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Advanced Development Engineering
Television Receiver Department

A TELEVISION SIMULATION OF THE "LAND TWO-COLOR" SYSTEM

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ABSRACT: A television simulation was made of the "Land two-color" system by using our two-tube display unit in conjunction with a color TV flying-spot-scanner. Both the "taking" and "reproducing" primaries were varied by means of electrical controls and optical filters.

The basic effect that Land reported was duplicated by using Red and Cyan taking characteristics and Orange and White reproducing primaries. The illusion of three colors was not as pronounced as Dr. Land's photographic method. The optimum taking characteristics were found to be a function of the picture material and the colors involved. The colors "seen" were red to orange, green to cyan, weak yellows, and pale blues. Adaptation of the eye to the reproducing primaries is definitely a part of this overall process. Few, if any, of the colors were saturated but a pleasing picture was obtained in most cases. We would conclude that this simulation approached our previous orange-cyan two color TV receiver in producing a pleasing color picture. It was definitely not as good as three-color TV nor Kodachrome slides.

This simulation was done during May 1958 by the above authors. We feel that a significant amount of further effort would be required to resolve the question of applying these principles to color television.

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SUBJECT: Two Color Evaluation

Syracuse, N. Y.
May 14, 1959

Mr. G. A. Schupp
O F F I C E

1. Progress since evaluation of May 1958:

(a) Land's further work as reported in the Scientific American and Fortune of May 1959. Although the Fortune article claims "Full" color rendition with two primaries, the chart of colors "seen" vs. various primaries shows that no two primaries will produce all colors. Land says that while two primaries appear to produce most of the sensations of color, that he suspects that a third stimulus will enrich and improve the colors developed by two primaries. Land is planning experiments with a third stimulus.

(b) Our preliminary experiments of last year with a two-color TV simulation indicated that we could produce pictures with, say, orange and white primaries that were pleasing but were definitely not as good as Kodachrome slides nor three-color TV. Our most pertinent observations were that color adaptation was taking place and that a different set of taking characteristics was requires to optimize any particular color within one picture.

(c) Eastman Kodak has tried both additive and subtractive primaries in this two-color field. They have also tried a third stimulus. All without arriving at a competitive picture. T. G. Veal reported (5/13/59) that they found it necessary to adjust the amplitude of the white light source for optimum colors in each slide viewed. He said he was also concerned about the adaptation that takes place. He said they had virtually no effort on two color at the present time except to reevaluate and to demonstrate. Since our visit last year they have demonstrated what they have to D. G. Fink of Philco, RCA, Stromberg-Carlson and the Technicolor people.

2. Conclusions from the above work:

(a) The two-color system of Land does produce the illusion of many colors but has certain limitations;

(b) These limitations are: Cannot produce all colors for any one set of primaries; cannot produce optimized pictures for one set of conditions; cannot produce flat color fields or color bars; cannot produce a picture which is comparable to Kodachrome or three-color TV.

(c) Land's system appears to have certain advantages within these limitations. These are the apparent insensitivity to gain and gamma changes in the two-color channels.

(d) It is not apparent how to apply these advantages to our present three-color system. It would probably mean a change of transmission standards but could result in much less critical adjustments in the transmission and reception of color signals.

(e) Land's experiments certainly represent a partial breakthrough in color simplification. Whether a complete breakthrough can or will be made cannot be predicted.

3. Possible development activity:

To keep abreast of this rapidly changing field there are several possible investigations that could be made:

(a) Set up our two-tube display and flying spot scanner again, for demonstrating and further exploring of "taking" and "reproducing" primaries.

(b) Viewing off-the-air color signals on the two-tube display by building an adjustable matrix unit for converting NTSC coordinates to two-color "taking" characteristics.

(c) Set up our two-tube display with a two-color camera for an evaluation of live material. Could be done in cooperation with TPD.

(d) A more thorough study of Land's results to determine if enough information exists to apply the results to the improvement or simplification of three-color TV.

4. Possible expected results:

(a) The development of a fuller understanding and evaluation of the two-color system.

(b) The two-color approach might progress far enough that we should seriously consider sponsoring work on the development of a two-color display unit.

(c) Have enough experience in this field so that if a complete breakthrough is made in this field we would be in a position to capitalize on it without delay.

5. Recommendations:

(a) At this time I would recommend that we put only a small effort on setting up the two-color display unit with the flying spot scanner and build the matrix box for off-the-air viewing. This can be done with about four man weeks of effort because most the equipment is on hand. Viewing of off-the-air programs would give us a first-hand reaction as to the ultimate value of this approach.

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