TELEVISION *in* COLOR

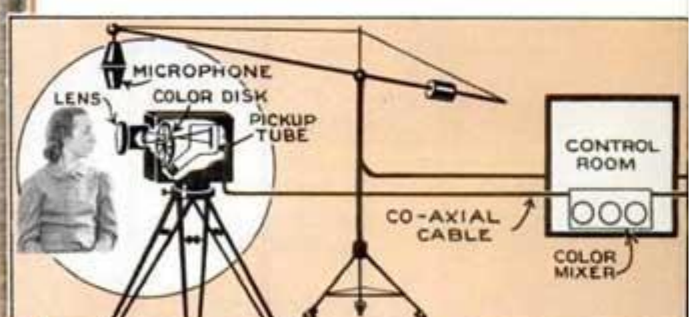
Above, scene in Columbia Broadcasting System's studio in which color television shot is being made. Right, approximately what you will see on television receiver screen. Taking a photo of color television is difficult because camera catches only color lines showing at moment picture is snapped.

By JULIAN LEGGETT

AFTER five years in its "swaddling clothes" of black and white, television is on the verge of changing to fancy dress. Within a short time, experts tell us, pictures in all the colors of the rainbow will be flashing through the air to the receiver screens of a favored few Americans living near transmitting stations.

Television in color has come with a rush, having been developed and demonstrated successfully in the laboratory while most of the nation still awaited the arrival of black-and-white television. Its secret is a couple of disks containing red, green and blue filters. One disk rotates

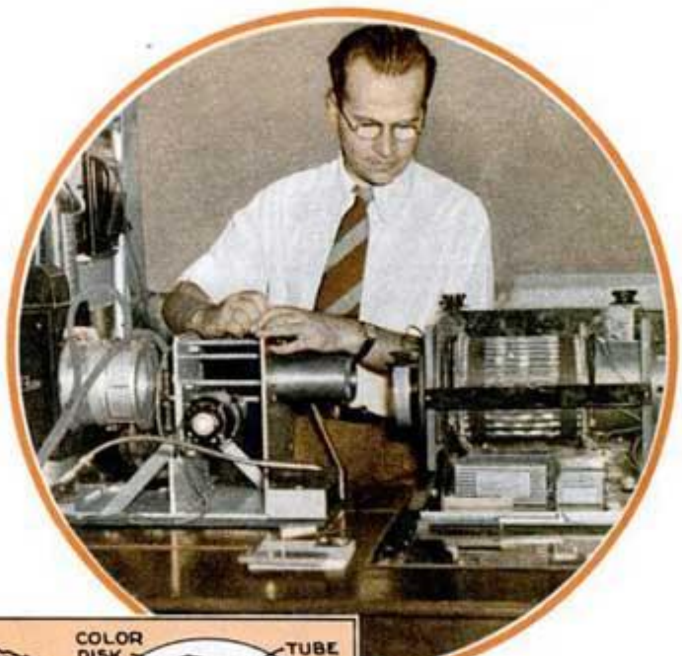
Top, viewing General Electric Company's demonstration of color television. Here only a revolving color disk has been added to standard television receiver; another disk is used at transmitting end. Left to right, Dr. P. C. Goldmark of Columbia, P. D. Reed of General Electric, Dr. E. F. W. Alexanderson of General Electric and G. H. Payne of Federal Communications Commission. Left, new Du Mont twenty-inch television receiver.

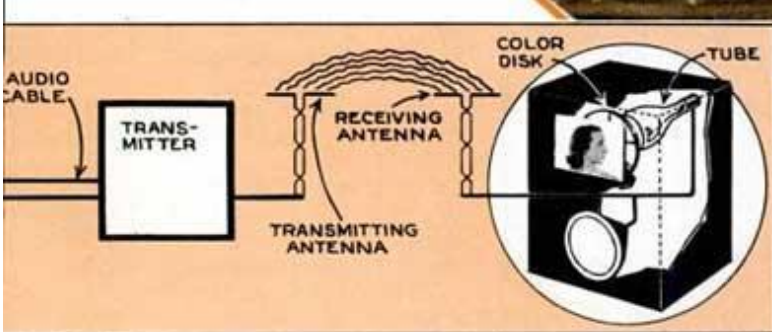


in front of a pickup tube at the transmitting end. Synchronized with it is the second disk which rotates in front of the receiver tube in the individual set. When the red filter is in front of the pickup tube, only those parts of the scene or picture being televised which contain red register in the pickup tube. At the same instant the red filter in front of the receiver tube in the individual set permits only red portions of the picture to reach the viewing screen. The same holds for the green and the blue filters, with each operation performed at lightning speed.

Comparatively few people understand how television works, even the black-and-white variety. If you place a strong magnifying glass over a photograph reproduction in a daily newspaper, you see that the original photograph, when it was made into an engraving, was broken up into a field of black dots varying in diameter and hence, to the eye, in density. To get a television image, the original subject in effect is broken into a number of electrical impulses which do approximately the same things when they arrive on the television viewing screen—they

Above, Rockwell Kent, looking in mirror, sees how he appears to television audience. Mirror is shown above lens of television camera in General Electric's studio at Schenectady, N. Y.





Above, Dr. Goldmark, CBS engineer, at still projector of color television equipment which he developed. Left, sketch of how color television works. The setup is identical with black-and-white television, save that color disks are used at transmitting and receiving ends and that controls include color mixer.

Above, at the controls in General Electric's television studio. This is a natural-color photo, as is the one below which shows a tester applying voltage to television receiving tube. The mask is protection against tube explosion.

appear in lines which create a picture. This picture is composed of 441 tiny lines—a standard in the industry.

Special equipment scans, or goes over the entire scene or picture being televised, picking up light waves which in turn are converted into the electrical impulses that are transmitted, then changed back into light waves at the receiving end, thus forming the picture. Dr. Peter C. Goldmark, chief engineer of Columbia Broadcasting System's television department, who developed the tri-color television system demonstrated recently, employs a scanning method different from that used in most black-and-white systems. The picture is completely scanned every sixtieth of a second, instead of every thirtieth of a second. However, at the end of the first sixtieth of a second, only two colors have been used. The third color requires an additional 1/120 of a second, bringing the total to one-fortieth of a second for a single picture in

full color. The Goldmark system works like this:

Odd-number lines are scanned in red in 1/120 of a second and the even-numbered lines are scanned in green in 1/120 of a second. At this point the whole picture has been scanned, but there is no blue. Time thus far: one-sixtieth of a second.

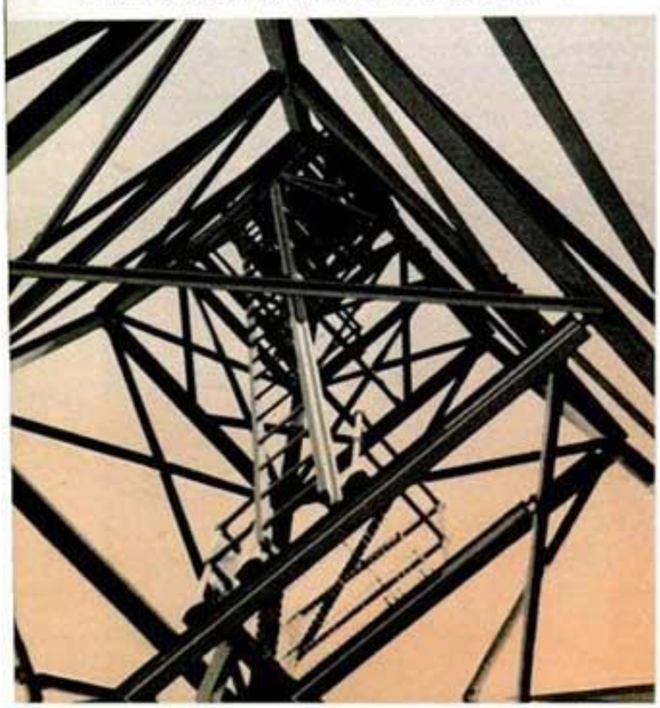
Now the red on the odd-number lines has faded and these same lines are scanned in blue in 1/120 of a second. Now the whole picture has been scanned one and one-half times, but in full color only once. Time: one-fortieth of a second.

The green on the even-number lines has now faded, so these same lines are scanned in red in 1/120 of a second. At this point the picture has been scanned twice, but in full color only one and one-third times. Elapsed time: one-thirtieth of a second.

Now the blue on the odd-num-

Above, typical scene in studio, with dancer and others performing for General Electric's television camera. This is a natural-color photo. Below, Dr. Alexanderson holding color disk of the type used in color television work. This also is a color photo.

Above, making adjustments on CBS telecine camera in studio control booth. This camera is used to telecast motion pictures from films. Below, unusual view of antenna employed to get good results in television work.



ber lines has faded and these same lines are scanned in green in 1/120 of a second. Now the red on even number lines has faded and these lines are scanned in blue in 1/120 second. At this point the picture has been scanned three times, twice in full color. Total time: one-twentieth of a second. And now the whole cycle begins again.

Dr. Goldmark's system is based largely on the fact, which he proved to his own satisfaction, that the human eye will remember a succession of three pictures, each in a different color, long enough to blend them into a single full-color image. Of course the pictures must be passed very rapidly before the eye to achieve this illusion of spontaneity, as well as simultaneity.

Students of color photography know that most color pictures are produced through the use of at least three separate elements. No matter what the process, the final photoprint usually requires three elements—three negatives or three transparencies superimposed upon mounting paper. On this basis, one would assume that projection of color television would require three projectors, all focused on the same scene and the resulting light mixed. This might be fairly simple if it weren't for the fact that each color beam needs the same transmitting area. In other words, a picture in three colors would require approximately three times as much space in the comparatively narrow transmitting band of ether assigned by the Federal Communications Commission.

The Goldmark system, by which only a single color is transmitted at one time but so rapidly that the human eye blends the colors to form the full-color image, solves this problem.

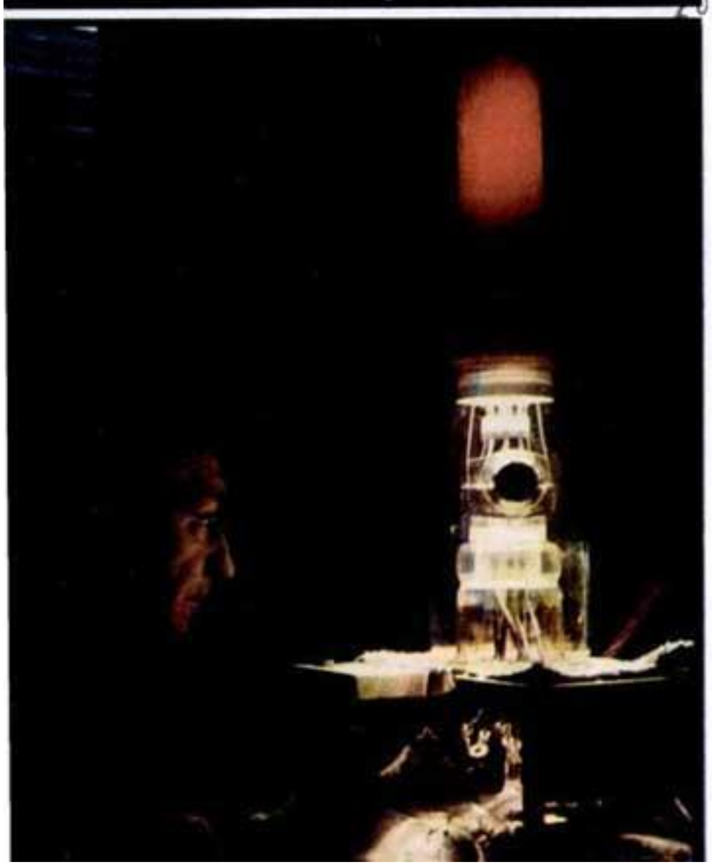
Originally the Columbia system employed motion-picture film, with the scene being first photographed on the film and then televised. Now Dr. Goldmark has found that direct pickup, televising the scene without using the film, is possible. In the direct pickup method achieved experimentally in the Columbia laboratories, no more intense light level is required than has been needed for

Du Mont television equipment—camera, controls, synchronizing signal generator, power supply and other units—all capable of being packed into auto (above) and (right) applying anode coating to television receiving tube at General Electric.

black-and-white television. In actual practice, however, color pickup probably will be improved by employing additional light, but the amount of light needed does not appear to present a problem, Dr. Goldmark points out.

An additional feature of the Columbia color television is color control, which will be used to justify the color values of scenes televised out of doors with those taken indoors. Sunlight has a different color from artificial light and refracts in different shades. With color, during a dramatic scene on the screen a room will suddenly, in effect, leap into flame at the turn of a dial. The same room, with another turn of the dial, will be made to shift from afternoon sunset to moonlight to morning glow. To establish a musical theme, an actual aura of "blue" can be cast on the image of a dance orchestra and character hints, emotional phases or "cooler" settings will be at the transmitting engineer's finger tips.

Color television, as demonstrated by Columbia, gives lifelike realism, seeming to add a third dimension. An idea of



what it is like may be gained from this:

Two receivers stand side by side, one showing black-and-white pictures, the other color pictures. On the first screen a girl appears strolling through a garden. The picture is just what you would expect to see in a vacation snapshot. On the other screen, the girl is discovered wearing a gay yellow hat, a bright blue dress and colored ribbons, the garden lawn has come to life in a gay green, and flowers in pink, blue, red and orange literally have leaped into being. The contrast is startling. In another scene the blue of the water stands out in sharp contrast to the blue of the sky as a trim yacht scuds by—evidence of the effect of color control.

Dr. E. F. W. Alexanderson of General Electric also is working on television in color. In a recent demonstration, no additional equipment other than a revolving disk was employed to convert black-and-white pictures to color. A two-color twenty-four inch revolving disk was installed about twelve inches in front of the picture end of the cathode-ray tube in a standard receiver. As the disk whirled at 1,800 revolutions per minute, its transparent field of orange-red and greenish-blue reproduced a program coming from a distant studio in realistic colors. At the studio a similar disk was whirling in front of the iconoscope pickup tube of the transmitter. In early experiments, General Electric engineers tried both two and three-color disks. With two colors and a speed of 1,800 revolutions per minute, the same colors succeeded each other thirty times per second. With three colors they *(Continued to page 128A)*

Top, Dr. Goldmark threads colored movie film into machine which projects it for telecast in full color. Bottom, examining fifty-kilowatt broadcasting tube which undergoes tests similar to those employed for television transmitting tubes at General Electric. Both these photos are taken from natural-color film.

Television in Color

(Continued from Coloroto Section)

succeeded each other twenty times per second, producing a color flicker. Therefore, the two-color disk, which gives good results without flicker, is being used experimentally for the present, the engineers feeling that this type is most practical for standard commercial receivers.

Allan B. Du Mont, television manufacturer, revealed recently that his engineers are developing a purely electronic means of producing television in color. This method is intended to eliminate the use of filters at the pickup, and color wheels at the receiver, substituting a special screen for automatically selecting and rendering the elementary colored images in proper sequence, without color wheels or other moving parts. For the present, Du Mont believes the industry should concentrate on commercializing good black-and-white television, since he views the problems as being rather in the direction of evolving satisfactory flexible standards which would allow either transmission of black-and-white or colored pictures agreeable to the majority of television interests. Thus, he reasons, might be laid a firm foundation for scheduled television broadcasts to be enjoyed with mass-produced receivers that will not become obsolete over night.

Although this lusty scientific "baby"—television—is some five years old, dating from its introduction in the present form, comparatively few Americans have seen a single black-and-white picture. Television transmitting stations are scarce, being limited to New York, Schenectady, Los Angeles, Chicago and a few other areas. Since the picture-carrying radio waves are extremely limited in range, reaching only to the horizon—usually about twenty-five miles, though General Electric picks up New York 129 miles away— reception necessarily is limited to those persons owning the proper equipment and living almost within sight of a transmitting station. Another obstacle to television progress is the fact that each station is forced to produce its own program. One means of producing chain or network programs is by using a coaxial cable, the cost of which is virtually prohibitive, and the other is a relay station system, such as General Electric employs to carry programs from New York to receivers more than 150 miles away. Of course, a relay system would call for the expenditure of large sums, too.

An invention that may give great impetus to television is a multiple arrangement of small cathode-ray tubes for projection of a large image instead of the present method of a single expensive cathode tube. The system would depend upon mass production of the small tubes, thus cutting costs considerably. The invention, by ingenious electrical circuits, provides that each small tube in turn is to scan a small section of a large screen. If a tube burns out, only a small part of the received image would be lost. To cover a wide theater screen, the inventor, Dr. Alfred N. Goldsmith, proposes to use as many as six, eight or twelve cathode tubes in a row. Below the first or top line of tubes would be another row of the same number, and so on until the bottom of the screen is reached—or the entire scene covered. The same system for the receiver in the home would employ a similar arrangement, save that smaller tubes would be used.

Dr. Goldsmith predicts that a home teleview screen, with tubes installed behind it, some day will be wheeled into the drawing room or living room like a tea table, connected to an existing television receiver and scenes projected on it "comparable in a small way to anything one now sees in the average movie."

Floodlights on Swinging Bracket "Panoram" with the Camera

So that floodlights can follow the action in making indoor movies, there is a bracket that mounts on a panoramic head to swing freely with the camera. The bracket fits all types of reflectors and its arms can be set at any angle.

Popular Mechanics, April 1941