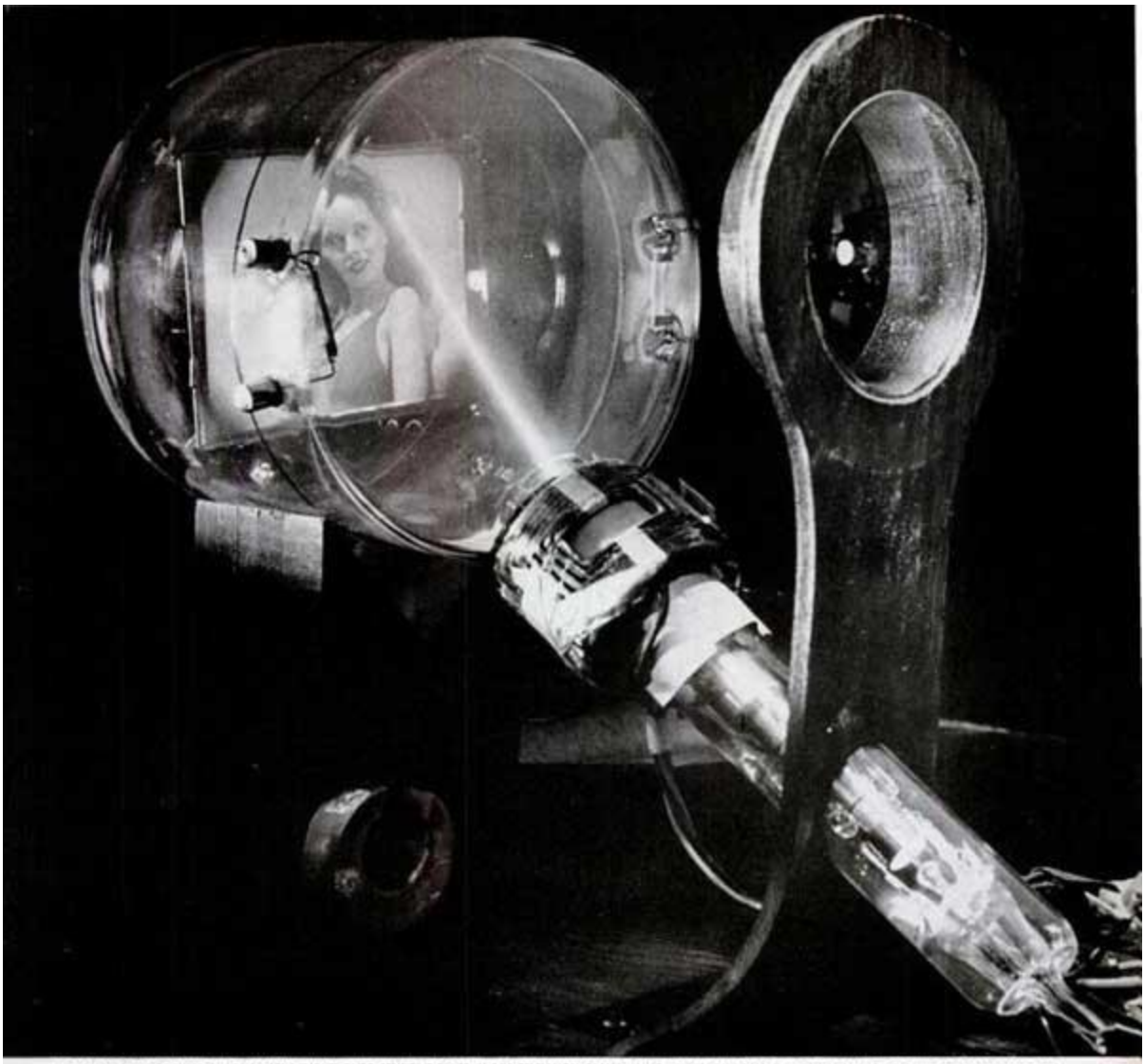


IMAGE OF GIRL IS FOCUSED THROUGH LENS (RIGHT) ONTO SENSITIVE PLATE IN RCA TELEVISION CAMERA TUBE. ELECTRON BEAM, ITS PATH SHOWN BY GLOWING GASES, SCANS PLATE

TELEVISION

THE NEXT GREAT DEVELOPMENT IN RADIO IS READY NOW FOR ITS ENORMOUS POSTWAR MARKET

Within the first postwar decade television will be firmly planted as a billion-dollar U. S. industry. Its impact on U. S. civilization is beyond present prediction. Television is more than the addition of sight to the sound of radio. It has a power to annihilate time and space that will unite everyone everywhere in the immediate experience of events in contemporary life and history.

The diagram below shows how television works. The process of televising starts with a camera tube in which, as in any other camera, a visible image of the subject is focused through lenses on a light-sensitive plate (*see also cover*). A beam of electrons is projected onto this plate and scans the image in a series of horizontal lines from top to bottom. The beam induces the plate to generate an electric current which varies in intensity with the values of light and shadow in the image at each point along each line. The information thus impressed on the electric current is amplified and then broadcast as a radio signal. In the television receiving set a picture tube (*shown on next page*) translates this information into a once more visible image.

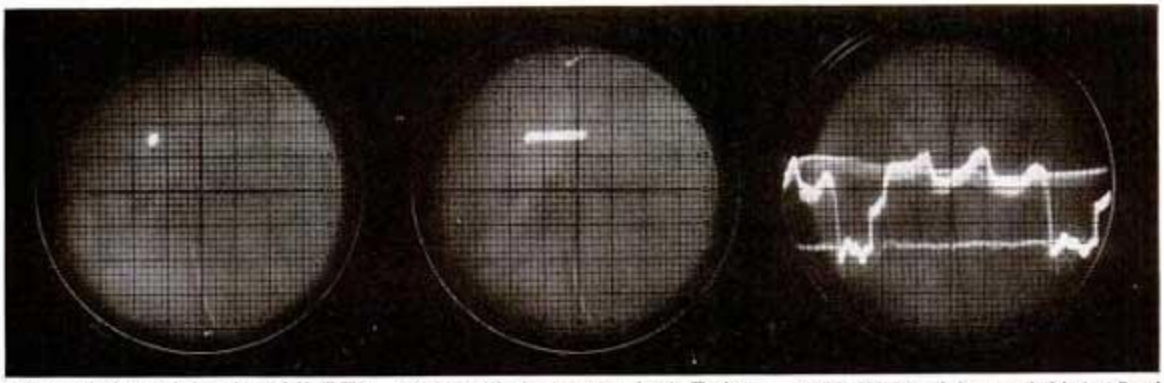
TELEVISION SEQUENCE: IMAGE FOCUSED ON PLATE, SCANNED BY BEAM (SEE TOP) IS TRANSLATED INTO RADIO SIGNAL, BROADCAST, TRANSLATED BACK INTO IMAGE BY RECEIVING SET

PICTURE TUBE reverses operation performed by camera tube shown on preceding page. It translates radio signal into visible picture. Electron gun, glowing inside tube at left, shoots stream of electrons at a layer of phosphor crystals on inside surface of tube face, making a point of light. Glowing gases in this demonstration tube trace the path of invisible beam.

LINES DRAWN BY ELECTRON BEAM CREATE PICTURE

The picture that is the end product of television is produced by the tube shown above. Like the camera tube the picture tube has an electron gun which fires a beam of electrons. The beam is aimed at a coating of fine phosphor crystals on the inside surface of the tube. When struck by the beam, these crystals glow with a brightness that depends on the intensity of the beam. The beam's intensity varies with the intensity of the current that has been set up by the sensitive plate in the camera tube (*previous page*) when scanned by camera beam. The picture beam, imitating camera beam, scans the phosphorescent screen in series of horizontal lines from top to bottom. Result is a pattern of light and shadow that reproduces the camera image.

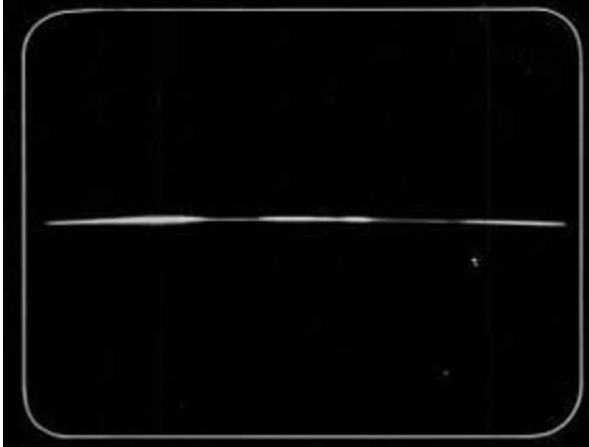
What the eye sees on a television picture tube is an optical illusion. No area larger than a pinhead is ever illuminated at any one instant. The whole picture, however, is traced before the eye 30 times per second, six frames faster than a moving picture. The line structure of the television picture determines its quality. At present standard of 525 lines from top to bottom it is equivalent to newspaper half-tone engraving.



POINT OF LIGHT glows on tube face as beam is held still. This is laboratory oscilloscope tube, cousin of the television tube.

A LINE IS TRACED as beam scans across the tube. The electromagnetic fields control travel of beam in the television tube.

A CURVE IS TRACED as the beam scans both horizontally and vertically. The television beam throws straight horizontal lines.



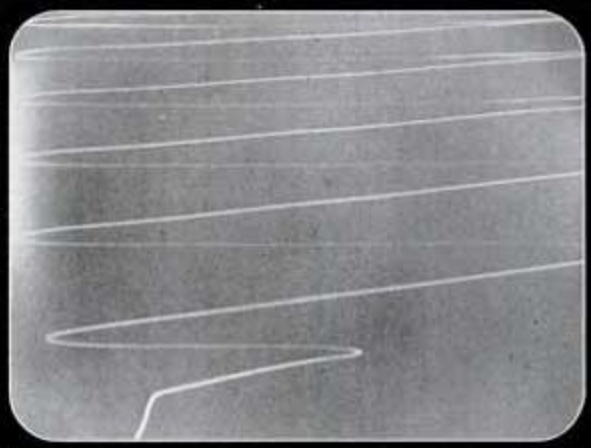
SINGLE-PICTURE LINE, traced on face of television tube, shows light and shadow across middle of girl's portrait. The beam traces line from left to right at a speed of 5,600 mph.

ASSEMBLY OF LINES, each with its own pattern of light and shadow, resolves into picture. In this demonstration picture, the lines are spread apart to show individual characteristics.

HALF THE LINES of final image are here drawn. Beam scans each picture twice, drawing odd-numbered lines in first passage, then draws the even-numbered lines between them.

COMPLETE PICTURE emerges, with the odd and even lines interlaced. The beam scans 60 half pictures, 30 full pictures per second. Photographs do not show quality of television picture.

GHOST IMAGE at the left is drawn by horizontal return trace of beam as it sweeps back across the screen from right to left. Ghost image is blanked out in television reception.



VERTICAL RETURN TRACE is drawn by beam when it reaches bottom of screen and goes back to top of screen to start new picture. This trace is also blanked in normal operation.

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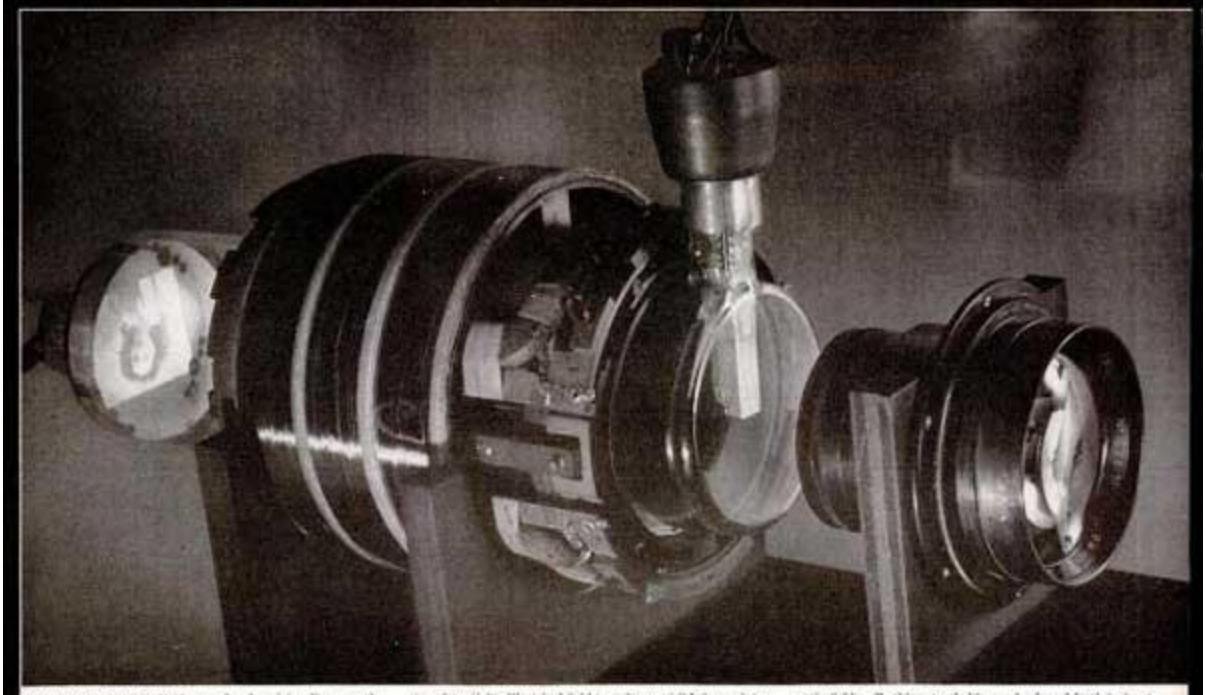
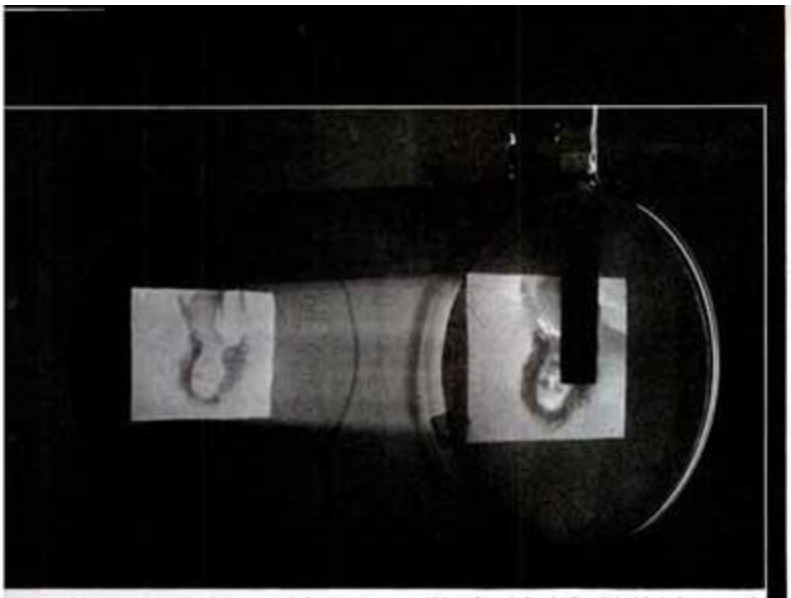
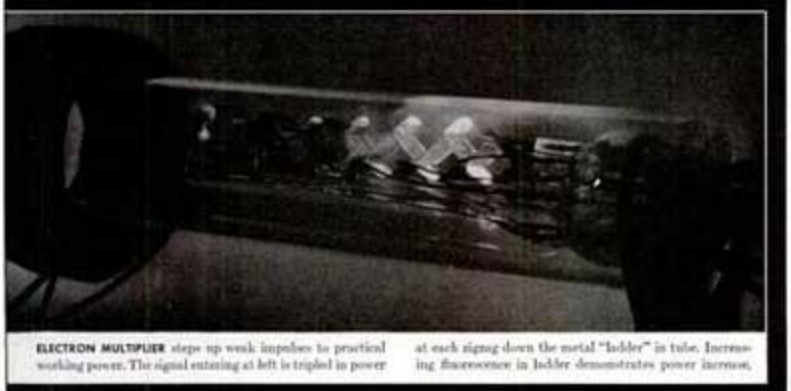


DISSECTOR CAMERA TUBE was developed by Farnsworth Television and Radio Corp. Image is focused on light-sensitive plate (*left*). Electrical field transforms visible image into extended electronic image (*top, opposite page*). Electromagnetic field pulls this extended image back and forth in front of scanning finger mounted vertically at front of the tube.

SCHMIDT PROJECTION system is an adaptation of Schmidt reflecting telescope. Image on small, 4-inch television tube (*center*) is pointed at the spherical mirror at left. The mirror reflects and projects image back through large lens in which tube is mounted and onto big screen. The tube would block light reflected from center of mirror—hence hole in the mirror.



EXTENDED IMAGE is carried by streams of electrons from sensitive plate at the back to the scanning finger (*right*) which analyzes it line by line. Principle is demonstrated here by light beams made visible by smoke inside tube.



ELECTRON MULTIPLIER steps up weak impulses to practical working power. The signal entering at left is tripled in power at each zigzag down the metal "ladder" in tube. Increasing fluorescence in ladder demonstrates power increase.

ON FULL-SIZED MOVIE SCREEN television image is thrown in full brilliance by a Schmidt projector. Comparatively low illumination of image makes other projectors impractical. Projection screens will be part of post-war home receivers.

NEW DEVICES MAKE IMAGES BIG AND SHARP

Television as a wondrous novelty does not begin to be television as a big industry and major public service. The novelty has long since rubbed off. Television's present audience consists of a few thousand pioneers, chiefly in the New York and Los Angeles metropolitan areas, who own prewar television receiving sets. They are unanimous on several counts. The prewar picture is too small, it is unclear and it is unreliable. It blurs and wobbles, comes and goes. To be worth a billion dollars, the television picture must be big, detailed and true and, finally, have full color.

Television engineers already know how to solve most of these problems and have pretty good clues to solution of the rest. A bigger picture tube, for example, is not the answer to big pictures because a big tube is expensive and fragile. Solution is the Schmidt optical system, one of the powerful tools of modern astronomy (*at bottom, opposite page*). The Schmidt system can be used to project a much-enlarged television image at full brilliance. The National Broadcasting Co. has already demonstrated satisfactory projection on a full-sized moving-picture screen. A new method of casting the optical parts in plastic will make the Schmidt system a mass-production item, available for home-receiving sets.

Color is also on the immediate horizon. The Columbia Broadcasting System's New York television studio has demonstrated a practical system of color television and has broadcast programs in color on a regular schedule. The system employs mechanical and optical principles to add color to the existing electronic picture. The image is broken down into primary colors by color filters mounted in a spinning drum in the camera, and reconstructed in full color by a spinning color wheel in the receiver.

The Farnsworth camera tube (*at top, opposite page*) incorporates one of the most useful of the new television devices, the electron multiplier. The multiplier boosts the strength of an electrical impulse several million times. To the television camera it will give a light sensitivity greater than that of the best modern photographic equipment. This will simplify studio lighting problems and will vastly extend the working range of the television camera as a news reporter.

COLOR TELEVISION CAMERA mounts the camera tube on its side. Lenses point down. Above left lens is the color drum.

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1929 picture was produced by a mechanical, not an electronic, scanning. With only 60 lines very little detail comes through.

1936 picture, with 343 lines, showed possibilities of electronic scanning system demonstrated by National Broadcasting Co.

1937 picture shows improvement achieved by advancing the standard to 441 lines. Standard of 525 lines was set in 1941.

INDUSTRY DEBATES ADVANCE IN PICTURE QUALITY

The war interrupted the debut of television at just the right moment. Enough was seen of it (*see below*) to establish that it worked and had a great future. But not too much was seen of it to blight that future by publicizing its prewar inadequacies.

In four years the war has achieved technical advances toward perfection of the art which might otherwise have taken a generation. Most of these advances are involved in military devices. Just how soon these advances will be harnessed to television is a question that is now under deliberation by committees representing the armed forces, manufacturers, laboratories and broadcasters.

In the midst of these discussions the two pictures on opposite page have become the focus of a hot argument. They were prepared by the television research staff of CBS. The top picture shows the picture quality possible in the present 525-line picture structure. The bottom picture shows the quality possible in a 735-line standard made feasible by military research.

In these pictures the television line structures have been translated into equivalent half-tone printing screens. For comparison the pictures should be viewed from about three feet away. The inset heads in the two pictures show their quality when they are doubled in size. Enlargement does not increase the number of lines, picture elements or dots. It only enlarges them and widens the spaces between them, making the image coarser. These insets should be viewed at a distance of six or seven feet. It is apparent that the 735-line standard produces a more detailed picture and is superior for enlargement to sizes which the postwar market will demand.

The line standard is determined by the region in the radio spectrum to which television is assigned. The present assigned region lies between 50 and 300 megacycles. This is a crowded region and in it television broadcasters are restricted to channels six megacycles wide. In such channels a 525-line picture is maximum. The 735-line standard requires an advance to the 500-1,000 megacycle frequencies pioneered during the war. Here it is possible to give television a wider channel, from 13 to 40 megacycles.

Such a radical change in assignment, now or at any other time, would impose immediate and total obsolescence on all existing equipment. A large group in the industry wants to freeze television on its 525-line standard and build a giant industry on the foundation of its present plant. The opposition declares that it is better to clean the slate now before too much is invested in technically obsolete equipment. It says that the ultra-high frequencies will yield not only a better black-and-white image, but also a full-color image better than any black and white.

The argument will probably be settled by continuing the present standards and letting the public know that better standards are on their way. Those who can afford to could then invest in the present equipment. The engineers will meanwhile proceed with all speed to convert their military secrets into postwar television.

DEWEY'S ACCEPTANCE SPEECH AT CHICAGO WAS TELEVISED

NEW YORK AIR-RAID WARDENS WERE TELEVISION-TRAINED

PRESIDENT WAS TELEVISED FROM WORLD'S FAIR IN 1939

TELEVISION REGULARLY COVERED NEW YORK PRIZEFIGHTS

NEW YORK FIRE WAS TELEVISION'S FIRST SPOT-NEWS STORY

TELEVISION ALSO COVERS FOOTBALL, BASEBALL, RACING

PRESENT 525-LINE STANDARD IS SHOWN (ABOVE) BY 65-LINE HALF-TONE SCREEN, WITH 33-LINE SCREEN INSET. POSSIBLE 725-LINE STANDARD IS SHOWN BY 100- AND 50-LINE SCREENS

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TELEVISION STUDIO, operated by the General Electric Co. at Schenectady, N. Y., has been on the air since 1939. Two mobile cameras make it possible to change quickly from close-up to long shot. Director in control room (*see opposite page*) instructs cameramen by telephone, simultaneously watches studio floor and camera images on mixing panel. By switching transmitter from camera to camera he varies image seen on home receiver. Producers estimate television will require 10 times radio's present staff. Six studios are now on the air.

SPORTS REPORTING has been major television-program item and proving ground for technical experiments. The low sensitivity of present camera required ideal weather for successful operation. Color will enhance sports coverage by transmitting team colors.

MINIATURE SETS and other motion-picture devices help solve television-studio problems. Synthetic miniature below is being televised from Hollywood studio of Paramount Pictures Inc. Motion-picture industry is laying plans for television operations, including television programs in movie theaters.

Life Magazine, September 4 1944