From: Chief Engineer, External Relations

C.E.E.R.

Room No. & Building: 602 H.W.H. Tel. Ext.: 5350

date: 22nd December 1966

Subject: "ARIEL" : ARTICLE ON COLOUR TELEVISION

To: D.E. Copy to: H.E.I.D.

(1) yes please

(2) Could we play the need for post

You will remember that a long time ago we promised the Editor we would produce an article on colour television at the appropriate moment. He would like to have one for publication early next summer. He thinks that by drumming up some advertisements for colour cameras, etc., he ~~hopes~~ may get enough money to pay for some illustrations in colour to accompany the article.

(1) I am sure you will have your own ideas about what should go in the article, but if it would help I will prepare some notes. I think it should start by explaining very simply how colour television differs from black and white television, should then go on to say what steps we are taking to provide studio equipment, O.B. equipment, telecine, video tape equipment and standards converters to operate in colour, and should say something about the distribution network, receivers and the prospects for colour in BBC-1.

(E.L.E. Pawley)

aerials etc ?

11.1

CSH

AS/20

From: Chief Engineer, External Relations

Room No & Building: 602 H.W.H. Tel. Ext.: 5350

date: 12th January 1967

Subject: "ARIEL" : ARTICLE ON COLOUR TELEVISION

To: D.E.

With reference to my memorandum of 22nd December, I attach some raw material for your article.

(E. L. E. Pawley)

ET

Att: P.S. The dates of forecasts will have to be checked immediately before publication.

AS/20

From: Chief Engineer, External Relations

Room No. & Building: 602 H.W.H. Tel. Ext.: 5350

date: 26th January 1967

Subject: "ARIEL" : ARTICLE ON COLOUR TELEVISION

To: D.E.

I have mentioned the point you raised to Peter Irving. He still thinks, as I do, that the issue should contain a simple explanation of how colour television works, but he appreciates your point that it does not marry up very well with the main topic of your article.

It would be quite easy to separate the explanation from the rest of the material and make a separate short article, illustrated by diagrams in colour, on "How it Works".

(E. L. E. Pawley)

ET

AS/20

DRAFT ARTICLE FOR "ARIEL"

12th January 1967
ELEP/ET

COLOUR TELEVISION IS NEARLY HERE!

by Sir Francis McLean
Director of Engineering

What an exciting world this is when we see it in full colour! This is the world we are going to show to BBC-2 viewers - or rather to those lucky enough to possess a colour receiver - when the colour service starts towards the end of this year.

Preparations for a colour service have been going on since 1954, when the first NTSC pictures were transmitted from Alexandra Palace. Since then there has been a great deal of development work and a long and often frustrating series of discussions in an attempt to reach agreement on a common system for the whole of Europe. The attempt failed and there will be two different systems, PAL and SECAM, in Europe, in addition to the NTSC system already established in the U.S.A., Canada, Japan and elsewhere. But we have learned a great deal from all the experiments that have been made and we are certainly capable of producing better colour pictures now than we would have been a few years ago.

You may think that black and white television is pretty complicated, and that colour cannot be much more so. This would be roughly true, were it not for the need for "compatibility" - that is for the pictures to be seen in black and white by those viewers who still have monochrome receivers. For many years they will be a majority - at first a very big majority - and they cannot be sacrificed to make a many-splendoured thing for their more fortunate brethren.

Probably you know that a black-and-white picture is built up on your screen by a thin pencil of electrons moving across inside the face of the tube and tracing out the picture varying in light and shade, in 625 horizontal lines (for BBC-2). To avoid flicker, and to portray

movement smoothly, the whole process has to be repeated 25 times a second. The inside of the face of the tube is coated uniformly with a material (a "phosphor") that glows where it is lit by a beam of electrons, and the strength of the beam tells it how brightly to glow at each point and at each moment of time.

To colour the picture 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 these 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 three or four times as much as black and white receivers.

The colour transmission must carry three separate signals to actuate the three electron guns and the colour camera must produce separate red,

green and blue signals. It would be fairly easy to transmit the three signals separately all the way from the camera to the receiver, but this would mean that black-and-white viewers would not be able to see the programmes that are transmitted in colour. It is necessary to combine the three signals in such a way that they will give the right impression of light and shade on black and white sets, and to transmit all the colour information in such a way that the colour signals will not produce interference patterns on the screen of a monochrome receiver. A most ingenious method of doing this was developed in the U.S.A. and launched as the NTSC system in 1953. Several other methods have since been proposed, notably the PAL and SECAM systems, all of which incorporate some of the basic principles of the NTSC system.

The BBC has, in the past, favoured the NTSC system, because it has been in use in the U.S.A. for nearly 14 years and its performance in service conditions is well known. However, it proved impossible to obtain agreement to its use in other European countries. The PAL system has certain advantages and a few disadvantages; it is an entirely acceptable system and will be used here and also in Germany, Italy and several other countries. France, the Eastern European countries, and some others have decided on SECAM. Fortunately for the international exchange of live programmes and of video tapes, pictures originated on any one of the three systems can be "transcoded" to any other, the change between NTSC and PAL being the easiest. Transcoders will be needed not only in the BBC, but in many countries relaying programmes from abroad by Eurovision or by satellite.

Whatever system is used for the "coding" of the colour signals - NTSC, PAL or SECAM - the cameras, the distribution network, the transmitters, and a considerable part of the receivers are the same. We were therefore able to get ahead with much of our planning and ordering of equipment before the decision on the choice of system was made in the Spring of 1966.

Colour, when it comes, has got to be good colour. It must attract an audience from the start and provide a market for receivers. A great deal of experimental work has been done, both on the technical side and on the programme production side, to ensure that we know what we are doing. Close co-operation is being maintained with the receiver manufacturers to make sure that, as far as possible, viewers can have pictures of a quality approaching what is seen on the monitors in the studio. This is not an easy problem - it is not yet completely solved in the U.S.A. where more than eight million colour sets are in use. Our Designs Department has tested early models of colour receivers as they come from the makers and has reported to them on their performance, so that any short-comings can be put right before production starts on a large scale. Colour will make heavy demands on dealers and servicemen, and on the facilities for training them in colour techniques.

To give the public and the trade an idea of what colour television will be like, we are equipping a van with colour receivers; it will tour the principal cities so that demonstrations can be given either in public halls or in the van itself. This is particularly necessary because there will be no Radio Show in 1967.

Receiving aerials are very important for the reception of BBC-2, and even more so for colour. Unfortunately many BBC-2 viewers are using quite inadequate aerials and so condemning themselves to a much poorer standard of reception than they ought to have.

What are we doing to equip the BBC to produce enough programmes in colour to enable BBC-2 to carry at least 15 hours a week of colour from the start of the service?

On the transmission side there is no problem, because all BBC-2 transmitters were designed for colour when they were built. They are now being provided with colour test equipment to make sure that the output is up to standard. Regular experimental transmissions on the PAL system have been made from the Crystal Palace station since May 1965 and from

Emley Moor since January 1967. Most other BBC-2 stations will be ready to transmit colour by June 1967 and all will be ready before the service opens.

The BBC-2 distribution network - mainly comprising microwave links rented from the Post Office - was also designed for colour from the beginning.

On the studio side, a great deal of planning and re-equipment has had to be done. A Presentation Suite at the Television Centre in London has been ready for colour since January 1967. Two other studios at the Centre, apart from Studio H at Lime Grove which has been used for a long time for experimental transmissions, will be ready by the late summer or autumn of 1967, and a third studio later. Colour cameras will also be provided at Alexandra Palace for News by early 1968 and this activity will later be transferred to the new spur at the Television Centre. Three Mobile Control Rooms for colour are being built, two of which should be available before the service opens. The new regional headquarters in Birmingham and Manchester will be equipped for colour from the start.

In addition to the cameras, colour telecines are being provided for transmitting films, video-tape recorders for recording and reproducing in colour, coders for converting the red, green and blue signals to the PAL format, transcoders for converting between PAL, SECAM and NTSC, and a great deal of equipment for monitoring, testing and training purposes. The difficult problem of recording colour pictures on film has not yet been solved, but fortunately they can be recorded on tape. Tape recorded on the American 525-line standard can be converted to 625 lines with the new electronic field-store converter developed by Designs Department, and transcoded from NTSC to PAL.

Colour cameras need rather more light than black and white cameras. Special lighting equipment is being used for colour, with a new system of control. Film cameras and processing equipment for colour films have also been ordered.

Test transmissions in colour within BBC-2 programme hours are starting in the spring of 1967. These are to help the Radio Industry and radio dealers to get receivers working and to give BBC staff practical experience with colour. By the summer of 1967 these transmissions should be extended to nearly all BBC-2 stations. The scale of these transmissions will be progressively increased until the actual colour service starts in the autumn.

This is a great adventure. Most of the equipment is new and untried. Few BBC staff have experience in colour working, although intensive training is in progress. Colour receivers present new problems to the Industry and to servicemen. The response of the public can only be surmised. Never before has the BBC committed itself to such an act of faith. Our well-wishers throughout the world will join with us in acclaiming its success - and we are determined that it shall succeed.

Suggested illustrations in colour :

Diagram illustrating principle of shadow mask tube

Colour test card

Photograph taken off tube