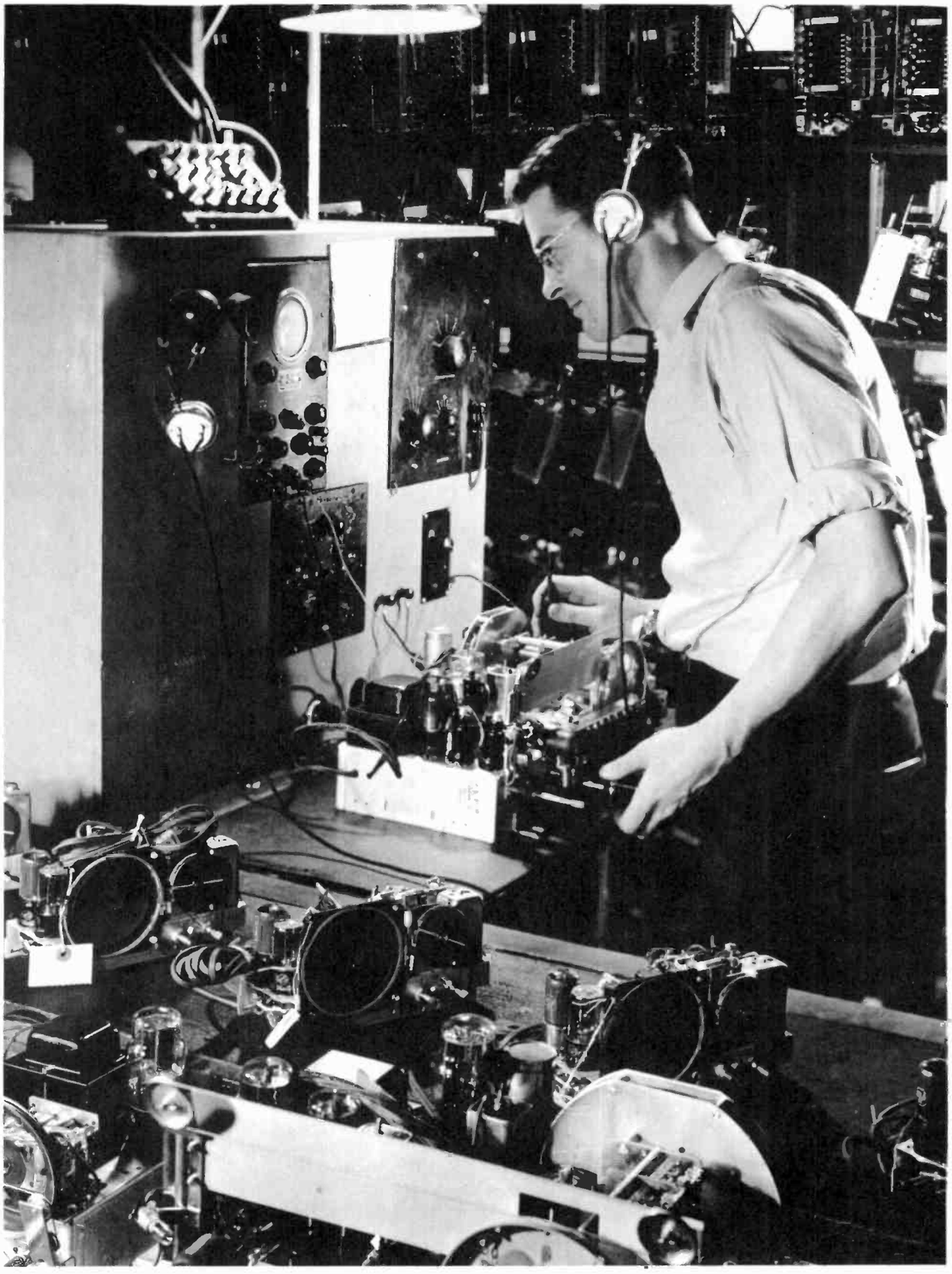
Into this radio pocket, in revenue, and out of it in wages, expenditures for materials, interest and dividends pours $675,000,000 annually.

It may be roughly divided as follows:

Sale of time by broadcasters, 1938.....	$140,000,000
Talent costs, 1938.....	30,000,000
Electricity, batteries, etc., to operate 35,000,000 receivers	150,000,000
6,000,000 radio sets sold in 1938.....	210,000,000
33,000,000 replacement tubes	40,000,000
Radio parts, supplies, etc.....	45,000,000
Servicing radio sets.....	60,000,000
U.S. Public paid for radio in 1938.....	$675,000,000

Some of the items making up these totals are even dizzier in their mathematical acrobatics.

Look at the sale of broadcasting time, for example. To all intents and purposes there wasn't any until 1927, when network broadcasting really began to get going. That year the bill was $4,000,000. In 1938 it was $140,000,000. A growth of 3500% in eleven years.



Radio receiver chassis test. Circuits are adjusted and receiver chassis tested prior to its assembly into its cabinet.

Expenses for "talent".

1921—none.

(Or none of record, except the salary of Milton Cross, first regular announcer at WJZ and still going strong.)

1938—$30,000,000.

There is a curious, but in this case logical analogy between the general trend of the financial figures of radio and those of power in the transmitters. They grew together, and in a ratio fairly similar. While the dollars multiplied, so did the watts, from the 75 watt station of KDKA in 1920 to the 500,000 watt transmitters of 1939.

What a big girl Cinderella turned out to be!

Like the original Cinderella, this one had an older sister. This older sister had done considerable growing before she had settled down, too. This older sister was the phonograph business.

It looked to the older sister as though this young radio Cinderella was not only going to capture her own Prince, but take away all the older sister's beaux beside.

It looked that way also to most of the business prognosticators and a large part of the general public.

It was not only logical but absolutely obvious that when radio got beyond the experimental stage and radio cabinets became general household equipment, phonograph cabinets would gather dust in the attic or mildew on the junk-pile.

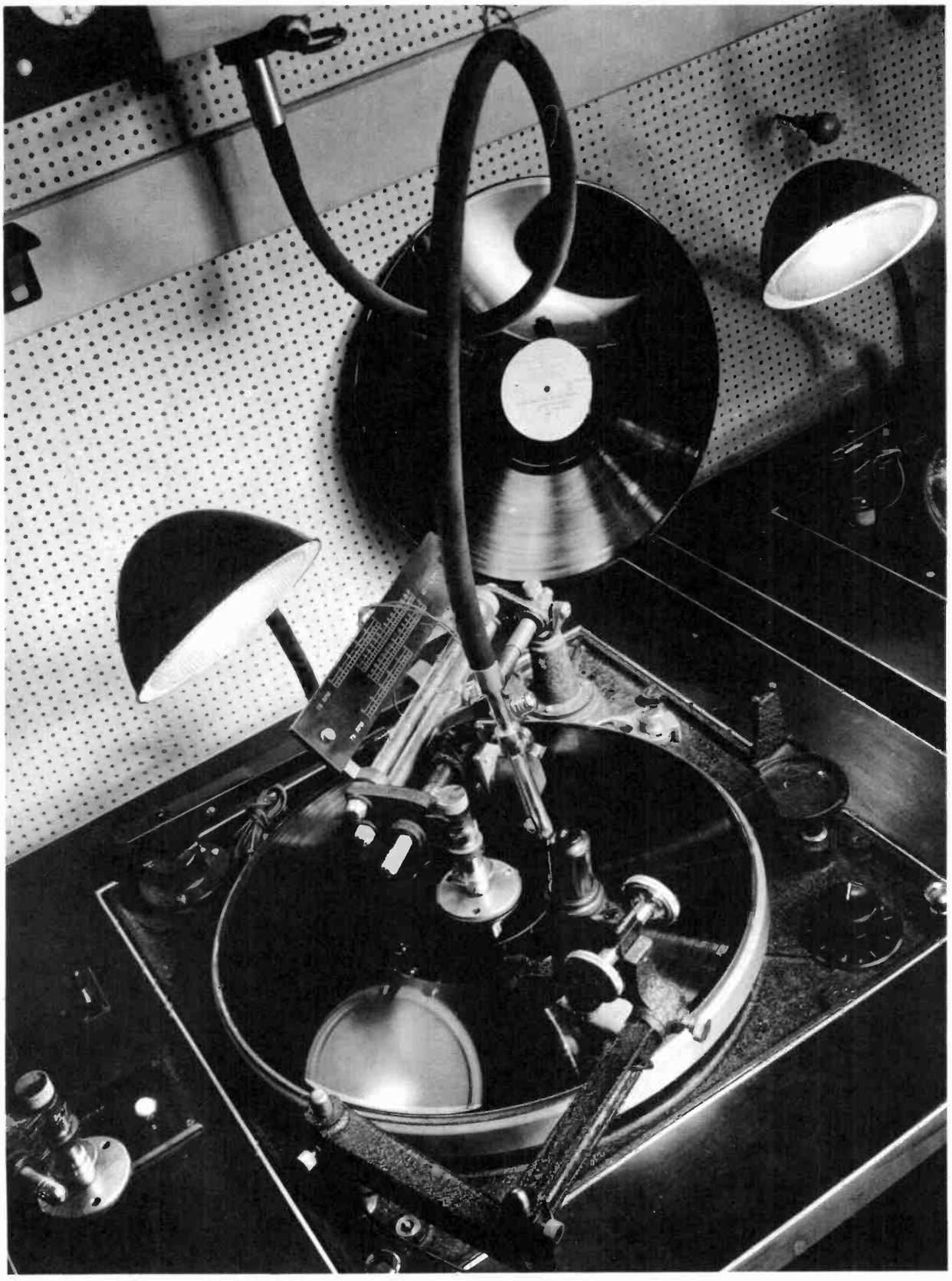
For the first five years of broadcasting, this obvious logic seemed to be functioning as per schedule. There hadn't been much improvement in phonograph instruments or records in fifteen years, and radio—"the new" began to "ring out the old" at a rapid rate. It wouldn't be long now before the final gong, said all the prophets.

But about 1926 this older sister of the radio Cinderella had her face lifted. For fifteen years or so she hadn't done anything much about her appearance, nor made any serious attempt to improve her voice.

Now she had her wrinkles ironed out and went in for voice culture.

In less metaphorical language, RCA-Victor, the phonograph older sister of radio, got out the Orthophonic Victrola. It was the tonal equal of the finest radios, and it had one very important feature that radio couldn't offer. Radio could give people the finest music in the world—but not always the particular music that the individual wanted at that exact moment. The Orthophonic would play what you wanted when you wanted it.

The public began to notice that the older sister, with her new duds and new complexion,



On the air and on the record. A direct transcription of the program is made by this machine.

and the vitamin treatment she had taken, was not such a bad number, after all. And she knew how to suit your moods, too.

Besides which, her voice had smoothed out a lot.

Shifting back to plain speech again, recording had been brought up to date. Phonograph records were now made electrically, by microphone, instead of directly into a horn by the singer's voice. They had new clarity, new beauty.

Sales of instruments and records rose by fifty per cent in two years.

Down they went again in 1930, 1931 and 1932—not because of radio but because sales of everything, including radio sets, went down.

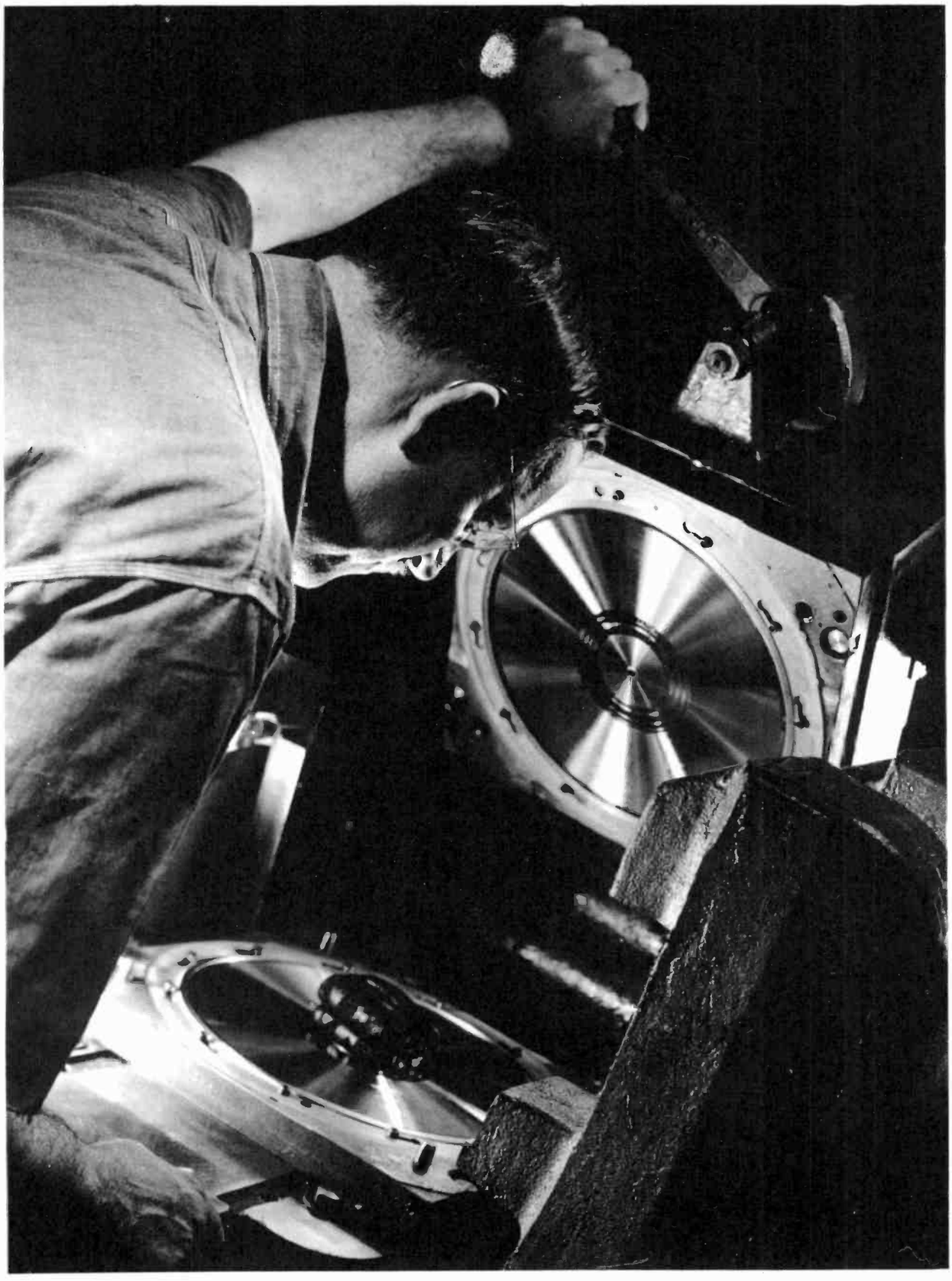
Victor counter-attacked the depression by again improving its recording and redesigning its instruments. Most spectacular of these changes was the record-player which attached to the amplifier of a radio and played through the loud speaker. The device by which a dozen records could be played by a robot that changed them automatically was pretty neat, too.

Victor also informed the world of these changes with a three million dollar advertising campaign.

The older sister was stepping out.

In 1934 phonograph and record sales increased 35 percent over 1933. In 1935 they doubled those of 1933. In 1936 they were nearly five times those of '33, and 1939 they will run to ten times.

And just to give logic one more jolt, one of the chief factors in accomplishing this result was the use by Victor of—radio advertising!



Making phonograph records. The lump on the lower plate is a "biscuit" of plastic material. When the two disks, top and bottom, are closed, hydraulic pressure squeezes the biscuit into a record.

CHAPTER EIGHT

Policing the Ether

ANDREW CARNEGIE said that he achieved his success by getting people who knew more than he did to work for him.

In preparing this chapter on the Federal Communications Commission we frankly avail ourselves of Andrew Carnegie's technique.

For Edward Kirby, of the National Association of Broadcasters, in a brochure he rightly titles, "The A.B.C. of Radio" outlines the functions, and explains the origin of the F.C.C. with such simplicity and clarity, that direct quotation is almost compulsory.

While Mr. Kirby wrote the script, Mr. Neville Miller, president of the N.A.B., will broadcast it for us. Take the mike, Mr. Miller.

Neville Miller speaking: Unlike pathways on the earth's surface, pathways of the air are exactly laid out in accordance with a fixed scientific pattern.

No detours here.

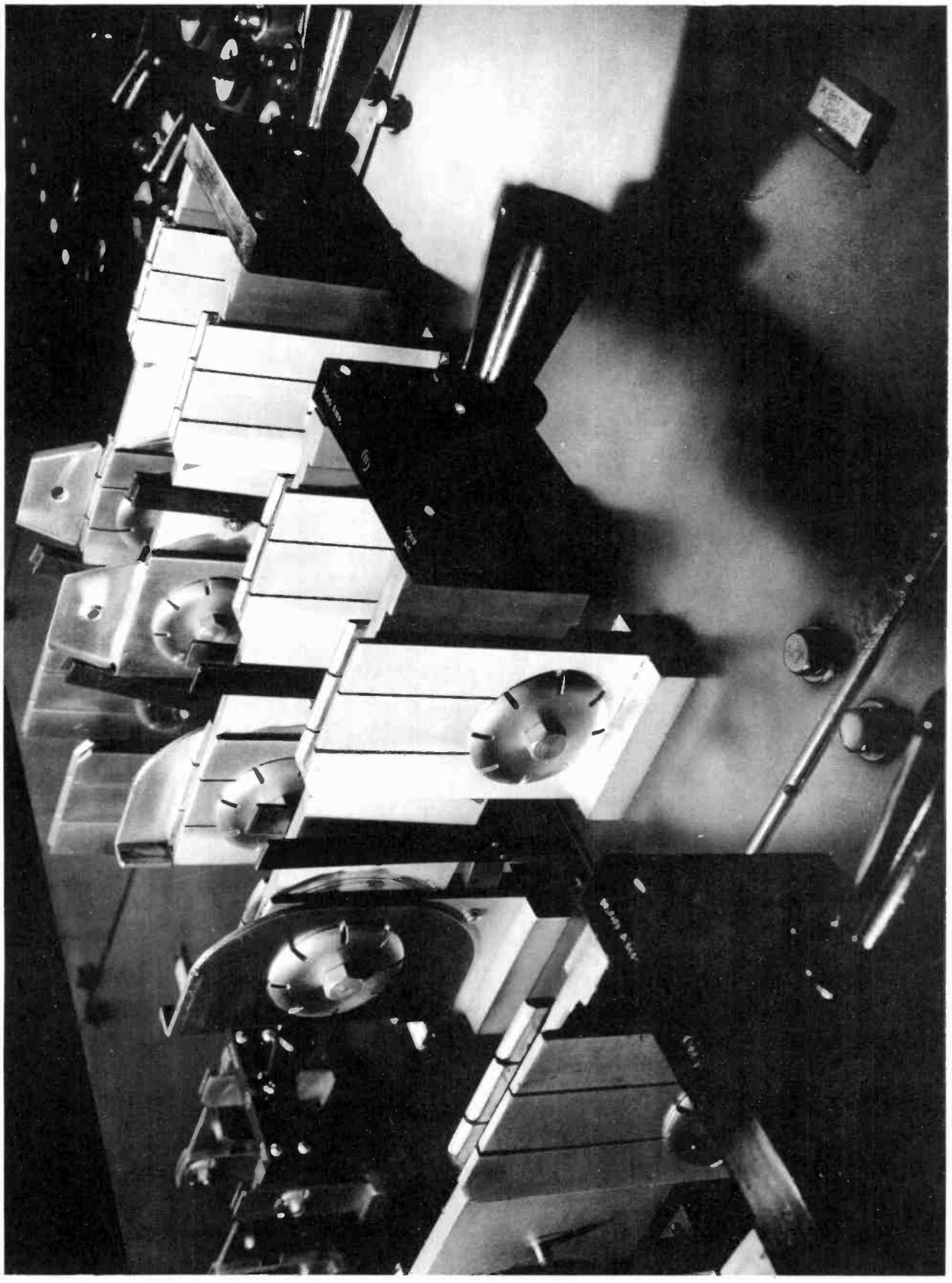
No new highways may be constructed, nor old ones abandoned.

For radio waves travel to our homes over pathways which have existed since the beginning of time: pathways which stop at no international boundary: which penetrate through the earth, and leap through space itself to reach us.

And so man, to use these swift pathways of the air, has had to accommodate himself to the fixed geography of radio.

And next, through international agreement, he has had to parcel out to the nations of the world a fair proportion of radio pathways so that all the peoples of the world could be served. Thus in the United States we find the span of the dial on our radio limited from 550 to 1600 kilocycles.

This is called the broadcasting band.



Main switches controlling low voltage power to broadcasting circuits.

Stations must be separated by a minimum of 10 kilocycles.

If you take the trouble to count, you'll find on the dial that there are 106 channels in this band.

Between these limits we are able to tune in the 763 stations broadcasting within the United States.

But the phenomenal thing here is the fact that these 763 stations are actually sending their broadcasts over but 106 radio pathways!

It is not possible for all 763 stations to reach everybody's home without interference.

This is where regulation enters the picture. . . .

The Federal Communications Commission tells each station over which pathway it may send its program to your home.

It requires that high technical standards be kept. It specifies the number of hours per day the station may operate and with what power.

Things were not always so orderly on the American airlanes!

Not so long ago, anybody in the United States who so wished could start a radio station!

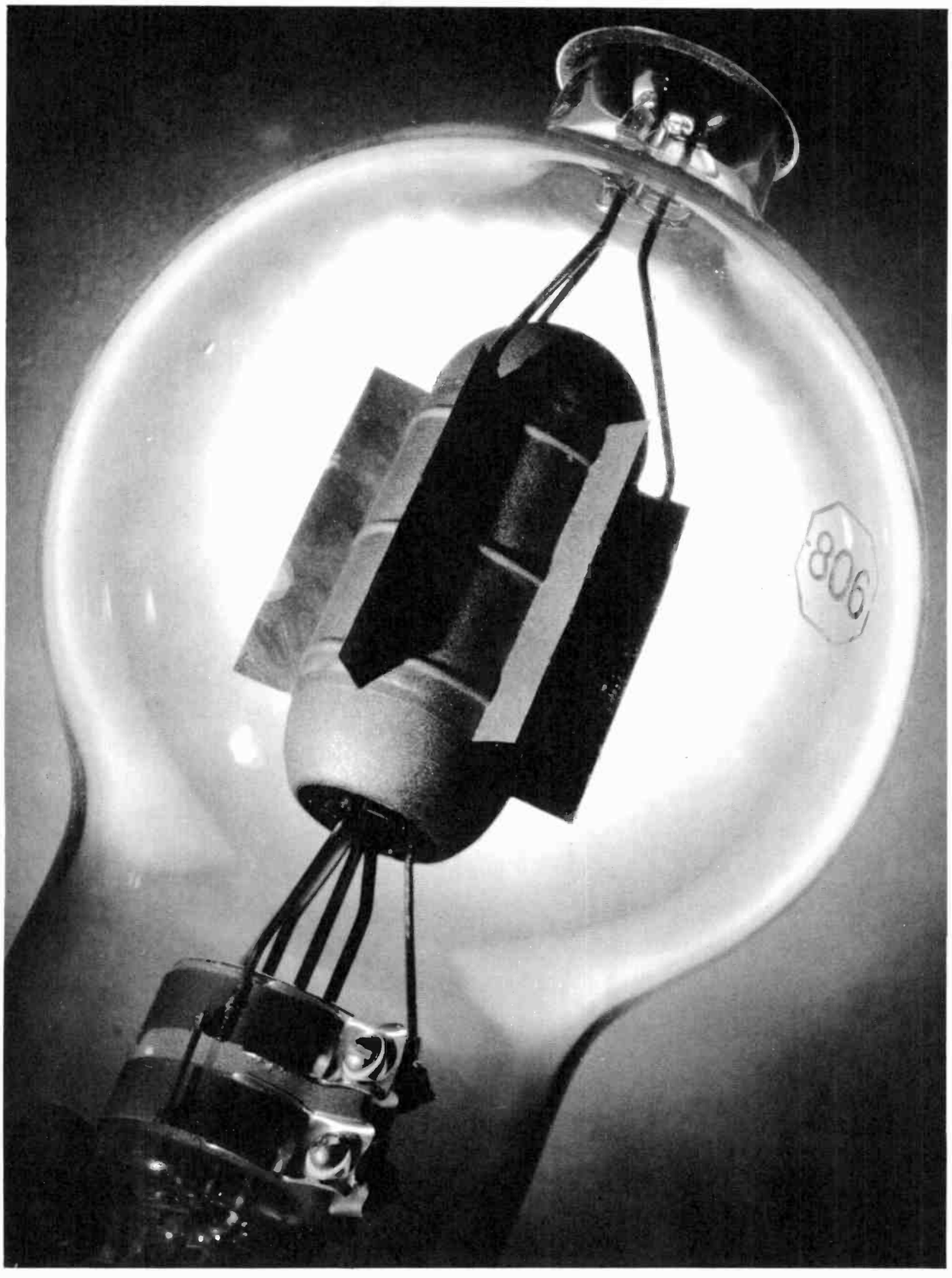
He could select any frequency he desired and begin broadcasting! There was then no traffic cop of the air to tell him to move over to another radio traffic lane; or to get off a one-way radio street. It made little difference whether somebody was already broadcasting on the frequency he chose, or not. He could do as he pleased. The courts ruled that he could!

This was in 1926, when Herbert Hoover was Secretary of Commerce. He had been endeavoring to bring about some orderly use of this broadcast band. Then someone challenged his authority, and the courts ruled that no government department had any jurisdiction of radio! Anybody could broadcast anywhere, anytime.

The result was utter chaos.

The air mushroomed with new stations that had passed no examination—technical, moral, financial or otherwise—as to their fitness to operate. Head on collisions of sound waves shook the ether, and ear-splitting sounds crackled from radio sets all over the nation. There was nothing to hear but noise, and finally the noise reached the ears of Congress.

Take it, Lowell Thomas.



Transmitting tube. The cylinder is the anode. The fins on it carry away the intense heat generated when the tube is operating.

Lowell Thomas: Between 1920 and 1924, as chronicled in our chapter on the growth of radio, stations jumped from one to 1400. In 1925 and 1926 competition and lack of direct revenue—for commercial broadcasting was negligible—reduced this number greatly. But the air was an unregulated jungle. Secretary Hoover had persuaded the broadcasters into a sort of gentlemen's agreement about channels and time, but too many of the signers immediately began jumping other gentlemen's air claims, and the agreement soon dissolved into thin ether. The court decision described by Mr. Miller was the final disintegrator. The fighting broadcasters themselves realized that something had to be done.

Take it, Mr. Miller.

Neville Miller: America needed a "Radio cop" and the first Radio Act of 1927 resulted. It laid an orderly pathway for radio in the United States.

There are 763 American stations.

. . . and 100 air-lanes . . . !

America needed that radio traffic cop!

To tell us where to broadcast and when!

But how was this new officer of the air to know when to turn his red and green signal?

Fortunately, early explorers in the land of radio brought home some discoveries that simplified the job.

They discovered:

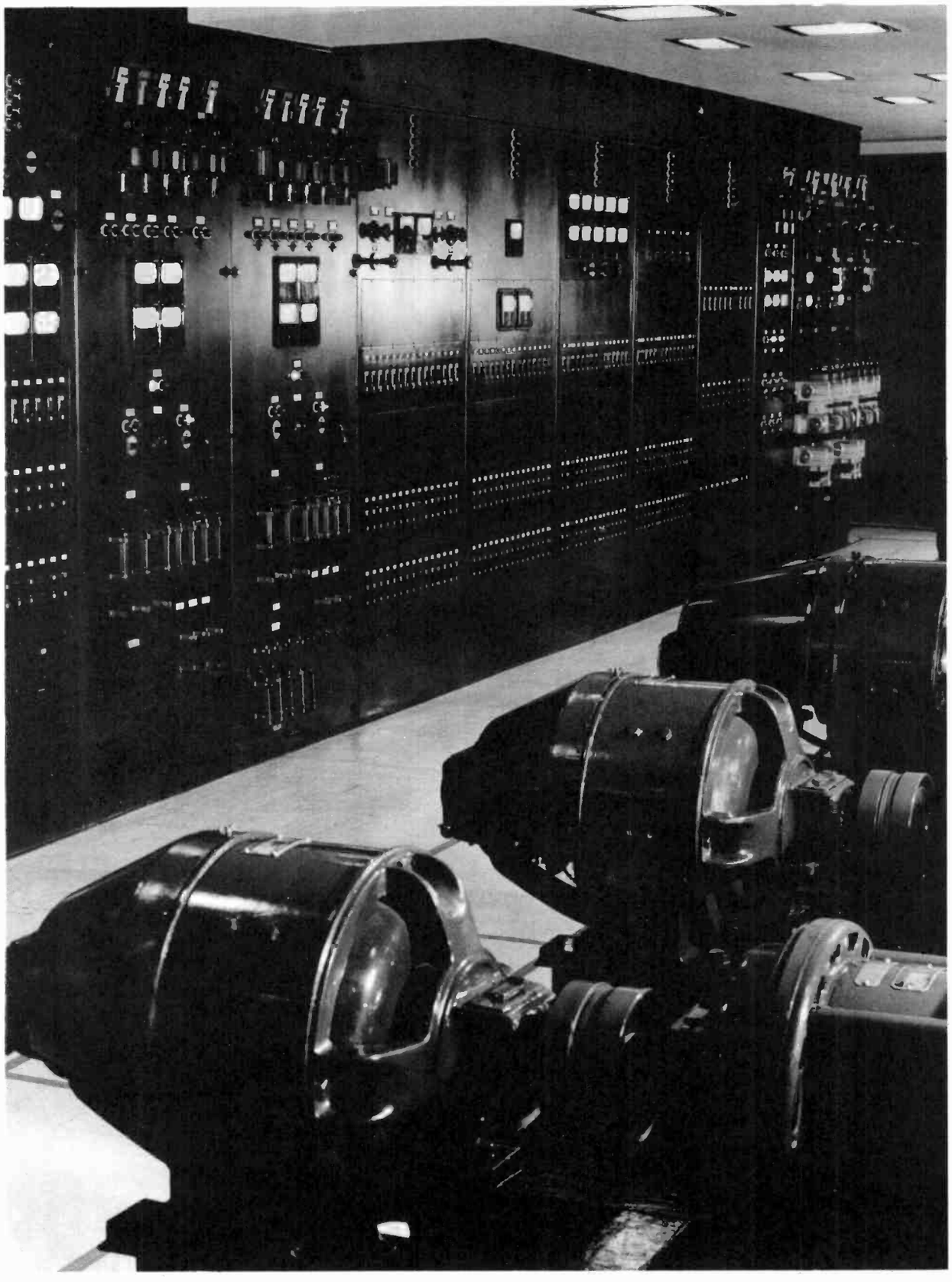
A—That each radio frequency must be separated from its neighboring frequency by a margin of ten kilocycles. Without this separation, radio waves tend to overlap and produce a whistling or a booming noise in the ears of the listener. This is called radio interference. This is why your radio dial is calibrated in units of ten kilocycles.

B—That just as a football player, in throwing a forward pass forty yards puts more power into his heave than he does when he tosses one but five yards, so must more power be put behind the radio wave to make it cover different distances beyond the transmitter.

C—That radio waves travel farther at night than they do in daytime. Rays of the sun affect them.

Now the radio traffic cop had something to work on.

For through the use of these radio discoveries, he was now able to guide the 763



Power plant. Generators and switchboard at a radio station.

radio stations along the 100 American radio highways without danger of head-on collisions and side-swiping interference.

For just such a purpose, Congress created the first Federal Radio Commission in 1927. In 1934 this was supplanted by the Federal Communications Commission, America's radio traffic cop!

But the American System of Broadcasting does not give that cop too much power. Congress gives every authority to the Federal Communications Commission needed for the orderly technical regulation of radio frequencies; it gives it no authority to control what can or cannot be said over the air. (Other than the necessary restraint that no one may utter profane, obscene, or indecent language over the radio.)

The Commission has been given no right to deny freedom of speech in radio. Candidates of recognized political parties must be granted equal facilities of expression by every radio station.

Thus, the American System of Broadcasting is based upon the same democratic ideals which guarantee us freedom of the press, freedom of religion, freedom of speech.

Though Congress provides that licenses may be granted for a three year period, the Commission has consistently issued them but for a six months' period.

Of this the Federal Council of the Churches of Christ in America recently said.

"No administrative government agency is wise enough to be intrusted with the decision as to what people shall hear. Freedom of radio is as important as freedom of the press. If either is curtailed, political and religious liberties are imperilled.

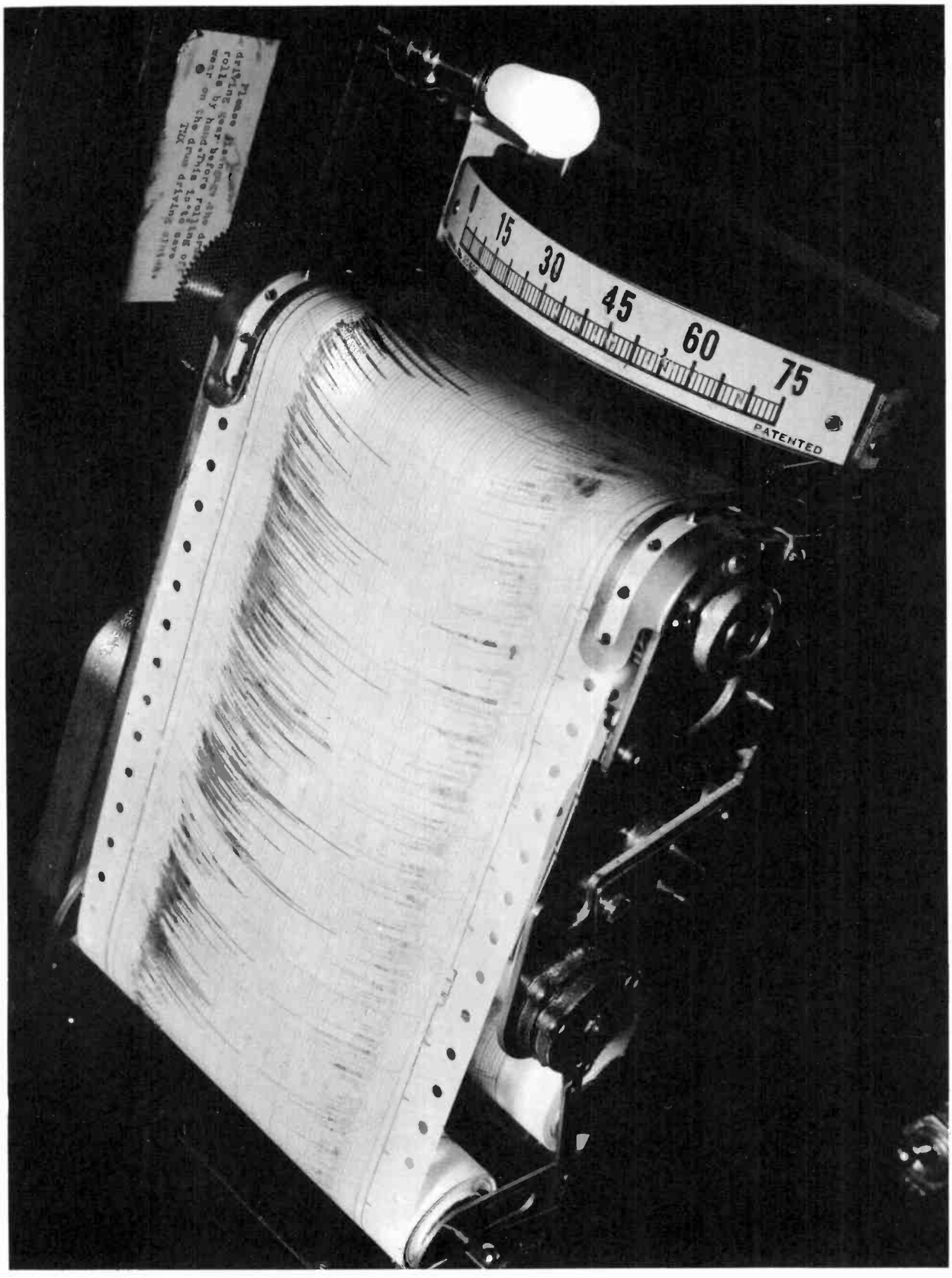
"For this reason we believe any attempt to regulate utterances over the radio by an administrative government agency, except within the canons of decency, propriety and public safety, *clearly defined by statute*, is dangerous and contrary to public policy. Any threat of non-renewal of a license on the basis of programs not yet broadcast we would regard as a form of censorship."

In other words, American Radio is free, and we mean to keep it so.

It is free to bring us swing or symphony; a church service or a comedian—whatever it is we want to hear.

No censor tells us what we shall hear and what we shall not hear.

It gives us both the right to listen and the right to be heard! It is free to be responsive to our wishes in matters of religion, education, music, drama, news, sports, entertainment.



Volume level recorder. An automatic instrument for charting the volume of sound transmitted in broadcasting.

In America we are our own radio censors!

No one can compel us to listen; no one can prevent us from dialing off.

Through the orderly assignment of American radio stations across the dial, we are free to tune from station to station to hear the programs we prefer!

As a result, Americans are getting the finest radio program service, unmatched anywhere in the world . . . without cost . . .

. . . without tax . . .

. . . without censorship . . .

. . . With the mere twist of a dial.

Thank you, Mr. Miller.

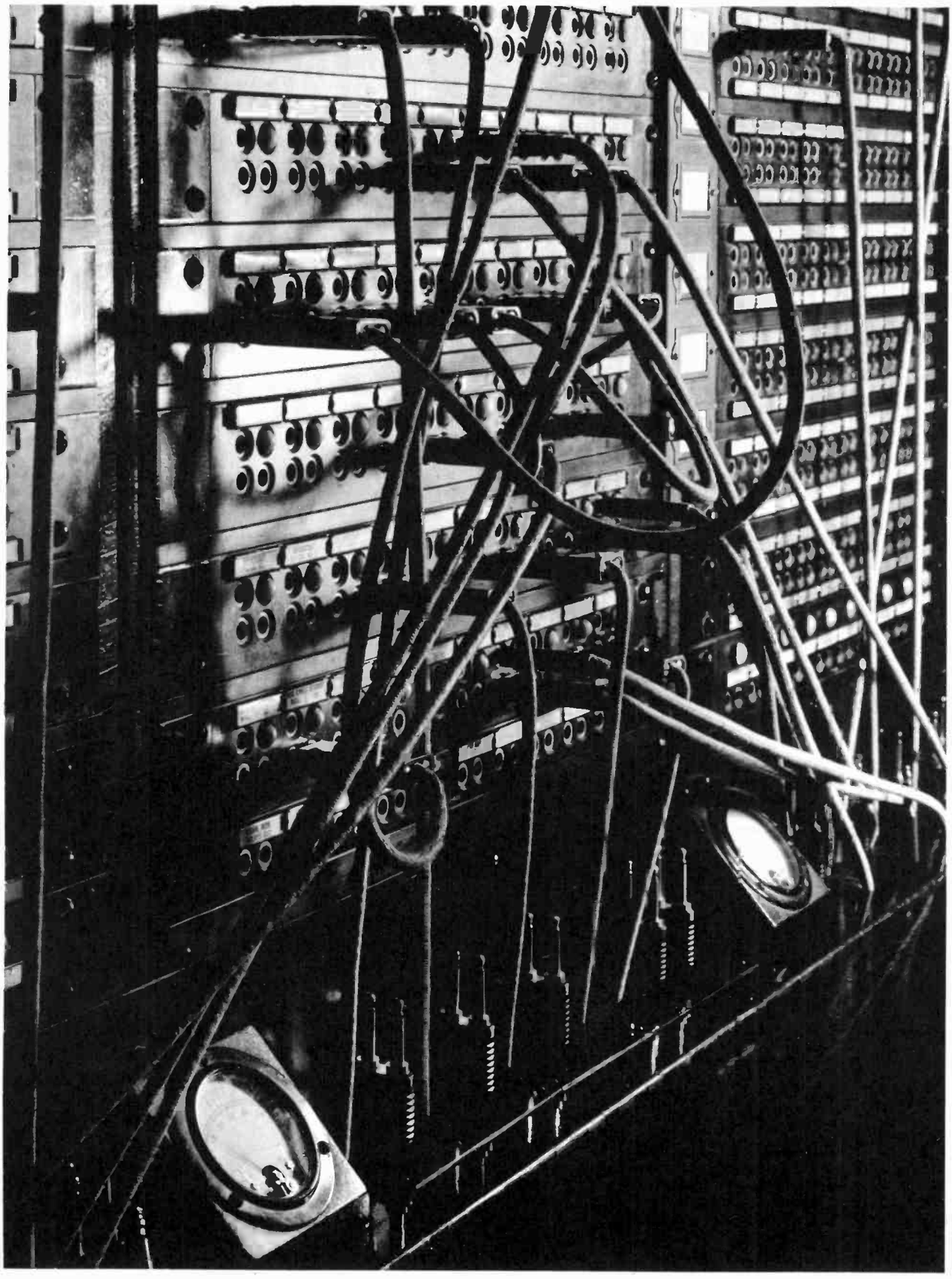
CHAPTER NINE

Network Necromancy

THE FIRST "NETWORK HOOK UP" was in 1923, between WNAC of Boston and WEAF of New York.

Characterizing a single wire connection between two stations—and an experimental one at that—as a "network" is, however, stretching the imagination further than the wire. One line really doesn't make much of a net unless it's badly tangled, and that's no way to run telephone service.

Network broadcasting of a minor-league type developed rapidly to a considerable extent for the next few years, but major-league networks started in May 1926 with the organization of National Broadcasting Company, in which was combined the operation of the broadcasting



Program patch rack. With these cords and plugs the operator can make connections between studios and network channels.

stations of Radio Corporation of America, General Electric and Westinghouse, as well as Station WEAF, which was purchased from the American Telephone and Telegraph Company. This became the National Broadcasting Company in November of the same year, when the Radio Corporation of America bought it.

NBC's original network, now known as the NBC Red, later joined by a second network, the NBC Blue, was sixteen stations, and among its most valuable assets were the commercial broadcasting rights under the basic radio patents of Westinghouse, A. T. and T., General Electric and RCA.

RCA had been created in 1919 with the permission, and almost by the command, of the U.S. Government. War experience had shown that it was not a good idea to have the control of the country's radio facilities and patents in the hands of a foreign nation, even a friendly one. British interests owned a large part of American Marconi.

It was the then Acting Secretary of the Navy who started negotiations resulting in the creation of RCA. His name was Franklin D. Roosevelt. The assets of American Marconi, including patent rights, were acquired by RCA. Cross licensing agreements were then entered into with General Electric, A. T. and T. and Westinghouse, giving to RCA rights under the patents of each of these companies.

The Columbia Broadcasting System was originally incorporated in 1927 as United Independent Broadcasters. It has sixteen stations but no studios. It rented two from WOR.

Independent Broadcasters became the Columbia Phonograph Broadcasting Company later in the same year, when Columbia Phonograph Co. bought it. In 1928 William S. Paley, who was sponsor for one of the first commercials on Columbia, liked the results of radio advertising so well that he bought the network. He is still its president.

WOR was organized by Bamberger's department store in 1922. But the Mutual Network, of which WOR is now a part, was not organized until 1934, when WOR, Newark; WGN, Chicago; WLW, Cincinnati; and WXYZ in Detroit joined forces. Mutual became coast-to-coast in 1936, when it tied up with the Don Lee network in California. It has 113 affiliated stations. Its president is W. E. MacFarlane.

There are twenty three minor-league networks, some relatively as important as the International League in baseball, some distinctly "bush" in size and power.

Briefly that's a Who's Who biography of Networks.

Now we go from Who to What.

What are networks?

Networks are a number of stations joined or "hooked up" on leased telephone wires so

The master traffic board. Here is kept the record of all programs, present and future.

that they broadcast as a unit. A map of the stations thus "hooked-up" over the country, and showing the leased lines joining them, would have the actual appearance of a fine woven net.

Well, *why* are networks?

Because listeners demanded them.

Now the radio fans of the United States are great letter writers—as a radio broadcaster like this present historian has reason to know—but it is doubtful if any of them wrote in to their favorite station and said "We want networks." There were two reasons why they didn't write in this fashion.

First, they didn't know what networks were.

Second, they didn't know they wanted them.

But they did know that they wanted bigger and better programs. The thrill of hearing voices —any voices; or music—any kind of music, over the air didn't last long. Listeners began to want quality. Voices of actors and singers of fame and genius, music of orchestras, jazz or symphonic of high standards, plays, operas, sport broadcasts, news from all over the world.

No business depends so completely on the good will of its public as radio. No other business can be turned off—click—by the twist of a knob. The demand for better programs *had* to be met.

But the kind of programs the public was requiring cost money—a great deal of money. Single broadcasting stations didn't have it, and couldn't get it. Set manufacturers were finding that they couldn't swing the kind of entertainment listeners wanted on the profits from their sales—yet if they didn't put on what fans desired, they wouldn't sell their sets.

Broadcasters did not sit long on the horns of this dilemma. The solution of their problem had already been indicated by the first sponsored network broadcasts in 1925, noted in an earlier chapter.

The answer to the public demand was large scale network broadcasting, NBC, Mutual, Columbia were not organized in any endeavor to hog the air lanes—(as a matter of fact they reduced the crowding.) These networks and others evolved out of the public's insistence on finer radio fare.

In this case logic was sound.

Radio had been proven a good advertising medium in local areas. But single stations couldn't furnish "circulation" enough to justify national advertisers in using them, except experimentally. String a lot of stations together, however, and you have "regional coverage" big enough to attract big advertisers and give them results. Loop a few score together, criss-crossing the land, and you have national coverage—and advertising patronage accordingly.

"Take a letter!" Take a hundred. . . . A corner of the mail room, with a few tons of fan mail being distributed.

It worked out that way. NBC's network grew from one network of 16 stations in 1926 to two networks with 171 in 1939, Columbia's from 16 in 1927 to 115 in 1939, Mutual from the original WOR station to 111 in 1939. Total advertising revenue of this Big Three and the Smaller Twenty-Three increased from $4,000,000 in 1927 to $140,000,000 in 1938.

The bigger and better programs thus financed kept in step with network growth. From the estimated $850,000 cost of "talent"—actors and musicians—in 1927, to the $30,000,000 talent bill in 1938. (And another several million in news coverage, domestic and foreign.)

The people hired as "talent" by all the networks in 1927, numbered a scant hundred. In 1939 the total is close to 25,000. And staffs have grown in similar fashion.

These large broadcasting networks are not actually companies at all. They are organized on the lines of the Associated Press, and consist mainly of individually-owned stations united, for the purpose of broadcasting, in the bonds of telephony. One for all and all for one, and nobody really "boss."

Of the 171 stations in the NBC two networks, NBC owns outright only 10, and leases three. Columbia owns 8 and leases 1 of the 115 that constitute the circuit. Mutual owns no stations whatever, but is an association of 111 different broadcasters.

No monopoly there!

Having shown how the demand for better programs brought about this system, it might be interesting to see, in general, what type of programs they are, and how much people listen to them.

The variety and scope of radio entertainment is illustrated graphically by figures as to the percent of total "time on the air" devoted to specific subjects.

Following is the table.

TYPE OF PROGRAM

Type of program	Per cent of total time
MUSIC	
Serious	6.48
Light	9.95
Popular	32.27
Other	3.75
Total	52.45
DRAMATIC	
General Drama	6.50
Comedy Scripts	.98
Children's Drama	1.63
Total	9.11
VARIETY	8.84
TALKS and DIALOGUES	
Social and Economic	2.33
Literature, History, and General Cultural	2.34
Household and Others of Special Interest to Women	2.68
Farm Management and Others of Special Interest to Farmers	1.67
Political	.31
Others	2.08
Total	11.41

Type of program	Per cent of total time
NEWS	
News Reports	6.56
Sport Flashes	.96
Market, Crop and Weather Reports	1.03
Total	8.55
RELIGIOUS and DEVOTIONAL	5.15

Type of program	Per cent of total time
SPECIAL EVENTS	
Meetings and Occasions of Civic Interest	.77
Sports	1.21
Other	.23
Total	2.21
MISCELLANEOUS	2.28

This is what 28,000,000 families listen to.

How long?

Surveys show they listen an average of five hours a day, or at least the radio is turned on for that time.

When?

Morning, afternoon and night—and, contrary to what you might think, very little more at night than any other time.

Also, despite certain concentrations of big programs on Sunday, for instance, the listening is statistically shown to be about the same each day of the week.

CHAPTER TEN

The Wishing Well

IN GOVERNMENT-CONTROLLED broadcasting at its best (which means the British Broadcasting Company), the public gets the programs the officials think it ought to have. Assuming no political censorship in this, the decision as to what listeners are to hear is nevertheless in a few bureaucratic hands.

In the American system, the listeners get what they want to hear. Oh, not every individual listener, all the time. Of course not. The scientist would like to hear more, and more profound, science. The "long hairs" would like more symphonies and the jitterbugs more swing. But as a whole the "fans" determine what the programs shall be.

The broadcasting "magnates" have very little to say about it. They determine what shall be tried out on the public, but the public decides what it will accept. And if the magnate is high handed and stubborn about his own ideas of what the listeners *ought* to listen to, rather than what they *do*, he will be a magnate without a job, and probably sans a shirt, before long.

But how do they *know* what the public wants?

There are four ways of checking this.

(1) By fan mail.

(2) By the Crossley system.

(3) By the sales resulting from sponsored programs.

The first two can be applied to any broadcast feature, the third, obviously, only to the commercials.

The fourth way is by surveys.

Because the very life of broadcasting depends upon the taste and wants of its public, the great networks—in addition to the daily watch on fan mail, the constant Crossley indices, and the sales-responses of programs—conduct continual countrywide surveys as to listener-habits and desires. There is not much b'guess and b'gosh about it, the broadcasters probably know more about their public than any business except that of life insurance.

By these checks and surveys they know almost exactly how many families own radio sets, and how many own more than one. They also have whole filing systems full of statistics, graphs, charts and summaries, showing to the third decimal point the incomes, capital, and occupations of these families, the age of each group, and probably their favorite color. There is no chance for these figures and charts to gather dust or turn yellow, for no one set of them remains accurate for more than a few weeks. Radio statisticians never grow fusty—it's a job for the alert.

At this time of writing—the figures may have altered a lot at your time of reading—they know that ownership of sets in rural communities has grown, not necessarily with the "business curve", as it does in cities, but in almost direct ratio to the growth of rural power lines.

They know that while approximately 70% of farm homes have radios, as compared to 90% in cities, rural families listen for more hours.

They know that the farmer's bed time has moved from nine to eleven because radio entertainment makes it worth while to stay up. They know that the country listeners prefer symphonic music to hot swing, and old songs, cowboy carols and hill-billy folk-songs to either. They know that they prefer homely, salty humor to "smart-cracking", though many of the most sophisticated programs are popular. They know radio is keeping the young folks on the farm. And they know when the women are listening, when the men are listening, and when the whole family is listening.

About metropolitans they are just as well informed.

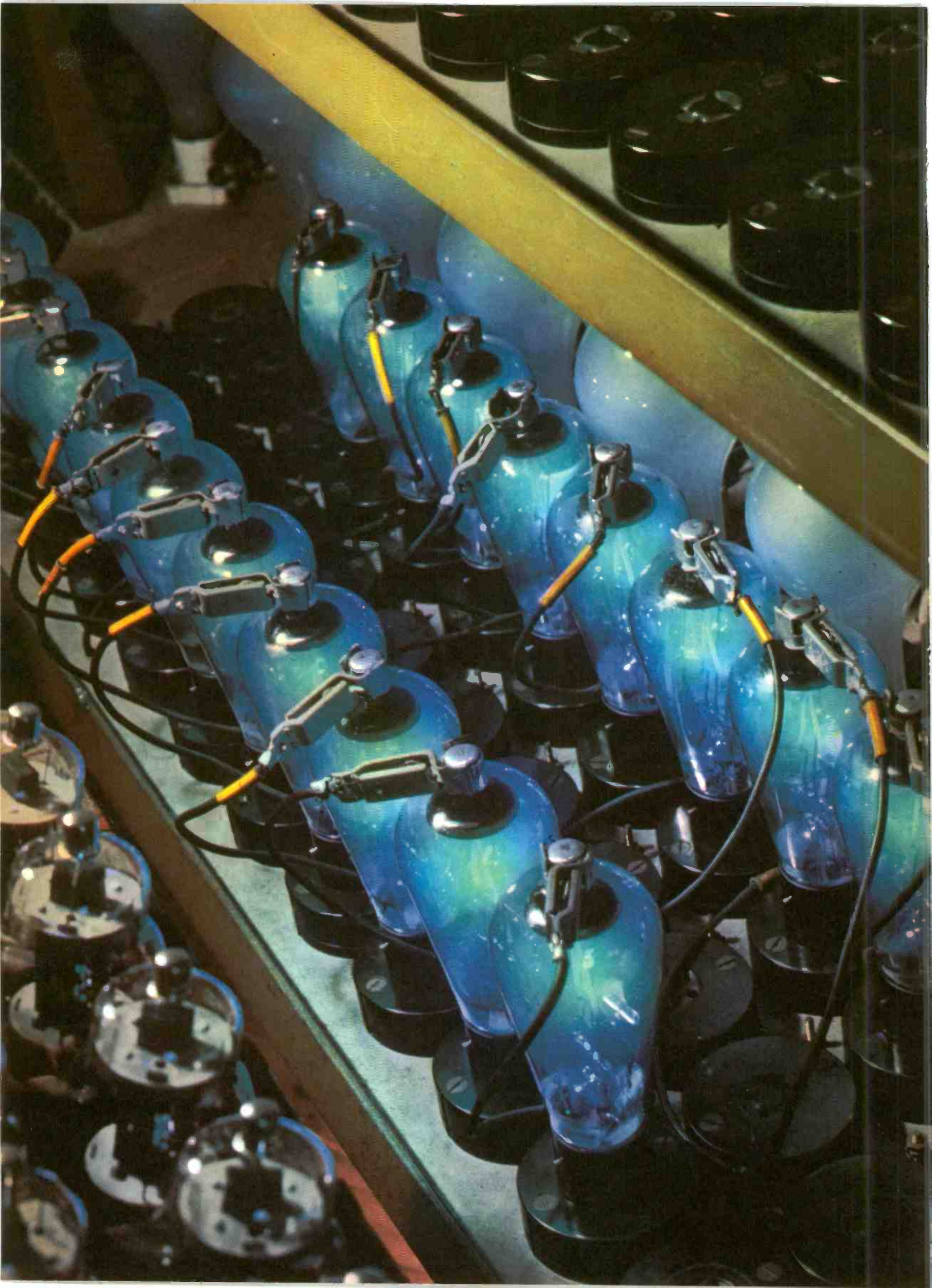
Trained corps of investigators and statisticians are steadily on the job, and their work is regarded as fully as important as that of laboratory researchers and engineers. For all the equipment and all the technical brains on broadcasting staffs would be of no avail if they didn't know and please the public they are trying to serve.

Surveys, however, are long view operations, covering the general trend of public taste and habits. For the quicker reaction to any individual program, the first three methods (and another that has just occurred to us) are followed.

Fan mail, in large quantities, if it is genuine, is a sound indication of a program's "pull". (Although there are companies who manufacture fan mail at so much per hundred letters, seasoned checkers are not usually fooled by it.)

The Crossley system is one of "sampling" listeners. It has been found that a comparatively small number of people, selected by occupation and location, will give an amazingly accurate cross-section of listener opinion. Such a group of people is called up, by telephone, questioned

Illustration on the following page: Seasoning rectifier tubes. These tubes are running at a peak-inverse voltage of 7500 volts. Each tube is operated in this test for a length of time sufficient to stabilize its electrial characteristics.




RCA

as to what they listen to, and queried especially as to the particular program that is being checked.

If the percentage who listen to a daytime program is below 1½% the report is generally "no dice"; 2% to 5% is good; 6%, excellent; 10%, a "knock-out."

At night, percentages must run higher; below 5% is poor; 5% to 10%, fair; 10% to 15%, good; 15% to 40%, a "wow."

Generally the Crossley index will be borne out, in a sponsored program, by sales of the product advertised. But not always—and when it isn't, the program disappears after its original thirteen weeks, and sometimes sooner, unless some other sponsor thinks he can make it pay.

The other method which we recalled suddenly a few lines back is really an extension of the "sales index" test for sponsored broadcasts. When the sponsor wants to find out what the quick rather than the steady response is to his program, he puts on a contest. "Finish in twenty-five words or less the following sentence: 'I like Whosis watsit because—' and win a thousand dollars. No cost, no obligation, but be sure to send in one watsit box top, or a 'reasonable facsimile'!"

There is, so far as we are aware, no instance of the winning sentence or slogan or essay ever being used in subsequent advertising. The broadcaster doesn't make his prize offer to get new copy ideas. His advertising agent can attend to that. He runs his contest to stimulate sales—therefore the box-top stipulation—, and to answer his own question "How'm I doing?"

Stoopnagle and Budd once had a lot of fun with this box top stunt when they were sponsored by a motor car company. They announced some whacky contest of their own, and told listeners to "tear off the top of a Cardiac Sedan and mail it with your entry".

But these contests serve their purpose, and that's why they continue.

The public also registers its opinion actively through groups, associations and formal and informal plebiscites. The National Women's Clubs vote annually on their preference in programs of entertainment and education.

Radio editors register something like mass opinion when they combine the views of the radio departments of the nation's newspapers in a rating of programs.

National Church Conferences, The National Educational Association, the Parents and Teachers' Association, and hundreds of other groups and conventions express officially their views as to what is good, bad or indifferent in broadcasting.

It is a universal subject, universally considered.

How universal the famous case of Orson Welles broadcast of "The War of the Worlds" illustrates. The mythical attack of the Martians on the earth was so dramatically expressed, that

Illustration on the preceding page: Life test of medium-power transmitting tube. A certain number of tubes are picked and operated as long as they will last. An automatic time recorder keeps an accurate account of the life of each.

hundreds of thousands of people—tuning in during the show—thought the synthetic news-broadcasts in the program were real, and got into a large sized panic. This was mainly due to the state of jitters that had been induced by the Munich crisis—then very fresh in people's minds.

At first a loud howl went up from many listeners who wanted to "do something" drastic about this broadcast, but the larger public, when it calmed down, merely laughed at its own excitement, and an enterprising sponsor bought the show.

All these methods indicate how important You, the listener, are to the radio broadcasting business. Basically, you *are* the business. Though YOU as an individual may not like a successful program, perhaps, and you may have been enthusiastic about one that faded mysteriously out of the ether after a few weeks; YOU—the general public—voted one program in and the other out, just as you do a Congressman.

And on the whole, you vote pretty intelligently. You do much better for yourself than the BBC's arbiters of radio taste and art do for the British public. And immensely better than the radio dictators do for their public in Italy and Germany—artistically, and quite aside from their suppression of free speech.

Because the sponsors have to please you or lose money, you get the livest, most interesting and highest quality radio entertainment that the world knows. Not only in the sponsored programs, which constitute but thirty-six percent of radio broadcasts, but in the 64% of sustaining programs which revenues from sponsors pay for.

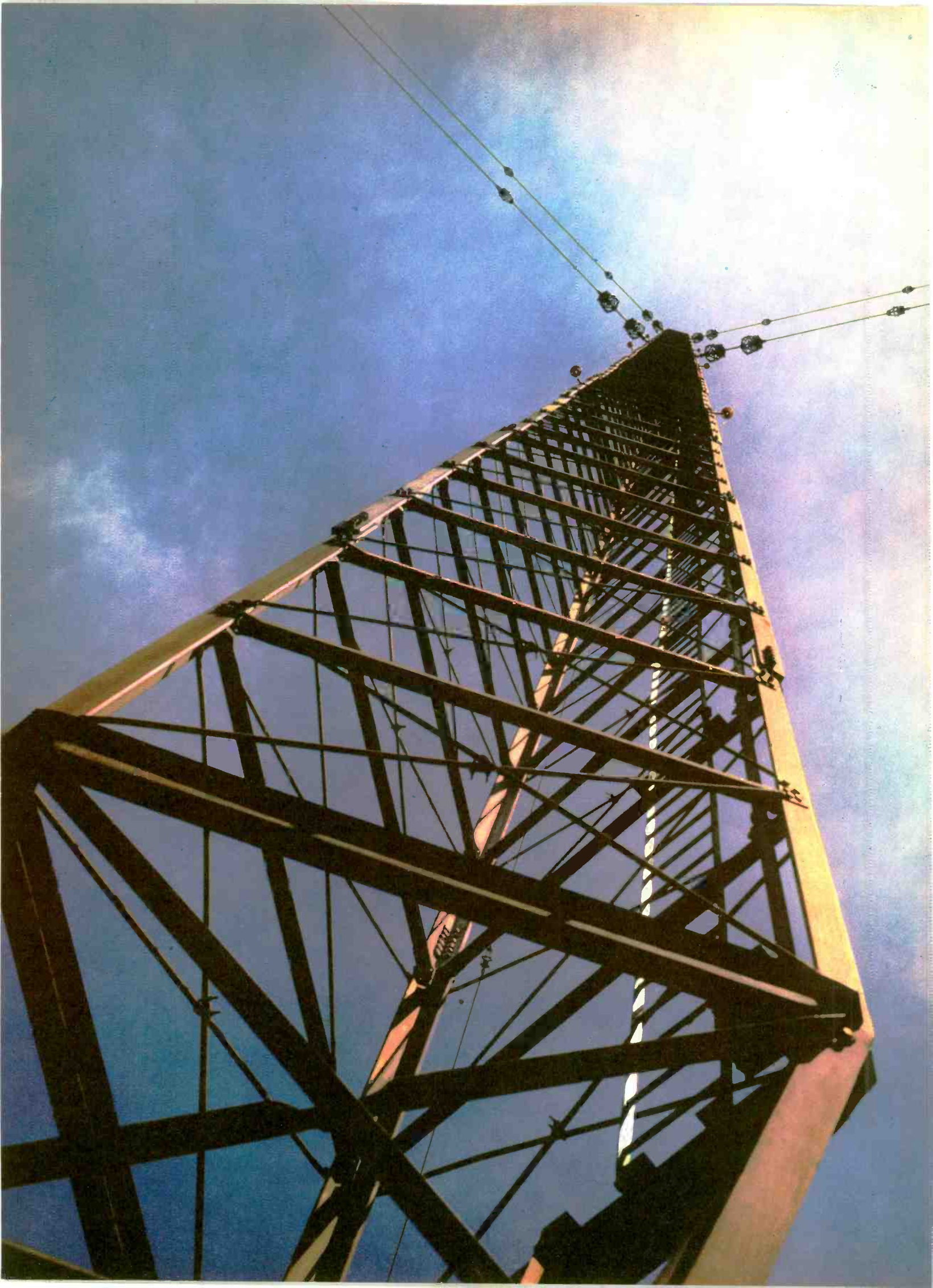
So don't be too impatient with the "commercial plug"—even the too intrusive and frequent kind. After all, it's only two minutes out of a fifteen, and hardly ever more than five minutes out of a sixty minute program, but it pays for that program—with about two hours of "sustaining" programs thrown in as a bonus.

The two hours of sustaining—or unsponsored—programs that are supported by every hour of commercial time, contain the bulk of radio's more "educational" offerings. Though some "highbrow" music—the Ford orchestra for example—is sponsored, most of it is "on sustaining". While certain symphonic orchestra broadcasts, picked up from their own concert halls, are not expensive,—they've got to play anyhow and they've found that radio builds up their future paying audiences—studio broadcasts by big orchestras cost heavily.

News broadcasts are nearly all on sustaining, though some radio reporters like Mark Hawley and Frank Singiser are sponsored. (The first news-broadcaster, KDKA, 1920, was Leo Rosenberg, now an advertising man in Chicago.)

Radio columnists—who specialize in a highly personal "slant" on the news, or who edito-

Illustration on the following page: Station WJZ's vertical radiator weighing about 230,000 pounds and rising 640 feet. The entire structure rests on a porcelain insulator only 15 inches in diameter at the base.



rialize—are nearly all sponsored. Gabriel Heatter, Boake Carter, Walter ("Flash") Winchell, and John B. Kennedy are examples. Sport commentators like Bill Stern and Clem McCarthy also frequently have commercial backing.

But the coverage on big news events, such as a Presidential election, the European crises, the explosion of the Hindenburg, floods and hurricanes, is "sustaining" and costly sustaining, too.

Distinctly educational programs, Science in the News, America's Town Meeting of the Air, the School of the Air; religious broadcasts like the Radio Pulpit and others; talks on art, literature and drama; political discussions, from the President's speeches to those of the president of the board of selectmen in a small town, are sustaining.

Championship football games, world's series baseball, and international tennis matches, as well as important ring battles are frequently broadcast by a sponsor, although many such sports are regularly classed as sustaining.

Sustaining programs of the "entertainment" type are of the same high quality as commercials. They employ the same kind of talent—though at lesser salaries ($18 per performance being the minimum and the maximum seldom, except in special cases, above $50) and are written and produced as carefully. Sometimes a "leetle bit" more carefully, for a sustaining author and cast hope to find a sponsor, as does the studio, and a program for sale needs more selling points than one already sold.

Plenty of these sustaining shows *do* sell to sponsors. Information Please, Paul Wing's Spelling Bee and Professor Quiz are recent examples.

But the percentage remains fairly constant—64 cents of the sponsor's dollar goes for broadcasts that, however valuable they are to the listener, represent no profit to the networks.

The sponsor pays high for the privilege of presenting one ring shows, free; higher for three-Ringling circuses. For a local program on a single small station he may lay down $7.00 for fifteen minutes—a rate of slightly under 50c a minute. For an hour he pays $25.00 or about 42c a minute.

For an hour period on a single big station in a metropolitan area such as New York, he pays 45 times as much. Four hundred and eighty dollars for a quarter hour, figures out at approximately thirty dollars every sixty seconds. For an hour of this same "big time" he must tilt the radio pot with what is known in financial circles as twelve hundred simoleons; twenty cases, bones, iron men, "singles" or, if we must be slangy, dollars a minute—35 cents each second. If the sponsor uses a whole network, and several of them use two or more, he may be paying as much as $30,000 an hour or $500 a minute in the hope of persuading you to buy his product,

Illustration on the preceding page: Tuning in from anywhere to everywhere. Today's portable magic box that picks up the universe.

or merely with the idea, which many national advertisers consider sound, of creating and maintaining your good will, and reminding you that they are in business and glad to oblige whenever you're in the market.

Between the sponsor's desire to get your trade, and your desire to have the most stimulating entertainment, has developed the American Broadcasting System—providing the very latest in magic, by the greatest magicians, in the most sumptuous style.

CHAPTER ELEVEN

The Crock of Gold

WITH THE HOUR OF TIME that the sponsor purchases, at from $25.00 for a small local station, to $15,000 for a national hook-up, the broadcasters furnish a studio and possibly throw in an announcer.

But the rest of the show is on the sponsor. If, to begin with, he wants some big name announcer like Graham McNamee, Ted Husing, Harry Von Zell, Milton Cross, or Don Wilson, instead of the regular company announcer, to do his commercials and play stooge to his comedian, he pays extra—a great deal extra, for these and other tops in announcing command high wages.

Yes, top announcers are expensive—and worth it. They are men with a lot of experience and a heap of personality. They are much more than mere readers of prepared commercial plugs and introductory scripts—though they can do both with a quality of lift and enthusiasm that starts things off with "umph." On some programs they are the em cees—Masters of Ceremonies —and where there is a regular Master of Ceremonies an announcer is his chief aide-de-camp.

Illustration on the following page: Be your own televisor. A smiling visitor makes her first appearance before the Iconoscope camera at the climactic point in NBC's guided television tour at Radio City.


1
RCA NBC
NBC

In some stations they are responsible for the actual electrical "timing" of the show, clearing the air for it and clicking it on and off at the proper instant. On others this is taken care of by the sound engineers. But in all stations, announcers have a lot to do with the dramatic pace and tempo. And not a few of them can do a mean bit of acting themselves—Harry Von Zell on the Fred Allen show, and Don Wilson, with Jack Benny, for instance, each in their time play many parts.

Somebody in radio once said that for each good announcer there were ten good actors, ten good singers and ten good musicians. Which has what Jane Ace calls "the earmuffs of a smart crack," but doesn't really mean a great deal, because there are about thirty times as many singers, actors and musicians as there are announcers.

But they do need a good announcer to pull them together—and sometimes keep them apart —on a program. A show particularly needs a good announcer, quick on the trigger, when something goes haywire. Then he may have to do some lightning adlibbing (talk without written lines), or snap the orchestra—via its leader, of course—into a saving bit of swing.

In announcing sporting events the announcer is adlibbing nearly all the time—aided, of course, by the events that are transpiring. But sometimes the events don't transpire on schedule, and since "dead air" (silence) is anathema (a major crime) in broadcasting, the announcer has to fill the pauses with intriguing chatter. It has to be lively and interesting even though nothing lively or interesting is happening, and on some occasions this sort of ad-libbing has been continued for a steady hour.

The Announcer doesn't have to be quite so versatile as in the early days, when he had to be able to do about everything connected with broadcasting. He got the show together, dug up scripts and music, secured talent, gave out parts, drilled the actors, ad-libbed introductions, doubled in brass and swept up after hours.

He has a more dignified and less varied job now. But it's still a tough one, and the requirements are high. If you have ambitions to be an announcer, the odds are almost exactly one thousand to one against your making the grade.

Here are the basic abilities listed as vital by David Ross.

An announcer must have a clear, authoritative speaking voice, an extensive and flexible vocabulary, and an understanding of the tonal quality of words beyond their dictionary meaning. The "right" word may not be the pleasing word.

He must understand the effect of understatement as well as of emphasis. He must not use "hifalutin' " language. He mustn't get excited in an emergency. He must understand his script.

Illustration on the preceding page: Bill Stern, ace sports announcer, tries a more difficult role of interpreting a boxing contest to a seeing audience that no longer needs a blow by blow description.

He must remember that—though millions may listen—his average audience is a family of three. To be welcome in such homes he must be a gentleman.

In their new applicants nearly all networks require a college education, some knowledge of music, and ability to speak fluently at least one foreign language.

And if you have all these qualifications you can then get yourself, somehow, two year's experience on a small station—for the networks won't generally give you a job until you have it.

After five or six years more, if you have personality, dependability, persuasiveness, charm, energy, adaptability, resourcefulness, brilliancy and luck, you may get into the large money group of announcers for whom sponsors pay extra. Nice work, if you can get it.

With his special announcer secured, the sponsor has just begun to pay.

His star, if he has a star, and he usually has, will cost him from $1,000 to $25,000 for that single hour. If he brings in guest stars, particularly from Hollywood—as half a dozen big programs do; that friendly visit for a few minutes of the hour will set him back from $1500 to $5,000. Nothing in this fast-moving, swift growing business has zoomed faster or higher than stars' salaries. From a "Thank you, George Spelvin—and you ought to be grateful for the publicity we've given you" in 1933; to the 1939 "Thank you, thank you, Mr. Spelvin—here's your check for $5000 and we hope you'll drop in on us again soon".

If the sponsor is putting on a drama—even a little drama—his "leads" too, will be expensive; from $500 to $2500 a performance. And "bit" players, while their union minimum is $15, average about $50 because, unlike the stars, they are paid for rehearsals.

Music isn't cheap, either. Members of any orchestra receive a minimum of $12 a performance, and $6 for rehearsals. But that's merely a minimum. The big time orchestras that are featured on commercial programs are usually star aggregations and are paid accordingly. The music may cost $1500 to $3000 a broadcast.

Which doesn't include the singer, who may draw down from $500 to $5000, and if he or she happens to have a combination of Grand Opera and Hollywood fame, as much as $15,000. The sponsor of a national hook up program is lucky if his hour (talent plus time) costs him only $25,000 and may regard $50,000 as not so bad.

These figures, of course, apply only to the hour or half-hour programs such as Good News, DeMille's Monday Night Plays, the Rudy Vallee Hour, the Bergen-McCarthy Show, Fred Allen, Jack Benny and Bing Crosby.

But for three or five-times-a-week fifteen-minute serials like Easy Aces, Myrt and Marge, and Vic and Sade, the performers seldom get more than $1000 a week. The cost of air-time, however, runs into large money.

Illustration on the following page: Alfred Wallenstein directs the orchestra as Margaret Speaks sings her solo on the Firestone Hour.


NBC

In other words, any large-scale sponsor pays a sizable proportion of that $140,000,000 income from advertisers to talent.

Every so often sponsors talk of reducing radio salaries, saying that they are fantastic. They are. Movie producers have been saying the same thing about movie salaries for many years. They're fantastic, too. But the only power than can reduce them, except for a brief time, is the public. When the public gets tired of a star, that star ceases to draw at the box office, or to sell his radio sponsor's merchandise. Then his salary gets reduced—or he doesn't get any at all. But so long as a star can draw the business, he'll get the salary, fantastic or otherwise. Because if one sponsor won't meet it, another will.

CHAPTER TWELVE

Generating Glamor

THE STUDIO from which this fantastically expensive broadcast goes forth is a far cry from the cement garage, sound proofed with a tent, which was KDKA's first studio.

It is, at a station like WEAF, WJZ, WABC, or WOR—a specially built room that will accommodate an audience of from 150 to 1500 people—and, of course, with adequate space and staging for the performers and the orchestra. According to the type of program for which it is used, its stage will be simply a raised platform, or a regular theater stage.

Calling such a studio a "far cry" from KDKA's original is a little misleading. No "cry", shout, yell or whistle can get into it from the outside, nor out of it save on the radio waves. It is sound-proofed. For perfect broadcasting this is essential. Not only must no sounds sneak in from outside, but no reverberations nor un-licensed vibrations must bounce about inside.

Illustration on the preceding page: Magic City from the Enchanters' Tower. A view from the RCA Building featuring the Chrysler Tower which houses the new CBS television transmitter.

One Long Pan, great Chinese detective, makes a gruesome discovery in the script of Fred Allen's "Town Hall Tonight" program. Troupers from the Mighty Allen Art Players supply the voices of hardened criminals, hysterical women, truck drivers and other dramatic accomplices.

The necessity for such precautions is illustrated by an experiment made by sound engineers with a base viol. With its point slightly embedded in the concrete of the eighth floor of a sky-scraper, vibrations made by its playing were perceptible four stories above and below.

The sound proofing to prevent such vibrations is most elaborate. The latest studios "float" their floors on springs topped with rubber cushions, and fill the space beneath with mineral wool. The studio walls and ceilings are hung on spring hooks, and the spaces between inner and outer walls are filled with sound-proof packing. And over the inner surface is a four inch blanket of fibrous sound absorbent stuff. Doors are double. There are no windows—an air conditioning plant supplies air and keeps the temperature and humidity constant. Clients' galleries are insulated from the studios with three ply glass set in rubber, and control rooms are similarly separated. Communication with the control room is by mikes and amplifiers.

With such a system no unauthorized vibrations have a chance, and no unintended sounds go out on the air.

In another chapter we've described generally the maze of wire and the vast array of equipment by which a program gets on the air, and several times we have mentioned the control rooms, and the Master Control Board.

What are these control rooms and boards for?

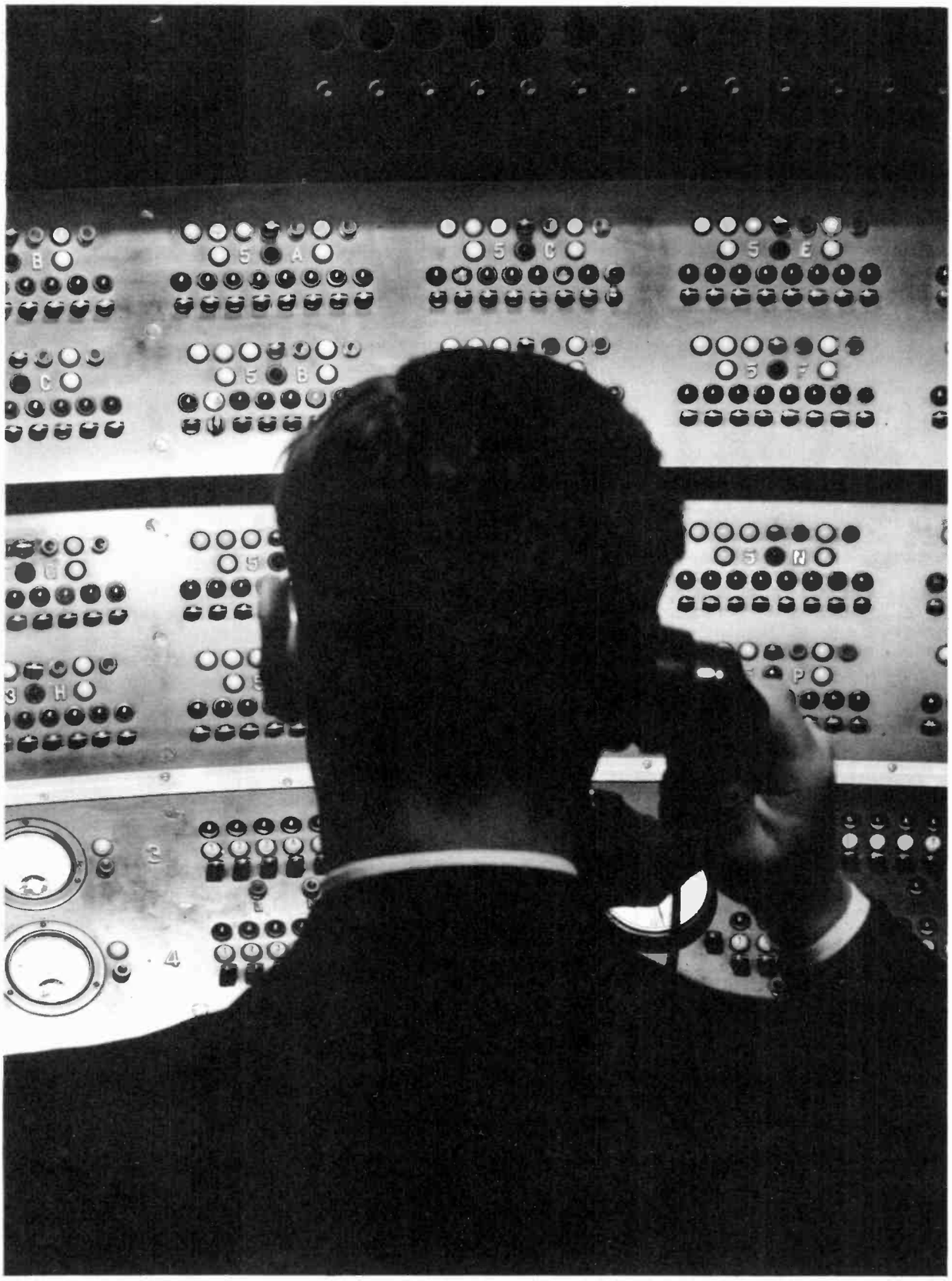
First, they are sampling stations. At their switches and controls sit engineers "sampling" the program as it goes through the wires to the transmitter. They hear it exactly as it sounds in the studio, and their "sampling" is not concerned with its artistic merit, but with its clarity, tonal quality and power. With their keys, buttons and switches they can increase or reduce volume, heighten or lower pitch, in fact tune the whole show pretty much as they please.

Hence, "control" boards.

Only the program being performed in the individual studio goes through the studio control room. *All* programs go through the master control board, which thus acts as a check and arbiter on everything the station is putting on the air.

From the studio control room the engineer in charge can talk to the studio through a loud speaker, and he hears everything that goes on in the studio through his receiver.

During a program, however, he signals manually to the director, through the sound proof window, indicating by recognized motions, whether the tempo should be faster or slower, the music or voices louder or softer, and whether the performers are too near or too far from the mikes. The control-room engineer is a mighty person, and it is well for directors and actors to obey him—for if he so wished he could make tenors sound like baritones and basses like sopranos, he could garble their voices into meaningless gabble, he could even shut them off



Another view of master control desk, showing the multiplicity of lights and dials.

the ether. There is a legend that a control-room engineer once did just that for five minutes. He said he was tired of the noise. Yes, he lost his job.

After its eighteen-hour day the station goes off the air, and most of the personnel go their separate ways. But each night a group of sound engineers checks over the whole system, testing and examining it to see that it is in shape.

In the news department, at least one man is on watch for any big event that may break. During such newsworthy events as the Lindbergh kidnapping, the Windsor-Simpson romance, the Florida hurricane and the Munich crisis, at least thirty announcers, reporters and technical men have stayed on duty all night.

So far as the listeners are concerned, when the announcer says "Good night" the program is over and gone forever. But in the vast files of the broadcasting station is not only a copy of each script, but disk records of every program, sustaining or commercial, and a copy of each piece of music that has been put on the air.

It is out at the station's transmitters—those tall towers shooting several hundred feet into the air—that the night work is most intense. Engineers go over every part of the delicate, powerful and complex equipment. At one transmitting station, struck twice by lightning in one night, nearly the whole equipment had to be rebuilt twice. But the transmitter was working in the morning!

CHAPTER THIRTEEN

Magic Miscellany

DOWN AT THE BOTTOM of nearly every statistical table, however meticulously and minutely itemized, there are generally some final figures unobtrusively slipped in under the category—"Misc—3.010203" or something like that.

Medical reports, corporation reports, even annual bank statements have a way of ending up with that concluding item—"Misc."——

If you've ever tried to keep a household budget, you know how that Misc., at first small, grows at a greater speed than the radio business, until, about the sixth month, it is the whole budget.

It is a convenient and comprehensive word, that Miscellaneous. It is a boarding-house-hash sort of word—it contains everything.

In the case of this chapter "miscellaneous" means the notes on phases of radio we meant to put in former chapters, and didn't, either because there wasn't room, or we put it off. Miscellaneous also means notes we couldn't decipher at the time, ideas we conceived after the first chapters had been put in print, and material which the industrious and efficient publicity departments of various networks continued to pile on our desk after we supposed the two tons of it originally furnished us was all there was.

Miscellaneous means that this will probably be a hodge-podge of a chapter, with very little logic—(but in that, as we've said several times before, it is like radio) and not much sequence. Nevertheless, it ought to make sense, and it might be interesting. If you have stuck with us this long you might as well stay with us as we turn into the home stretch on our miscellaneous way.

One of those notes we had difficulty in decoding ultimately proved to read, "The Paradox of Time." It had been jotted down as a suggestion to be elaborated on in the introduction, but though it didn't seem to find room there, it shouldn't be crowded out altogether.

The Paradox of Time is radio.

With speech—and now visual images—broadcast on waves with the speed of light, man seemed to have annihilated Time. Messages that, only about a century ago, might take three months to go half way round the world, radio transmits, by spoken words, instantaneously. In communication, so far as the earth is concerned, time has ceased to exist. It may take a million years for our broadcast vibrations to reach Betelgeuse, but Calcutta picks them up in a hundred thousandth of a second, and the Betelgeese wouldn't understand English anyhow.

But the paradox is that radio isn't the Master of Time, but its slave. The old man with the scythe is the totalitarian dictator of broadcasting. In the technical and engineering departments synchronization—the timing of one wave with another, the rhythm of one machine with another—is the first and last requirement of successful transmission. In television the factor of time multiplies astronomically as the speed of the electrons increases.

In the producing departments the old boy with the white forelock stands over announcers, actors, musicians and directors—a radio Simon Legree with a stop-watch for a whip. The show must go on—and off, on time. It must also click along in tune with the infinite—that is to say, with the tick of clocks and watches set to synchronize with the march of a million suns.

Or, if you don't care for that stately line, the program has to be "on the nose."

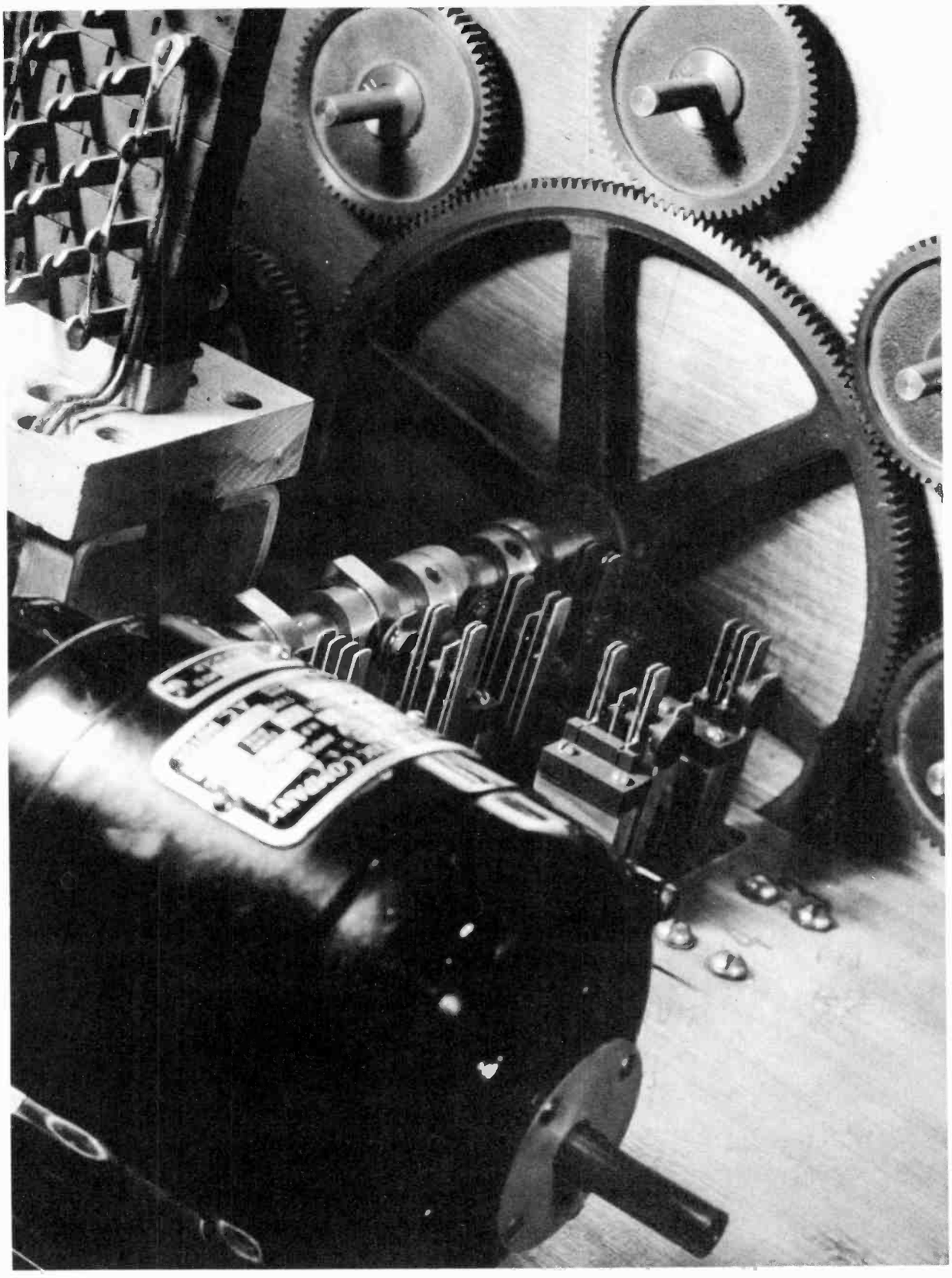
Clock-watchers don't get far in other businesses, in radio nobody but a clock-watcher gets anywhere.

Since clocks are pieces of machinery, the transition to the next item in the notes is easy. It reads "Not a robot machine—people make it."

If recollection is accurate, that note was set down as a reminder for the narrator to clear up any possible misconception as to broadcasting being a process chiefly conducted by automatic apparatus. A number of chapters—particularly those about the technical side of radio and television—might have conveyed such an impression, which wouldn't be true at all.

There is a vast deal of automatic, and uncannily deft machinery used in radio. There are hundreds, thousands, of dials, gauges, governors and rheostats that control, with something very like human intelligence, still other complicated mechanical automatons. But People made them, and People keep them operating. And the more intricately automatic the machinery, the more skilled and intelligent these people have to be.

The New York headquarters of a single broadcasting network has 500 employees in its engineering department alone, of whom 100 are men with engineering degrees, responsible for the "brain-work" of the department. Out of their researches, experiments and inventions grew —and grows—the orderly labyrinth of electrical and mechanical devices that is a radio plant.



Machine Magic. This automatic operator enables a news announcer to clear all channels for a flash by pushing a button.

Out of their heads and those of many others like them this whole great industry has been created.

Their work goes further than that. It is from laboratories and draughting rooms such as theirs that the neon ground lights of a flying field have been evolved, as well as the directional beam, and the whole system of radio communication that makes blind flying possible, and aviation constantly safer.

The plant they design and equip, the operating and directing engineers cause to function and keep functioning. This requires people of no lesser quality, but with a different type of ability.

The other four hundred in such a staff—mechanics, electricians, plumbers, steamfitters—must be craftsmen of high skill. It is a delicate—and sometimes dangerous—job to keep a radio plant at top efficiency, and nothing less is tolerated. Nor can the offices of a radio engineering staff be populated with personnel that isn't the best obtainable. The records are multifarious and complex, and the correspondence is intricate and technical.

There are more people—thousands of them—"behind the front" in this big network. Most of them, even if you're one of the two or three thousand persons who daily tour the networks headquarters, you never see. If your contact with radio is only through being one of the seven or eight thousand in studio audiences, you'll see fewer still.

Where are they?

Several hundred in the accounting department. Keeping the multitudinous details of the inter-station business of a network straight is of itself a major task. And that's a small part of the whole.

Hundreds in the general offices, where policies are made by radio tycoons and assistant tycoons, and carried out by office managers, executive clerks, chief clerks, secretaries, stenographers, typists and—miscellaneous.

Probably at least a hundred in the publicity department, where the Story of Radio is told in copy for newspapers, copy for magazines, copy for mailing and copy for commercial broadcasts. Where it is written in historical, sociological, ethnological and pedagogical form; told in the short story method, and in the style of a novel, and put in booklets, brochures and books, pamphlets and pictures, digests and collections, and arranged in statistics, summaries and recapitulations. To paraphrase Colonel Stoopnagle, "publicity people have more work than anybody."

The copyright department, which has to "clear" all radio programs, would probably declare that the publicity people were comparatively leisurely, however.

"Shooting" stars. Photographing performers for publicity purposes is an important phase of radio work.

Practically everything heard on the air comes under the copyright laws, and making sure the broadcasters—and the creators—of programs are protected is a matter of eternal vigilance and constant investigation. For this the copyright departments must have musicians, literary experts, people who know the theater, the music business, classic or swing, people with wide knowledge of the publishing business, and of course several legal pundits on copyright laws. For the leg work and paper work connected with clearing shows there is a big office staff.

For not only every piece of music and every play, novel or story used in radio has to be "cleared" but every "gag" too. ("However," some wise-cracker remarked, "copyrights only run fifty-six years, so most of the gags are in the public domain.")

Sometimes it is difficult to find who owns a copyright. In that case, the Library of Congress files down in Washington, are consulted—via telegram. Often a search of the copyright owner will reveal that the copyright has run out, or that there is some sort of irregularity which puts the book or play "in the public domain."

Most of the music is cleared through ASCAP—the American Society of Composers, Authors and Publishers of music. ASCAP has a contract with the networks under which broadcasters pay lump sums for performing rights on all compositions by ASCAP members, and ASCAP distributes the money according to the number of times a musical number has been used.

Many composers and publishers are free-lance, outside these large institutions. They have to be contacted directly. A great many modern symphonic works are in this category. Fees on them are paid directly to the composer.

Fees in music range in price—running sometimes to as much as $250.00 for permission on one composition.

Another type of composer outside the jurisdiction of the large publishing protective associations is the man who owns a very tiny publishing firm, publishing most of his own compositions. This man may own one number which is popular in radio. Every time it is done he must be personally wired. There is a woman in Buffalo, for instance, who must be telegraphed for permission every time the number "Schnitzelbank" is done on the air. Her husband, now dead, once took out a copyright on it.

The most familiar numbers—things everybody thinks are public property—are very carefully watched and checked by the Copyright Division. "Sweet Adeline"—that old parlor favorite—is strictly copyrighted. So is "Sidewalks of New York," sometimes known as "East Side, West Side." So is the little children's song, "Happy Birthday to You," sometimes known as "Good Morning, Dear Teacher." Copyright on this number is owned by two school-teachers in the Middle West. This innocent little tune once figured heavily in a radio lawsuit.

Then the programming department, which is in charge of everything pertaining to the creating of the twenty thousand or more programs a big network will put on the air annually, contains several hundred of these unseen people in radio. Auditioning alone requires five or six large rooms for that special purpose, and takes all the time of a number of the employees and some of the "brass hats." There are 25,000 radio actors, and most of them pass through these rooms on their way in—or out. Then there are the semi-amateurs, the newcomers, who want, and are generally given, their chance.

And merely handling the enormous stream of unsolicited scripts that come to a big broadcasting station needs a lot of people.

Practically none of this surging tide of miscellaneous amateur scripts ever merges with the air waves. Radio writing is a professional's job. Trained writers for the stage, the magazines and the newspapers can adapt their technique to that of broadcasting with no great difficulty, though some of the ablest authors find it wise to work with collaborators schooled in making the blind see.

For the radio audience, when within the range of the loudspeakers of its receivers, has no eyes, and the script writer must translate visual images into sound and speech so cunningly that the eyes of imagination will create a picture where no actual picture exists.

For this, only one amateur in ten or twenty thousand has the equipment and still fewer the experience. The infinitesimal fraction of aspirants who break through even then make their first opening through an Idea to be fashioned into a script by a seasoned expert, and not by an already complete manuscript.

These professional radio writers are a small and select group of the unseen people in radio. A program department has a few on regular salary, but the bulk of shows are turned out by prolific freelances like Henry Carlton, Hyman Brown, Peter Dixon, Carlton Morse and Milton Geiger. Or by women like Elaine Carrington, Gertrude Berg and Lillian Laufferty, and perhaps a dozen others who can demand a "by line" from the announcer, or who have to be content with anonymity and a good-sized check.

Then there are the "gag writers", a very specialized and harried lot. In the good old days of vaudeville, a comedian could—and generally did—get along for ten or fifteen years with the same set of jokes, occasionally revamped and repainted. Radio dealt that routine a death blow.

Each performance now requires new japes and wheezes, or those that seem new. Hence the comedians with their teams and sometimes crews of gag-makers and gag-twisters.

Hence the gag-conferences that go on for the week preceding a Jack Benny or Fred Allen show, or those of Eddie Cantor, Burns and Allen, Bob Hope and Fibber McGee. And hence the

cross reference files of quips, cracks and badinage into which the gag writers mine for nuggets that may be smelted into bright golden laughs, they hope.

Rates for radio writing, though they have grown more liberal as broadcasters realized the necessity for better material, are still not as high as top magazine and movie-writers receive. They run from $25 for the average sustaining quarter hour script, to $500 and once in a while $1000 for an hour show. But an hour show may run to nearly ten thousand words, and ten cents a word is not big money in the writing business. Still, the arrived professionals in radio do very well.

Delving through the archives of the program departments, one may find hundreds of stories of the early appearances of Joe Cook, Ed Wynn, Jones and Hare, Ruth Etting, Ginger Rogers, and scores of other present day stars.

Yes, miscellaneous is the word for the program people and their activities.

More hundreds of these behind-the-fronters are in the recording departments, in the typing bureau, where, daily hundreds of scripts must be typed—with many copies—and often retyped several times as authors and directors rewrite them in rehearsal. Still more hundreds are keeping the immense music library in such order that any director can lay his hand on exactly what he wants when he wants it; filing the disk records of each show; filing the scripts of every performance; and looking after the statistical records that, as told elsewhere, cover every detail of the lives of listeners. There are, of course, thousands of other records to be filed and kept—the vast correspondence of the departments already named, and that of others we haven't space to mention.

Yes, broadcasting may run with robot efficiency, but it isn't robots that run it. It's people, thousands of them—human beings, "most remarkable like you"—you twenty-eight million families of people who decide what the broadcasting people shall broadcast to people like you.

CHAPTER FOURTEEN

The End of the Rainbow

THIS BROADCAST of Radio's Magic Show is drawing near the dead line. The red hand of the studio clock is swiftly moving toward the final minute, and the engineer in the control room is signalling to step up the tempo.

Were this a television broadcast—a "telecast"—you would see a studio stage piled with sets, effects and scenic investiture for the projection of many enchantments which our little hour has given us no chance to use.

Even though we are turning the last pages of our script, it is still true, as our first few pages announced, "when it comes to magic, you ain't seen nothing, yet."

Were our program a serial, instead of a one-time performance, we might devote each episode to the story behind each invention that has improved, or revolutionized, this magic industry.

If our program were to stay on the air as long as Amos and Andy, One Man's Family, or Rudy Vallee, we might, after we had finished the story of inventions, turn to the stories of Vallee, or Gosden and Correll, or Bing Crosby or Bob Burns, or Edgar Bergen or Guy Lombardo; Kate Smith, or Maxine or the Pickens Sisters or any of the other Cinderellas who made good.

After six or eight years of that we could start a series of episodes about the managerial and administrative magic of men like David Sarnoff of RCA, Lenox R. Lohr and Merton Aylesworth of NBC, William S. Paley of Columbia, and engineering and technical geniuses (call them genii) like Alexanderson, Zworykin, Farnsworth, Hartley, Colpitt, Goldmark, Popelle and Hanson.

And we could go on for ten thousand episodes, describing what this white magic of radio has meant to the shut-ins, and the sick, and the lonely hearts in far and desert places, and of how it has summoned rescue in time of danger, and brought charity and human kindness to

broken and suffering people from the generous hearts and pockets of their neighbors all over a continent.

And we could go more deeply into the subject of research, and of what we owe to the laboratories and experiment stations on which manufacturers and broadcasters have spent—under the much maligned profit-system—fifty million dollars in twenty years. What state-controlled enterprise matches that?

There are whole libraries and a vast paraphernalia of necromancy in radio that we have not even been able to examine, let alone to use in script or picture.

But perhaps our broadcast has given you a little glimpse into the mysteries of this magic craft, which has touched our lives with its invisible wand of romance. Dictators may have made it a black art for terror and oppression in some lands, but here it is a sorcery which, weird and mighty, far reaching and universal as it is, is controlled by something mightier—the one hundred and thirty million kilowatt power of a free and aspiring people.

INDEX TO PHOTOGRAPHIC DATA ON PICTURES

The illustrations were made with the following equipment and materials:

Rolleiflex—using Panatomic X film—Developer used DK 20

4 x 5 Graphic with Carl Zeiss Tessar 18 cm. Compur Shutter—using Panatomic X film or 4 x 5 Kodachrome—Developer used DK 20

8 x 10 Century View Camera. Carl Zeiss Triple Convertible Protar—Defender XF Panchromatic film—Developer used DK 50

Devin Color Camera—Zeiss Apo-Tessar 30 cm. Eastman plates—Developer used DK 50

The lighting equipment consisted mainly of 6 light portable stands with photoflood R2 bulbs, 2-1000 watt vent lights and occasionally flash equipment.

PAGE	TITLE	LIGHTING USED, F NUMBER AND TIME.
	Frontispiece	*Graphic—Kodachrome F32—3 seconds—late afternoon*
13	*Transformer test. These transformers are used in superheterodyne receivers and accurate adjustment is necessary to provide proper operation.*	*Graphic—F22—¼ second—2 R2 plus daylight*
15	*Testing television. Checking on receiver's efficiency by means of test oscillator and large cathode ray oscillograph.*	*8 x 10—F16—¼ second—6 R2*
17	*Not bubbles—but glass. The girl behind those perfect hands is testing radio tubes for imperfections in the glass.*	*8 x 10—F16—1/10 second—2 R2 on hands—1 R2 beneath table*
19	*The "ham" explorer. A young amateur of 1919 actually gets reception. Crude magic, but it dazzles Dad, too.*	*Devin—12 Flash no. 75—F32 Full flash*
21	*Dr. E. E. Flory examining experimental type of television tubes. These are comparatively simple, only about a million parts.*	*8 x 10—F32—¼ second—6 R2*
22	*David Sarnoff president of the Radio Corporation of America, examining a water-cooled transmitting tube.*	*Devin—6 Flash no. 75—F22—Full flash*
25	*Assembling the mounts of beam power transmitting tubes. Parts are assembled on a jig which aligns and spaces them while they are spot-welded together.*	*Rolleiflex—F16—1/25 second—6 R2*
27	*Loud speaker cone manufacture. Checking voice coil to make sure that it is within necessary close tolerances as to size and roundness.*	*8 x 10—F32—1 second—6 R2*
29	*Loud-speaker response meter. Mr. R. Hackley operating semi-automatic device for checking response of loudspeaker. Charting roll in the lower right corner.*	*8 x 10—F22—¼ second—6 R2*
31	*Dr. H. F. Olson with ultra directional microphone. This device picks up only the sound that is within a 30 degree angle directly in front of it.*	*8 x 10—F22—½ second 6 R2*
33	*These are electron chasers. Dr. J. Rajchman is using these queer appliances to learn which way electrons go and why.*	*8 x 10—F22—½ second—4 R2 on top—1000 watt below rubber table*
35	*Television tinkering. Bottom view of chassis used in television receiver having a 5 inch picture tube. Shows operator on production line soldering connection. Not a simple job.*	*8 x 10—F16—1 second—3 R2*

PAGE	TITLE	LIGHTING USED, F NUMBER AND TIME.
37	*Video chassis of television receiver. Some idea of the complexity of television equipment may be gained from this photograph.*	*8 x 10—F45—5 seconds—2 R2*
39	*The dance as expressed in this graceful ballet of Tamara Toumanova finds a new audience through television.*	*Devin—F32—Full flash—6 No. 75 in reflectors—2 banks of 30 each No. 20*
41	*Lights! And plenty of them. Illumination must be brilliant for television studios.*	*Rolleiflex—F22—1/50 second—Studio lighting*
42	*NBC television antenna array on the Empire State Building. The ring-like antenna at the top is for sound; the torpedo-shaped radiators below launch picture "signals" on the air in all directions.*	*Kodachrome—F11—1/25 second—Photographed thru' 3 x 4 feet mirror extended 8 feet beyond building*
45	*Inside stuff on a television receiver. (1) Mirror on underside of lid to reflect image; (2) Kinescope picture tube; (3) Frame for picture tube; (4) Television receiving chassis; (5) Radio broadcast receiving chassis; (6) Loudspeaker; (7) and (8) Power supply chassis; (9) Interlocking safety switch to throw off all power when back of cabinet is opened.*	*8 x 10—F64—10 seconds—2 1000 watt vent lights.*
47	*Behind the television image. Three Iconoscope cameras operate simultaneously in picking up a live talent show. Push buttons in the associated control room make one picture out of the three camera shots.*	*Rolleiflex—F16— 1/25 second—Studio lighting*
49	*Tamara Toumanova, celebrated ballerina, has a moment's respite during rehearsal of a television sequence.*	*8 x 10—F32—1/10 second—Studio lighting*
51	*W. L. Marshall demonstrates the program director's hand signals (1) O.K.—everything is all right (2) too fast; drag it out (3) bring up the level; louder (4) turning motion of the hand—faster (5) come closer to the microphone (6) the stop watch, the tyrant over the program director (7) on the nose, exactly on time.*	*8 x 10—F11—about 1/25 second—2 2000 watt spots*
53	*Production Director (left) timing the script during rehearsal.*	*8 x 10—F32—¼ second—6 R2*
55	*Edward Everett Horton runs through his script in a rehearsal of the Rudy Vallee Hour.*	*Rolleiflex—F22—1/50 second—6 Flash distributed over set*
57	*Amplifiers. A few of the several hundred in a station which magnify voices and music trillions of times.*	*8 x 10—F64—10 seconds—4 R2*
59	*Sealing together bulb sections of a big air-cooled transmitting tube. The craftsman skillfully fashions the bulb when the glass becomes plastic at yellow heat.*	*Kodachrome type B—F11—¼ second—4 R2*
61	*Master control desk. Part of the intricate equipment by which broadcasts are switched over a network.*	*8 x 10—F32—1 second—6 R2—2 1000 watt vents*
62	*Ray Kinney and his orchestra do a "nemo" from the Hotel Lexington.*	*Devin—F22—1/50 second—6 No. 75—30 No. 20*
65	*Lathrop Mack, night news editor, reads a late press bulletin on the tense European situation in a hastily arranged newscast over nationwide networks. A battery of news tickers supplies the material.*	*8 x 10—F22—¼ second—6 R2*

PAGE	TITLE	LIGHTING USED, F NUMBER AND TIME.
67	*Forty-five seconds left of the last minute. Lowell Thomas gets a visual warning from program director Charles Warburton, that his quarter hour on the air is nearing an end. Hugh James, standing at the control console, is ready with the closing announcement.*	*8 x 10—F22—¼ second—4 R2—2 vents*
69	*Hudson Hawley, news editor of the NBC International Division, scans a press association story for its interest to one or more of the six language groups addressed over short-wave stations X3XAL and W3XL.*	*8 x 10—F22—½ second—2 R2—and daylight*
71	*Main distributing frame. A small section of the frame from which radiate the thousands of miles of wire used in broadcasting.*	*8 x 10—F64—8 seconds—4 R2*
73	*Through the looking glass. The announcer is seen through the Studio Control Room window—reading his script into the microphone while the engineer contacts the Master Control Room by phone.*	*8 x 10—F45—1 second—6 R2*
75	*Heigho, Everybody, this is ——? No prizes for the correct answer, but they hire a keeper for you if you don't know Rudy Vallee.*	*Rolleiflex—F8—1/25 second—4 R2*
77	*A few minutes to go. The Vallee musicians relax, tune up or go over the score before the warning "one minute to go" brings them to attention.*	*Rolleiflex—F16—1/25 second—2 W20 flash*
79	*Maurice Ellis and chorus from The Hot Mikado turn on the heat for the Magic Key of RCA.*	*Devin—F22—1/50 second—6 No. 75*
81	*Thunder to order. The sound effects man beats it out on the drum.*	*Rolleiflex—F16—1/10 second—2 1000 watt vents*
83	*Sound and fury. Putting shots, thunder, hoof beats, fizzing drinks, sirens, speeding trains and cars on the record for a radio thriller.*	*Rolleiflex—F22—1/10 second—4 R2—2 1000 watt*
85	*What's that noise? A conglomeration of sound effects apparatus from the Sound Effects Storeroom. Shelves (in the background) are labeled with such intriguing titles as "squeaks" "rattles" "whistles" "wails" "crashes" and "explosions."*	*8 x 10—F64—5 seconds—4 R2*
87	*Radio receiver chassis assembly line. Girls soldering wires and small parts in position.*	*Graphic—F32—½ second—6 R2*
89	*Assembling loud speakers. Part of the job of making your radio set.*	*8 x 10—F22—¼ second—6 R2—2 vents*
91	*Radio receiver chassis test. Circuits are adjusted and receiver chassis tested prior to its assembly into its cabinet.*	*8 x 10—F45—1 second—6 R2*
93	*On the air and on the record. A direct transcription of the program is made by this machine.*	*8 x 10—F45—5 seconds—3 R2*
95	*Making phonograph records. The lump on the lower plate is a "biscuit" of plastic material. When the two disks, top and bottom, are closed, hydraulic pressure squeezes the biscuit into a record.*	*8 x 10—F22—1 second—6 R2*
97	*Main switches controlling low voltage power to broadcasting circuits.*	*8 x 10—F45—3 seconds—2 R2—1 vent*
99	*Transmitting tube. The cylinder is the anode. The fins on it carry away the intense heat generated when the tube is operating.*	*8 x 10—F45—6 seconds—2 R2*

PAGE	TITLE	LIGHTING USED, F NUMBER AND TIME.
101	*Power plant. Generators and switchboard at a radio station.*	*8 x 10—F45—15 seconds—2 vents*
103	*Volume level recorder. An automatic instrument for charting the volume of sound transmitted in broadcasting.*	*8 x 10—F45—5 seconds—1 vent*
105	*Program patch rack. With these cords and plugs the operator can make connections between studios and network channels.*	*8 x 10—F45—6 seconds—2 vents*
107	*The master traffic board. Here is kept the record of all programs, present and future.*	*8 x 10—F32—1 second—6 R2*
109	*"Take a letter!" Take a hundred. . . . A corner of the mail room, with a few tons of fan mail being distributed.*	*8 x 10—F22—½ second—1 vent—3 R2*
114	*Seasoning rectifier tubes. These tubes are running at a peak-inverse voltage of 7500 volts. Each tube is operated in this test for a length of time sufficient to stabilize its electrical characteristics.*	*Kodachrome—F22—8 seconds—Light from bulbs*
115	*Life test of medium-power transmitting tube. Out of production, a certain number of tubes are picked at random and operated as long as they will last. An automatic time recorder keeps an accurate account of the useful life of each tube in the test.*	*Kodachrome—F22—30 seconds—Light from tube—1 R2*
118	*Station WJZ's vertical radiator weighing about 230,000 pounds and rising 640 feet. The entire structure rests on a porcelain insulator only 15 inches in diameter at the base.*	*Kodachrome—F45—2 seconds*
119	*Tuning in from anywhere to everywhere. Today's portable magic box that picks up the universe.*	*Devin—F32—Full flash—6 No. 75 in reflectors and 30 No. 20*
122	*Be your own televisor. A smiling visitor makes her first appearance before the Iconoscope camera at the climatic point in NBC's guided television tour at Radio City.*	*Devin—F22—1/50 second—6 No. 75 in reflectors*
123	*Bill Stern, ace sports announcer, tries a more difficult role of interpreting a boxing contest to a seeing audience that no longer needs a blow by blow description.*	*Devin—F22—1/50 second—6 No. 75 in reflectors*
126	*Alfred Wallenstein directs the orchestra as Margaret Speaks sings her solo on the Firestone Hour.*	*Devin—F32—1/50 second—6 No. 75 in reflectors and 30 No. 20*
127	*Magic City from the Enchanters' Tower. A view from the RCA Building featuring the Chrysler Tower which houses the new CBS television transmitter.*	*Kodachrome—F45—3 seconds*
129	*One Long Pan, great Chinese detective, makes a gruesome discovery in the script of Fred Allen's "Town Hall Tonight" program. Troupers from the Mighty Allen Art Players supply the voices of hardened criminals, hysterical women, truck drivers and other dramatic accomplices.*	*8 x 10—F32—1/100 second—6 No. 20 flash bulbs in reflectors*
131	*Another view of master control desk, showing the multiplicity of lights and dials.*	*8 x 10—F32—1 second—2 vents*
135	*Machine Magic. This automatic operator enables a news announcer to clear all channels for a flash by pushing a button.*	*8 x 10—F45—4 seconds—3 R2*
137	*"Shooting" stars. Photographing performers for publicity purposes is an important phase of radio work.*	*8 x 10—F32—1 second—3 R2—1 1500 watt spot*

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