Director of Engineering

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'ARIEL' ARTICLE ON COLOUR TELEVISION

The Editor, Ariel

I enclose herewith the proposed article which I hope you will find satisfactory. If, however, you would like it amended or in any way lengthened, shortened or changed please do not hesitate to say so.

The first figure is on page 15 of the booklet on Colorimetry, which is enclosed. The second is on page 3 of the Science Journal Reprint, also enclosed. Could I take it that you will get the approval of the latter publication for repeating this diagram? Figure 3 is the enclosed slide.

CVG
Atts.

Phoned re proof 5/9

F. C. McLEAN.

ARTICLE FOR ARIEL

COLOUR TELEVISION

by

Sir Francis McLean, Director of Engineering

Following

From its inception on 1st July we are now about ~~half-way through~~ Colour Launching to ~~the~~ start ~~of~~ the full service on 2nd December. We have already seen what colour can do to television in some striking outside broadcasts, in some of our regular film programmes, and in some other programmes.

To many people, particularly in the Engineering Division, who have been working on colour since 1950 it has seemed almost incredible that we should at last be in operation, but this is the case, and everybody who has worked on colour all these years is very glad that this is so, and is confident that the joint efforts of ourselves, the Industry and the Post Office will result in a service that will be attractive to the public and will give a new meaning to television.

We had hoped that it would be possible to reach agreement in Europe and in large parts of the world on a common colour system, but unfortunately such agreement could not be realised so that in addition to the split of world television into those areas which are based on 60 pictures per second and those based on 50 pictures per second, we have this further split in the 50 pictures per second areas of the world into the proponents of the PAL system and of the SECAM system.

Basically, however, there is very little difference between all the systems, and it is possible to convert fairly readily between one and the other, but of course with some loss of picture quality and added complication to the means employed. All the systems employ the same basic approach as first evolved in the NTSC system. This is to produce a signal which is in every respect similar to the signal we are accustomed to in black-and-white television and to continue to radiate this so that black-and-white receivers continue to get an adequate television signal, thus fulfilling the need for "compatibility". To this standard black-and-white signal we

add another signal which gives the colour content of the picture. The basic content of this colour signal is also the same in all three systems; the difference exists in the way that this colour information is coded.

Before talking about coding, it is perhaps advisable to consider the basis of a colour television system. White light is a mixture of all the colours of the rainbow, but we can obtain an effective white light if we mix together only three colours, that is, certain shades of red, green and blue. This is show in Fig.1, where the sum of these three colours gives us white. Therefore if we take the white light entering the camera and we analyse this white light to obtain the separate amounts of each of these three colours and use these to produce signals equivalent to the blue picture, the green picture and the red picture, as show in Fig.2, we shall have analysed the picture and obtained the basic information for transmission. To transmit these three signals separately would, however, be impossible within the spectrum space available in the television channels and would destroy the compatible aspect of the transmission. What we do therefore is to combine these three signals in such a way that they form a single signal, to include this in the available channel space with the normal black-and-white signal, and then transmit the whole over the air. This is the coding process. In the receiver we do the converse process, that is, decode the signal into the three components that make up the colour signal, and use these to get signals corresponding to the blue, green and red components of the picture. We then have the problem of displaying these. Although a number of other proposals have been, and are being, tried, at the present time the only practicable device for home reception is the shadow mask tube.

p.15 of Color-imetry

p.3 of Science Journal

To obtain a colour pictures we must have a screen that will glow in different colours and some means of telling it what colour it is to show at every point in the picture, as well as how strongly it must glow. Almost any colour can be produced by combining light of the three primary colours, red, green and blue, in the right proportions. The screen of a colour receiver is coated inside with three different materials each of

which glows in one of the three colours when struck by an electron beam. The whole of the inner surface of the screen is covered with small specks of the three materials arranged in about 400,000 groups of three, so that when viewed from the normal distance the light from each little triangle is either red, green, or blue, or any combination of these primaries. (A certain proportion of each produces white, so that a colour receiver will produce black-and-white pictures when the programme is being sent out uncoloured.)

The next problem is to arrange for three separate electron beams to scan the screen in such a way that the 'red' beam strikes only the specks of red phosphor, the 'green' beam only the green specks and the 'blue' beam only the blue specks. This is done by an ingenious arrangement called a "shadow mask", which is pierced by a large number of small holes so placed that only the beam from the 'red' gun strikes the specks of red phosphor, and so on. The shadow mask and the screen itself have to be manufactured and put together very precisely indeed. This is one reason why colour receivers will cost at the present time some three or four times as much as black-and-white receivers. The resulting set looks, until it is switched on, exactly like a black-and-white set except in most sets there is one additional control which adjusts the intensity of the colours. Some however have a second additional knob which adjusts the tint of both the black-and-white and the colour picture. Normally these need not be touched and the colour receivers will reproduce either black-and-white pictures or colour pictures without attention from the viewer, dependent only on hwat kind of signal is being put out from the transmitter.

In anticipation that colour would one day come, all our planning for BBC-2 was done with this in mind. The transmitters and the network will accept colour, as will the programme lines. The studios in so far as both lighting and ventilation are concerned were made so that colour equipment could be used. Our telecine equipments, video tape recorders, etc., were all made colour capable by the addition of a certain amount of equipment. We have built two colour MCRs, the first of which has been in use since early June and the second is about to go into use.

The basic principle of operation of this equipment is, of course, the same as for operating similar equipment in black-and-white but the addition of colour naturally brings in an additional complexity. In operation it is, of course, necessary to acquire the same diagnostic abilities in colour as have been achieved in black-and-white after many years' experience. The help in this situation intensive training in colour was started at Wood Norton and in Studio H in the autumn of last year and some hundreds of engineering staff have been through training at Wood Norton and in Studio H, and large numbers of programme staff have also been through training in Studio H. In addition we habe been gaining as much experience as possible with the operation of the equipment in Presentation B and with commissioning of equipment for Studios 6 and 8 and the colour MCR. All this is very necessary if we are to maintain the same uniformity of excellence in the colour field as we have established in the black-and-white field. Indeed overall we have to be more careful with colour than in black-and-white, for whereas the public are not able to percieve readily distortions in the grey scale of a picture they will see very readily distortions in the colour value of a picture.

The overall performance of any television system is, of course, very dependent on the receivers used. The Radio Industry and ourselves are very conscious of this and there has been close co-operation between us in experimentation with receivers and in test transmissions. In Addition, to demonstrate what can be obtained with colour reception we have equipped a mobile colour van and this is touring the country and stopping at selected centres to demonstrate what colour reception means. A most importatn part of colour reception is a good UHF aerial. By publicity over the air, by the printed word and by mobile demonstrations we are bringing this home to the public as we are confident that with a good aerial UHF reception can be reliable and give good colour standards. It is virtually free from many of the interference problems, particularly sporadic-E propagation which causes such trouble on our Band I transmissions. This confidence in the excellence of UHF reception is obtained as a result of a very intensive investigation of UHF reception carried out in the London, Midland and Lancashire areas last winter.

This start of colour is a project on a scale and at a speed of development that we have never before attempted. Within a few months we will be spreading colour to reach three-quarters of the population of the U.K. and we will be completing facilities so that almost the whole of BBC-2 will be in colour. All of us who are close to the problem feel very certain of the appeal of colour and confident of the increased appreciation and enjoyment that it will being to all colour viewers.

/Fig. 3, photo off end of tube - bowl of fruit/

FCMcL/CVG
27.6.67