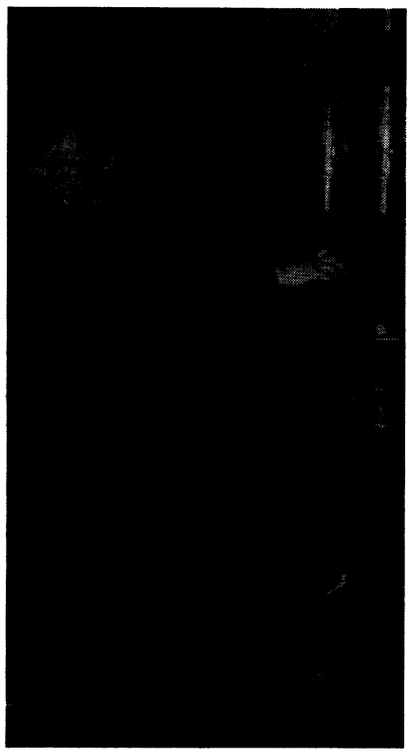
Color Television Makes American Debut

Television

The day when we shall not only see our distant friends as we talk to them over the telephone, but when we shall also see the flesh tints of their faces, the red of their lips and the colors of their clothes, was brought nearer with the demonstration of color television at the Bell Telephone Laboratories in New York on June 27. Color television has been achieved previously in England, but the Bell demonstration was the first time that it had been done in this country, and much nearer perfection.

In one part of the laboratory building a girl in a fancy dress sat in front of the transmitter, as shown on our cover picture. A group of newspaper men and scientists in the auditorium sat in front of the receiver and saw a faithful reproduction of her dress and features in all their natural hues. An American flag was held in front of the transmitter and the red, white and blue were immediately reproduced in the receiver. Flowers, fruit and other colored subjects were also transmitted.

It was on April 7, 1927, that the first satisfactory long-distance television was demonstrated by the Bell engineers, when Mr. Hoover, then Secretary of Commerce, sat in front of a machine in Washington and was seen and heard in New York. This was the result of researches of a group of scientists under the direction of Dr. Herbert E. Ives. Years ago Dr. Ives' father, Frederic E. Ives, of Philadelphia, invented one of the first successful methods of color photography. The new method of color television is essentially a combination of these two achievements of father and son.



DR. HERBERT E. IVES, at the color television receiver

In the Ives color photography, three photographs were made of the same scene. One was taken through a red glass filter, and recorded the reds of the scene. Another was taken through a blue filter and recorded all the areas of this color, while a plate exposed behind one of green showed all the greens. These were made into lantern slides. In a triple magic lantern all three were projected on the same screen. Over the slide showing the reds was placed a red glass, over the one showing the greens a green glass and over the third a blue glass. Thus, all three colors of the original scene were combined on the screen, and a natural color reproduction was the result.

A method used by Mr. Ives, Sr., in a later color camera to combine three images is now used to combine the light from three glow lamps in the color television receiver.

The following article, by Dr. Herbert Ives, tells the details of the new method. Previous television achievements of Dr. Ives and his colleagues were described in the SCIENCE NEWS-LETTER for April 16, 1927, page 237, and for July 21, 1928, page 35.

Science News-Letter, July 6, 1929

Television in Color

Television

By HERBERT E. IVES
Member of the Technical Staff,
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Over two years ago Bell Telephone Laboratories demonstrated a practical system of television. For the first time successful representations of objects at rest or in motion were transmitted electrically — over wires or through the ether—for considerable distances. The reproduction of the scene then transmitted was in monochrome—the orange-red color of the neon lamp. Recent developments of the laboratories, however, have made it possible to reproduce scenes with their true color values. The appearance of reality in the reproduced scene is thus greatly enhanced.

One of the most significant features of this new achievement is that it does not require completely new apparatus. The same light sources, driving motors, scanning discs, synchronizing systems, and the same type of circuit and method of amplification are used as in the monochromatic system. The only new features are the type and arrangements of the photo-electric cells at the sending end, and the type and arrangements of the neon and argon lamps at the receiving end. The outstanding contributions that have made the present achievement possible are a new photo-electric cell, new gas cells for reproducing the image, and the equipment associated directly with them.

To render the correct tone of colored objects, it was necessary to obtain photo-electric cells which—like the modern orthochromatic or panchromatic plate—would be sensitive throughout the visible spectrum. This requirement has been satisfactorily met. Through the work of A. R. Olpin and G. R. Stilwell a new kind of photoelectric cell has been developed, which uses sodium in place of potassium. Its active surface is sensitized by a complicated process using sulphur vapor and oxygen instead of by a glow discharge of hydrogen as with the former type of cell.

The response of the new cell to color, instead of stopping in the blue-green region, continues all the way to the deep red. Because the former potassium cells were responsive only to the blue end of the spectrum, objects of a yellowish color appeared darker than they should have and the tone of the reproduced scene was not quite correct. This disadvantage applied particu- (*Turn to next page*)

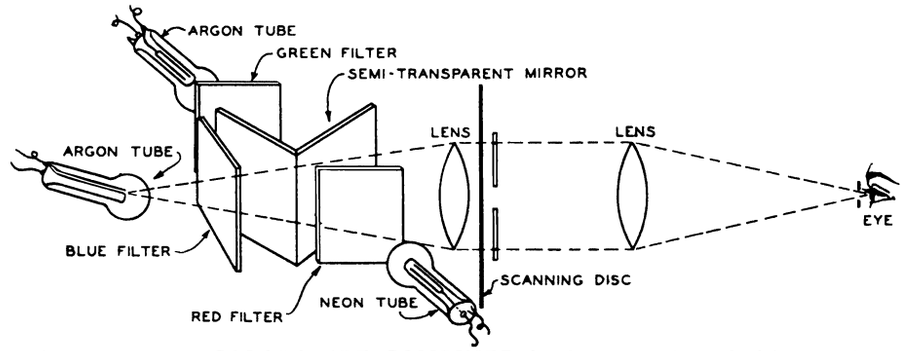
Television in Color—*Continued*

larly to persons of dark or tanned complexion. When the new cells are used in the original television apparatus and with yellow filters—similar to those used in photographing landscapes in order to make the blue sky appear properly dark—this defect is corrected and the images assume their correct values of light and shade no matter what the color of the object or the complexion of the sitter. It is the availability of the new photo-electric cells which makes color television possible by their use.

The development of color television has been greatly simplified by the fact that as far as the eye is concerned any color may be represented by the proper mixture of just three fundamental colors—red, green, and blue. This fact was utilized in the development of color photography, and all the research that had been done in that field was available as background for color television. A host of methods of combining the three basic colors to form the reproduced image was available but, insofar as the sending or scanning end is concerned, a method was developed which has no counterpart in color photography. The method of "beam scanning"—used in the first television demonstration—has been employed.

To apply this method to color television, three sets of photo-electric cells are employed in place of the one set used before. Each of these sets is provided with color filters made up of sheets of colored gelatin. One set has filters of an orange-red color which make the cells see things as the hypothetical red sensitive nerves of the retina see them; another set has yellow-green filters to give the green signal, and the third set has greenish-blue filters which perform a corresponding function for the blue constituent of vision. The scanning disc and the light source are the same as with the beam scanning arrangement used in monochromatic television. The only difference is in the photo-electric cells, and thanks to the tri-chromatic nature of color vision, it is only necessary to have three times the number of cells used previously to reproduce all colors. Three series of television signals, one for each set of cells, are generated instead of one and three channels are used for the transmission of the television signals.

The photo-electric cell container,



HOW THREE COLORS ARE COMBINED in the new color television receiver

or "cage," has been built in a somewhat different form from that used in our first demonstration. There three cells were used arranged in an inverted "U" in a plane in front of the object. In the new photo-cell cage twenty-four cells are employed, two with "blue" filters, eight with "green" filters, and fourteen with "red" filters. These numbers are so chosen with respect to the relative sensitiveness of the cells to different colors that the photo-electric signals are of about equal value for the three colors. The cells are placed in three banks, one bank in front of and above the position of the scanned object, one bank diagonally to the right, and another bank diagonally to the left, so that the cells receive light from both sides of the object and above. In placing the cells they are so distributed by color as to give no predominance in any direction to any color. In addition, large sheets of rough pressed glass are set up some distance in front of the cell containers so that the light reflected from the object to the cells is well diffused.

The television signals produced in the color sensitive photo-electric cells through the color filters are no different electrically from those used in monochromatic television. Three sets of amplifiers are required, one for each color, and three communication channels in place of one, but the communication channels are exactly similar to those which were used with the same scanning disc before.

For color television the thre images must be received in their appropriate colors, and viewed simultaneously and in superposition. The first problem was to find light sources which, like the neon lamp previously used, would respond with the requisite fidelity to the high-frequency signals of television, and at the same time give red, green and blue light. With such lamps available a decision would have to be made as to how the three colors could best be combined to form a single image.

Several methods of reception are possible. For displaying the transmitted image to a large audience a grid could be employed similar to that used for the earlier demonstration, but it would consist of three parallel tubes instead of a single one.

Thus far the television images have been received in a manner similar essentially to our method for monochromatic television. The surface of a disc similar to that used at the sending end is viewed, and the light from the receiving lamp is focussed on the pupil of the observer's eye by suitable lenses. To combine the light of the three lamps, they are placed at some distance behind the scanning disc and two semi-transparent mirrors are set up at right angles to each other but each at 45° to the line of sight. One lamp is then viewed directly through both mirrors and one lamp is seen by reflection from each, as illustrated by the accompanying diagram.

The matter of suitable lamps to provide the red, green, and blue light has required a great deal of study. There is no difficulty about the red light because the neon glow lamp which has been used previously in television can be transformed into a suitable red light by interposing a red filter. For the sources of green and blue light nothing nearly so efficient as the neon lamp was available. The decision finally made was to use another one of the noble gases—argon—which has a very considerable number of emission lines in the blue and green region of the spectrum. Two argon lamps are employed, one with a blue filter to transmit the blue lines and one with a green filter transparent to the green lines of its spectrum.

These argon (*Turn to page* 5)

Men and Woodpeckers Alike

Ornithology

By WILLIAM E. RITTER
Honorary President, Science Service

California woodpeckers are like men in taking some thought for the morrow. They gather into barns, at least to the extent of sticking acorns into holes which they bore into trees. I have been watching them a good deal lately, to learn more about the way these birds use their heads (chiefly brains and beaks) in solving their economic and social problems.

That they gain a real advantage by their unique provisioning activity is quite clear; and some aspects of the performance are surprisingly well done. But what wastefulness and inefficiency, even to the crassest foolishness, the birds show in some other aspects of their work! A lot of this is due to their doing altogether too much. Hole-making for acorn-storing is a fine thing and is great fun; so the birds go right on making holes whether they are going to put acorns in them or not.

Likewise, gathering acorns and putting them in holes is a fine thing, and great sport besides. Consequently, acorn-storing it is, day in and day out, as long as the acorn harvest lasts, with very little regard for what the actual needs of the future may be or even as to whether the nuts are being put where they can be got if the effort is made to get them later on.

Some of the collections I have made are of acorns converted into mere rubbish by decay and insect-eating, so long ago and so unprotectedly were they stored.

What has made this field work especially interesting to me was the opportunity to observe the similarity between the way California woodpeckers and California men act in relation to their economic problems.

For instance, on the same day one may observe woodpeckers producing acorn stores far beyond any need or consuming ability of theirs; likewise, men producing raisin grapes in quantities beyond the possibility of disposing of them to anybody's good, and oil men pumping oil out of the ground with all the speed and force they can muster with very little regard to the real need, present or future, for oil by the community.

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Television in Color—*Continued*

lamps, unfortunately, are not nearly so bright as neon lamps and it was, therefore, necessary to use various expedients to increase their effective brilliancy. Special lamps to work at high current densities were constructed with long, narrow and hollow cathodes so that streams of cold water could cool them. The cathode is viewed end-on. This greatly foreshortens the thin glowing layer of gas and thus increases its apparent brightness. Even so it is necessary to operate these lamps from a special "I" tube amplifier to obtain currents as high as 200 milliamperes.

The receiving apparatus at present consists of one of the 16-inch television discs used in our earlier experimental work. Behind it are the three special lamps and a lens system which focusses the light into a small aperture in front of the disc. The observer looking into this aperture receives, through each hole of the disc as it passes by, light from the three lamps—each controlled by its appropriate signal from the sending end. When the intensities of the three images are properly adjusted he therefore sees an image in its true colors, and with the general appearance of a small colored motion picture.

Satisfactory television in colors is a far more difficult task than is monochromatic television. Errors of quality which would pass unnoticed in an image of only one color may be fatal to true color reproduction where three such images are superimposed and viewed simultaneously. In three-color television any deviations from correct tone rendering throw out the balance of the colors so that while the three images might be adjusted to give certain colors properly, others would suffer from excess or deficiency of certain of the constituents.

Color television constitutes a definite further step in the solution of the many problems presented in the electrical communication of images. It is, however, obviously more expensive as well as more difficult than the earlier monochromatic form, involving extra communication channels as well as additional apparatus.

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First Glances at New Books

THE SUMERIANS—C. Leonard Woolley—*Clarendon Press, Oxford* ($2.50). Students and other readers who really want to know more about the temples and royal tombs of Ur of the Chaldees will find here a thorough account and will be quite satisfied with the clear explanations and fine photographs. The little volume might have had a wider popular appeal had Mr. Woolley seen fit to recount the manner and procedure in which some of his remarkable finds have been made, and had he presented the richly picturesque existence of the kings of Ur in a more dramatic literary fashion. We are still waiting for those kings to "come alive" as Tutankhamen has done. But then, perhaps, that is another book and another story.

Archæology
Science News-Letter, July 6, 1929

OLD CIVILIZATIONS OF THE NEW WORLD—A. Hyatt Verrill—*Bobbs-Merrill* ($5). The most solid and spectacular cultures that developed on American soil—chiefly those of the tropics and sub-tropics—are described, so that the layman may better understand and compare the achievements of the Aztecs, the Incas, and the rest.

Archæology
Science News-Letter, July 6, 1929

BEFORE COLUMBUS—Cecil E. Stevens—*Silver, Burdett* ($1.32). How the Indians of Porto Rico lived before the coming of the white man, told simply in story form for child readers. A good antidote for the idea often gained by children that America before the days of Columbus was merely a wilderness in which painted savages ran wild. The folklore tales brought into the narrative have the color and romance of popular fairy stories.

Ethnology
Science News-Letter, July 6, 1929

OPINIONS RENDERED BY THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE: 105 to 114—*Smithsonian Institution.* Of interest to systematic zoologists.

Taxonomy
Science News-Letter, July 6, 1929

THE ARCHERS HANDBOOK—Philip Rounsevelle—*The Archers Company, Pinehurst, N. C.* (25c). A company of craftsmen tell in brief compass the most important facts about the ancient sport of archery and the implements employed therein.

Sports
Science News-Letter, July 6, 1929