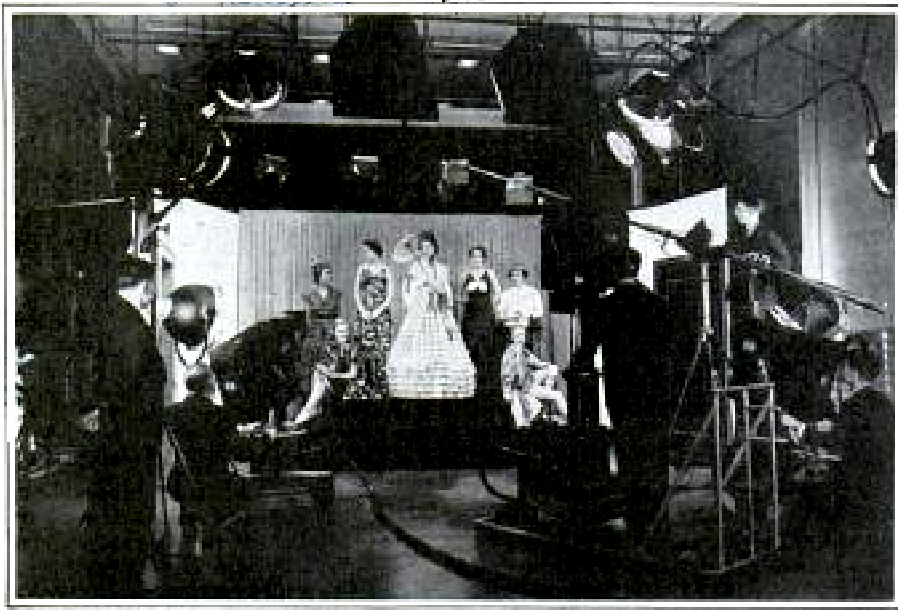
WHERE IS



Photos courtesy National Broadcasting Company

Scene in NBC experimental television studio in RCA building, New York, during a television fashion parade. Eighty-seven programs were telecast by NBC last year

TEN years ago a woman sat under blinding lights in John L. Baird's television studio in London while a group of men, assembled around a receiver in Hartsdale, N. Y., saw her face on a screen.

That radio transmission of a moving picture across 3,000 miles of ocean led many to believe that television, a new Twentieth-century wonder, was about to round the corner and, like radio, enter most American homes. But years passed and nothing of this sort happened. People still are asking, "When will we have television?"

There are three different answers to this question, all of them true. We have television right now—as a laboratory accomplishment. We have it also in the home—but it is limited to the homes of a few experimenters living within a few miles of a few stations. As far as most people are concerned, however, we do not have it at all. And no one knows, even now, when it will be ready for the general public.

Indeed, it might appear to the layman that television has moved backward, instead of forward, since 1928. Baird's historic telecast spanned an ocean, but the pictures which you may see eventually in your home probably will come from a transmitter, the effective range of which will be limited to the horizon line—twenty to fifty miles, depending on the height of the antenna.

If a 3,000-mile telecast was possible ten years ago, why are they limited to fifty miles now? There are several reasons.

Clearer pictures are being transmitted today and they are being transmitted over short waves, instead of long ones. If a wide band of long-wave frequencies were available, and if weather and other conditions are favorable, the range of good television signals is sufficient to transmit a low-definition picture clear around the globe, according to C. W. Farrier, NBC television coordinator.

But to transmit a picture of high definition by short wave and under varying con-

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ditions, the dependable radius of a single transmitter has been found to be limited to the horizon—about as far as you can see. To send a program beyond the horizon without fear of failure, two or more transmitters must be connected by co-axial cable, the only known metallic conductor which can be used for telecasting.

And co-axial cable, capable of conducting fre-

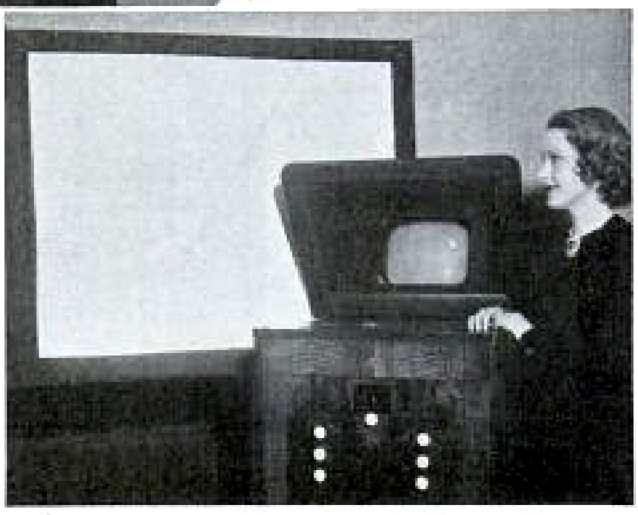
Engineer at control board as he monitors television image. Above, focusing on Miss Patience in television studio before a telecast

quencies as high as 1,000 kilocycles or of carrying 200 telephone conversations at once, is expensive. But this is still inadequate for modern high-definition television transmission. One such circuit now connects New York and Philadelphia, but it will cost millions of dollars to crisscross the country with co-axial cables and link many transmitters together. Until this is done, however, there can be no chain television transmission like the radio broadcasts which go out to a network of stations from a central point.

Also, a television transmitter costs more to buy and to operate than a radio station of comparable quality. And even after these costly transmitters are built and linked together by co-axial cable, only those living within a few miles of the transmitters will be able to receive pictures.

A television receiver is much more complicated than a sound receiver because it must be exactly in step with the transmitter to the millionth part of a second or there will be—no picture. Video, as television may soon be known, is a system of synchronizing and harmonizing many vital parts. If receivers and transmitters do not fit, as a key fits a lock, the system cannot function.

One stumbling block to public television today is lack of standardization. Uniform standards are more essential in television than in sound broadcasting because of the precise synchronization required between transmitter and receiver. Standardization will enable you to "look in" on two or three video programs in your territory instead of only one. Ten standards have been agreed on and a committee of the Radio Manufacturers' Association is attempting to agree upon others which will enable re-



Regulation television receiver and three-by-four-foot screen on which image was "stepped up." Above, "Kinescope" projection tube which cast enlarged image on screen

ceiver makers to provide instruments which will not become obsolete over night.

Despite the rather gloomy outlook for television for the masses in the immediate future, notable advances have been made in the art in recent years. One of the most important was Dr. Vladimir Zworykin's invention of electronic scanning which helped overcome the time element, one of the big problems in television, but of no consequence in sound broadcasting.

In sound broadcasting, Arthur Van Dyck of RCA points out, only one sound is transmitted at a time and this sound, even if it is a complex one, can be represented by one electric current. But no picture can be represented by one current or one anything else because it is composed of many elements. If you look at a scene ten feet square from a distance where the eye can see objects one inch in diameter, there are nearly 15,000 one-inch areas, which you must describe to convey the exact scene to someone else.

Given unlimited time, you might do this with a simple telegraph code. Suppose you arrange a code in which "one" means white, "two" signifies gray and "three" black. By dividing the scene into imaginary squares, 100 each way, numbering them in sequence from one to 10,000, and sending a friend 10,000 digits, each representing the shade in one square, you would enable him to reproduce the scene on a sheet of paper ruled into 100 squares each way.

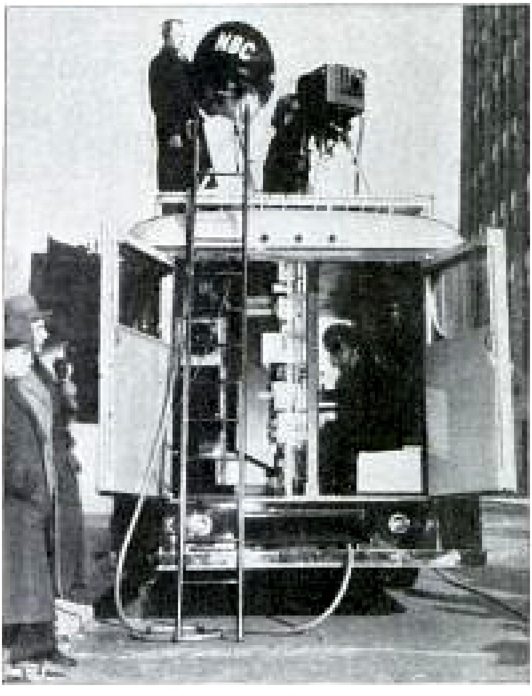
Obviously, this would be a tedious process. If, however, instead of sending numbers by telegraph code, you transmitted one electric impulse for each square in sequence, the strength of each impulse corresponding to the degree of light in the square it represents, you might send a description of the picture in 10,000 seconds, or two and one-half hours, if you transmitted one impulse per second.

At the receiving end a printing device would be necessary to record each impulse in the same order and location and with an ink intensity corresponding to the current intensity of each impulse. The chief prob-

lem is one of synchronization between transmitter and receiver. This is the facsimile system, used on wire and radio, except that several impulses are sent each second, so only ten minutes or so are required to transmit a picture, instead of two and one-half hours.

But here's the rub. Television must transmit moving scenes, sending as many as thirty pictures per second so that, as in the movies, the eye will be deceived into believing it sees a continuous scene rather than a succession of stills. To send thirty pictures per second, transmitting information about each little part of each picture and repeating the process many times each second, a system 18,000 times faster than facsimile is required.

Here we have the primary cause of most of the television engineering problems—the time element, the necessity for transmitting an enormous amount of information very accurately and very quickly. Electronic scanning with the aid of the "Iconoscope" has helped solve the problem.



Mobile television unit which picks up both sight and sound. Top, girl as she appeared before "Iconoscope" camera and the 441-line televised image of girl as it appeared in television receiver

The Iconoscope converts light waves into electricity just as the microphone converts sound waves into electricity. The Iconoscope contains a plate upon which the scene being televised is focused. The surface of this plate is covered with thousands of photoelectric cells, microscopic in size, each separate from the others and each generating electric voltage proportional to the light which strikes it. To use these voltages, they must be collected from each cell.

This might be done by brushing a tiny wire across the plate, contacting the whole area bit by bit. But the idea is imprac-



Photos at top © by Felix the Cat, Inc.

Above, left to right, image transmitted with sixty-line, 120-line and 441-line definition. Dots on map show locations of television receivers in New York metropolitan area which get programs from antenna atop Empire State building, below

tical, partly because of the speed with which the operation must be performed. So a beam of electrons is utilized instead. This tiny "searchlight" travels over the plate, line by line, collecting the electric charge from each cell in turn.

The present standard calls for 441 of these lines on the plate from top to bottom, whereas the first systems had only twenty-four. The greater the number of lines, of course, the greater the detail of the pictures. But the more lines there are to cover, the more work the little beam must do and the more information there is to transmit. It has been found that 441 lines is the best compromise between picture quality and apparatus difficulty and this number has been made standard for this country.

The beam explores the whole plate thirty times per second and there are about 250,000 spots to be thus visited. It "reads" from left to right at two miles per second, and from right to left at twenty miles per second. If your eye could move that fast, you could plow through a 1,000-page book in about five seconds. Thus this beam is about the busiest thing in this world.

The electric currents obtained by the beam from the cells are small but they can be amplified and then you have currents carrying intelligence representing the picture. These currents control the transmitter antenna current. At the receiving end, the entire process is reversed with the aid of the "Kinescope," the inverse of the "Iconoscope."

The Kinescope has a plate and beam of electrons playing upon it, just as does the Iconoscope. In the former, however, the plate or screen comprises one end of the tube itself, is made nearly flat, and coated on the inside with a thin layer of material which fluoresces, or gives off light, when electrons strike it. When the electron beam in the Kinescope strikes the screen in one spot, about the size of a pinhead, this spot glows, its brightness varying as the strength of the beam varies.

That spot of light is used to reproduce each spot of the picture, one at a time. The beam "paints" the lights and shadows of each tiny element of the picture as a series of spots, but to our slowly reacting eyes, the spots are not visible and the screen appears to be illuminated evenly all over. The flying beam of the Kinescope must be in perfect step with the flying beam of the Iconoscope, miles distant, or there will be no picture. Synchronization is one of the television problems which has been solved.

Scenes of any size can be televised by the transmitter but at the receiving end, the size of the picture is determined definitely by the size and brilliancy of the Kinescope screen. At present, there are two standard sizes, one about five by seven inches, the other about seven by ten inches. Last fall, NBC showed television on a seven-by-ten-foot screen, but there is a size limit for the tubes beyond which it is impractical to go. It has been found that the most desirable size of picture for television or movies is one where the height of the picture represents one-fourth the distance between screen and observer. In the home, the desirable viewing distance may be eight or ten feet, so the picture height should be about two feet.

"There is good promise of eventual accomplishment of this goal," says Mr. Van Dyck, "but at present it seems probable that the television receiver which is 'just around the corner' will have a picture about seven by ten inches."

Partly because so much information must be crowded into so small a period of time, tremendously high frequencies are necessary in television. Your light circuit

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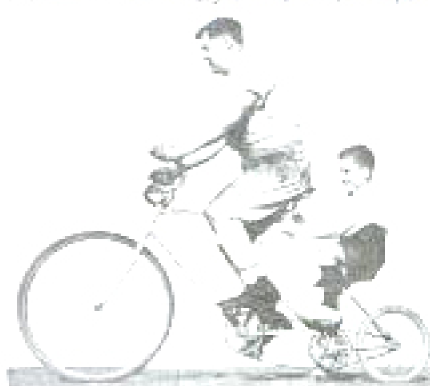
Baby Goes for a Buggy Ride with Trained Cat for Nurse

Proving a cat can be trained to do tricks, "Bum," dressed up as nursemaid, takes the proper pose for pushing the pram

Here is a buggy rated at one catpower. All dressed up in her Sunday best, "Bum," the trained cat, poses at the "controls" ready to take the baby for an afternoon's outing in the pram.

Two Pedal but Only One Steers on Bike with Rumble Seat

Rumble seats for bicycles—a new version of the "bicycle built for two." It is an Australian's idea. The "aft" seat was mounted low for the junior member of the family, who can help pedal but has to let dad do all the steering. The diameter of the rear wheel is only half that of the front.



Here is the father-and-son bicycle built in Australia, a two-level model with the youngster down under

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probably has a frequency of sixty cycles per second—sixty pulses of flow in each direction—but sound broadcast stations use frequencies up to 1,500,000 cycles per second while television goes up around 50,000,000. And radio laboratories are experimenting with frequencies of more than a billion cycles per second!

Some of the most difficult problems of television result from these rapid reversals of current. We think of electricity as instantaneous but it is not. It has a speed of about 186,000 miles per second. So when we call upon a current to travel even a few feet and reverse itself—but to do this millions of times per second—we encounter limitations even in the speed of electricity.

Eighty-seven video programs were telecast by NBC last year. Only about 100 families, however, were able to enjoy these telecasts radiating from the antenna atop the Empire State building because there are only that many receivers in the New York metropolitan area, most of them in the homes of RCA and NBC engineers.

Engineers, designers, cameramen, costumers and directors work with special scene compositions, materials, colors and lighting in preparing a video performance. High-efficiency, non-glare lights have been developed for telecasting but the illumination required for a television scene is still somewhat greater than for the movies.

Most people assume television programs will be accompanied by sound but programs without sound have been found desirable in some instances. In fact, television may take up pantomime acting where Hollywood left it when the movies began recording sound with sight.

While passing through the earphone stage, television needs what radio needed in the days of crystal sets—hams and tinkerers. RCA recently made available to amateurs certain specialized parts, including several Kinescopes, and before long complete television kits containing all the parts for receivers may be available. Once the art emerges from the laboratory, the nation's hams and tinkerers will play an important part in its development.

And what of the hams who perform this labor of love? They will probably be the television—or video—servicemen and distributors of tomorrow.