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REPORT ON VISIT TO MOSCOW

29th September - 8th October 1964

Following on discussion with Mr. Novakovsky (Head of Radio Institute) an invitation was received from the State Scientific Co-ordination Committee for a BBC delegation to visit Moscow and discuss with the authorities concerned there the whole problem of the choice of a colour system. Accordingly Mr. F.C. McLean (D.E.), Mr. S.N. Watson (H.D.D.), and Dr. R.D.A. Maurice (A.H.R.D.) went to Moscow on the 29th September and returned on the 8th October.

We found when we got there that a programme of visits to the important Committees dealing with these problems had been arranged and we were also asked to give a series of lectures dealing with our overall appraisal of the situation and with varied aspects of both colour and black-and-white television broadcasting. This was done and at all these lectures we had a good and appreciative audience of from 50 to 70 people from all the interests concerned. We attended meetings of the four bodies principally concerned with the choice of a colour system. At these meetings there were usually about fifteen or so apparently senior people. The four bodies, and the number of meetings we had with them are:

1. The State Committee on Radio-Electronics of the U.S.S.R. (2 meetings)

Chairman: Kalmikov (whom we did not see)

First Deputy: Kazansky - a very competent and forceful man

Deputy to Kazansky: Lobov

This Committee appears to have a large number of members and controls the design, development and manufacture of receivers, studio equipment, transmitters, test equipment, etc. The Radio Institute is under the control of this Committee and Novakovsky reports to Kazansky.

2. The Ministry of Communications (1 meeting)

Minister (P.M.G.): Psurzev

Deputies: Klohev
Serjaichuk
Ravid

Head of Long Lines Department: Dombrowski

This Ministry is very nearly the same as the British Post Office in that it controls and operates line communications but it also operates the radio transmitters for sound and television broadcasting. It controls frequency allocations.

3. The State Committee on Radio and Television

Chairman: Kharlamov

Deputy: Maksakov

This Ministry controls the programmes and the operational activities of the engineers under its command. It operates a development laboratory for colour.

4. The State Committee on Co-ordination of Scientific Research (3 meetings)

Chairman: Streljchenko - present at meeting with Kazansky and in the chair at the three meetings we had with this Committee.

This Committee is charged with co-ordinating the work and presumably the decisions of the three preceding bodies. We had the impression however that its membership was much less forceful and less decisive than the three foregoing Committees.

In addition, however, we were told that a special committee is being formed to make a recommendation to the Government on the colour television system to be adopted. We were further told that this committee was being instructed to report before the end of the year and that the U.S.S.R. intended to take a firm decision on the system they wished to use by the end of the year. It seems that they do want to press for a decision at Vienna.

We were very well received everywhere. The general approach at all meetings was to ask us to make a statement - which we did on the lines of Appendix 1 - with a slightly varied stress and elaboration dependent on the conditions and whether it was the first or a subsequent meeting. We then answered a large number of questions, nearly always very good and well directed to the point at issue and were then asked to put our questions. This we did both orally and in written form (see Appendix 2). Our questions were varied but the general line was in accordance with our views (see Appendix 1). We tried to find out their reactions and as far as we could what definite results they had available at this time. The reception to our questions was perhaps all that we could expect in the circumstances but we usually obtained very little information on technical matters. Precise of the statements made at the various meetings are in Appendix 3.

We had 3 meetings with the Co-ordination Committee (Mr. Streljchenko, Chairman)

" " 1 " " Mr. Kazansky, Deputy Chairman at the Committee on Radioelectronics and one with his Assistant Mr. Lobov.

We had 2 meetings with the Ministry of Communications - Mr. Dombrowski (Head of Long Lines Department)

We had 1 meeting with the Ministry of Broadcasting - Mr. Kharlamov (Chairman)

Our principal impressions of all this are:

1. The U.S.S.R. does intend to take a decision on colour by the end of the year for submission to the C.C.I.R. in Vienna and to start a colour service by the 50th Anniversary of the October Revolution on 7th November 1967 (7th November was 27th October in the Tsarist calendar). Dombrowski, however, said that he thought further extensive tests should be made before a definite decision was taken.
2. That considerable effect has been caused by the visits of C.F.T. (SECAM) and Telefunken (PAL) and that before we arrived most of the people concerned would have decided in favour of SECAM or PAL.
3. If we had not come it is doubtful whether they would have sent representatives to the London meeting.
4. We believe we have made an impression and that they are now prepared to look more favourably on the adoption of NTSC. They are now aware of the relative factors involved in the assessment of the three systems and in particular the importance of compatibility and the need to provide for future developments.
5. A number of points came up repeatedly:
 - a. What was the situation in the U.K. on the start of a service. We referred to and read out the P.M.G.'s statement and said that the BBC hoped to have its facilities ready by the end of 1966 in order to train staff and rehearse for a service in 1967. To this end we would order as follows:
 - i. equipment not dependent on the system in November 1964.
 - ii. equipment dependent on the system in May 1965 - after the Vienna meeting.The transmitters, lines, etc. being built and provided for BBC-2 have all been designed for colour.
 - b. Was opinion in the U.K. unanimously in favour of NTSC? We said that the P.M.G.'s Committee, on which are represented the Post Office, BBC, I.T.A., I.T.C.A., Industry, and representatives of the general public, was unanimously in favour of NTSC. Copies of the Saward article in the Financial Times were distributed.
 - c. What was the position in Europe - this was outlined with particular reference to Dr. Gerber's statement.
 - d. We had many enquiries and statements as to alleged slow progress in the U.S.A. These we countered and produced evidence of the present rapid growth of colour television receiver sales and handed out copies of paragraphs from the Television Digest, Vol.4, No. 37, of 14th September 1964.

6. We gave a series of lectures on subjects connected with colour. These were very well attended by engineers from all the Committees and activities and we did our best to make clear the points at issue. The interest in these lectures was high and the questions were good.
7. All bodies that we met were very friendly, gave us a very good welcome, and were clearly very pleased that we had come and said so.
8. The development of the multiburst automatic equaliser for differential phase aroused great interest and was seen as a possible method of overcoming their difficulties with long distance line transmission. They were much interested in our offer to try out the devices on the circuit London - Moscow provided that this was co-ordinated with the EBU/OIRT which, of course, we said we would do. They said they had to envisage colour distribution over internal circuits in the U.S.S.R. having lengths of up to 16,000kms.
9. We had difficulty in obtaining details of the results of U.S.S.R. tests and we formed the opinion that few tests had been made and some of these had not been done with sufficiently good equipment to give valid results. We hope that our visit will impress on them the importance of using the right equipment and methods.
10. We saw little technical activity but some details are given in Appendix 8.
11. In Appendix 10 we give a brief summary of important points made at the meetings with the various Committees, by ourselves and by them.

We came away from our visit feeling that it had gone very well and that we had been able to make appreciable impact on the situation. That we were able to do this is in no small measure due to the excellent arrangements made for us by Mr. Garrett, Scientific Attache in Moscow, and also from approaches that had been made by Mr. Chuev, U.S.S.R. Scientific Attache in London.

FCMcL/VAL
22.10.64

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App. 3, 4, 5, 8, 10
to follow

APPENDIX 1: GENERAL STATEMENT MADE BY D.E. ON POLICY AND TIMETABLE

1. Work on colour over the last ten years

We have made appraisals of various systems and proposals. Colour was transmitted on VHF 405 lines for many years and experimental transmissions on 625 lines on UHF have taken place during the last two years and still continue. For six months we made tests with two H.P. transmitters working into the same aerial system and we made direct comparisons of the same pictures transmitted on NTSC, SECAM, and PAL, two at a time. These tests were observed by technical and non-technical observers. It is important to include non-technical observers in the appraisal. As a result of these tests and for reasons which my colleagues and I will give we have come to the conclusion that the NTSC is the system which will give the best overall results when considered from the point of both the origination and transmitting authorities and the viewing public.

2. The basic factors in the choice of a colour system are:

1. The colour quality as viewed on a receiver of minimum cost and complexity shall be good.
2. The corresponding black-and-white picture seen on a normal receiver shall not be appreciably worse than that of a normal black-and-white transmission. This we think is a most important consideration.
3. We should be prepared to accept complexity in the studio, distribution and transmission but should use every endeavour to keep the receiver as simple and reliable over a long time and as easy to operate as possible.
4. We should choose a system which will have the maximum possible capacity for future developments - better display devices, single gun tubes and so on.
5. The system should have the best possibility for the world wide exchange of programmes.

A grading system for the appraisals has been used and is already accepted. A similar grading scale was accepted EBU/OIRT Sofia. One grade is a significant change in appraisals.

3. Picture Quality and Inherent Compatibility of the Systems

- a. In general seen on colour tubes so far available these three systems give the same quality of colour picture, but SECAM is liable to flicker on horizontal edges and give spurious information on vertical edges. (Note 1). With regard to the compatible picture, NTSC is significantly better (Note 2). Observers find a difference of up to one grade between the NTSC and the SECAM pictures when transmitting from a live studio.

Note 1: Com.T.(E) 114 page 4 section 4

Note 2: Com.T.(E) 129 Tables 4 and 5

- b. The NTSC system has higher inherent capabilities than SECAM because it transmits full information. The PAL system may have slightly reduced vertical definition by reason of the averaging effect of the chrominance signal between successive lines. It also has a tendency to produce venetian blind effects which reduces its acceptability. This also applies to delay line PAL. The SECAM system reduces the possible resolution still further (Note 3). This may become significant when higher resolution display tubes appear on the market.

The NTSC system also seems to be advantageous in being more readily adaptable to single gun tube working (Note 4).

With present display tubes all three systems are acceptable as far as colour is concerned but NTSC has a strong advantage on the black-and-white picture (Note 2).

4. Receivers

Receiver cost figures are very hard to define. The basic fact is that the NTSC receiver has the minimum number of components. The synchronous AM detector of the NTSC receiver is more straightforward and easier to adjust than the FM discriminator and associated correction circuits of the SECAM receivers.

Very little information is available yet about the reliability of receivers in the hands of the public in Europe. In the U.S.A. some four million receivers are already in the hands of the public and sales are increasing at the rate of 1.5 - 2 million sets per annum. American experience shows that the public has no difficulty in adjusting a receiver (Note 5). Tests are in hand in the U.K. to obtain information as to the performance of receivers in the hands of non-technical public and information on this should be available by the end of the year. As far as the limited information so far available is concerned it was shown (Note 6) that both NTSC and SECAM receivers required approximately the same number of adjustments irrespective of system.

Three factors influence the desirability for hue and saturation controls:

1. The personal taste of the viewer
2. The effect of change of ambient lighting as between daylight and evening viewing
3. Ability to correct for minor errors in the transmission or receiver which may well extend the effective life of the receiver.

If required, however, automatic control of these features (hue and saturation) is now a known art.

Note 2: Com.T.(E) 129 Tables 4 and 5

Note 3: Com.T.(E) 122 page 6 section 6

Note 4: "Report on the EBU Ad Hoc Group on Colour Television" page 36, section 3

Note 5: Com.T.(E) 52 pages 15 and 16 section 6.

Note 6: "Record of Investigation Undertaken by E.B.U. Ad Hoc Group on Colour Television" Table on page 99.

Publications from the U.S.A. Government in Television Digest for 14th September showed that colour receiver sales in 1962 were 438,000, and in 1963 were 747,000. Reliable forecasts for 1964 show 1.6 million. For the last three years therefore, sales have doubled on the sales of the previous year. Information provided by C.B.S. gives their estimate that before the end of 1965 there will be a total of 5,000,000 receivers in the hands of the public.

5. Studio Problems and Recording

As far as normal studio problems are concerned NTSC is the simplest system and can be handled with little more equipment than is required for black and white. SECAM, however, requires a basic and important change in the studio mixing arrangements. On recording the situation is not quite so clear. NTSC colour recording does require a high performance recorder fitted with Colortec but this machine gives good colour quality and good black-and-white quality. Acceptable colour recording can be obtained on lower grade machines using the SECAM or PAL system but with these lower grade machines some preliminary laboratory investigations show that the SECAM III compatible black-and-white picture is not so good. On balance we feel that NTSC is the easier system to deal with overall and with regard to recording we feel that the further improvements which have been made in the last few years will continue and that this is therefore not a limiting problem. While admittedly SECAM at the present time would make studio recording more simple in the long term NTSC will represent no problem.

6. Programme Distribution Problems

For the distribution of programmes over long communication lines SECAM at the present time would seem to have an advantage. NTSC demands a higher standard of engineering than does SECAM. Such a standard has been developed in the U.S.A. (Note 7) and in Europe (Notes 8 and 9) and will become increasingly available throughout programme distribution network in Europe. However, if programme distribution links do not meet these requirements at the present time we believe it will be possible by using additional signals such as a multi-level-burst system to enable automatic correction to be made (Note 10). We hope to demonstrate these effects at the October meeting in London.

7. International Colour Programme Exchange

For international programme exchange by link or by recorded programme within the 50 field area the differences between the systems are scarcely significant. Programme interchange of colour between 50 and 60 field areas is going to be a matter of considerable difficulty. Conversion from 50 to 60 fields will be difficult but it may be that in future

Note 7: Com.T.(E) 52 page 12

Note 8: "Record of Investigations Undertaken by E.B.U. Ad Hoc Group on Colour Television" pages 136 and 137, Tables III and IV.

Note 9: BBC Designs Department Technical Memorandum No. 8.115(64)

Note 10: Com.T.(E) 124

pictures of either 50 or 60 fields may be radiated in Europe. If this should happen then the NTSC would seem to have a distinct advantage to the other systems. We believe that we might come to a field store conversion from 50 to 60 and that the use of the use of the same colour system on the output side as the input side encourages this possibility. In many parts of the world NTSC is already established and there would seem advantage in Europe's being as well situated as possible to have exchange of programmes, receivers, techniques, and all the other factors that come with the establishment of a successful colour service.

8. Radio Propagation Problems

As far as the performance of the transmitters is concerned we think there is little difficulty in meeting the requirements of any of the three systems (Note 11).

Our tests have shown that the service area of all the systems are equal but slightly smaller than the service areas of monochrome and compatible transmissions (Notes 12 and 13). A small proportion of our existing viewers of the black-and-white service are looking at pictures that are worse than grade 3A. The NTSC system has the advantage that even on these poorer pictures the colour is still acceptable. SECAM I however, gets spectacularly worse when the quality of the black-and-white pictures gets below the grade 3A level. SECAM III was designed to overcome this defect, but the price paid has been a reduction in compatibility. Whereas SECAM I was found to be about 0.7 grades worse than NTSC (Note 14), SECAM III is found to be about 1.25 grades worse than NTSC (Note 15). Tests in Switzerland in mountainous areas have shown that in cases where reception is marred by echoes the NTSC system is slightly inferior to the other two (Note 16).

The BBC proposes to be ready to start a colour service at the end of 1966. This gives little time to do all the work. Equipment not dependent on the system chosen, that is all equipment except the coders, decoders, and mixers will be ordered by the end of the year and the equipment for coding, decoding, and mixing will be ordered immediately after the Vienna meeting in March/April 1965. The radio receiver industry has already made many prototype receivers and a large number of these is being tried out in the homes of non-technical people at the present time. Small scale manufacture of shadow mask tubes is already in hand and it is thought that adequate supplies will be available for the start of a service at the end of 1966. The first receiver will probably have the 53cm. 70° tube but within a short time it is thought that 63cm. 90° tubes will be used.

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- Note 11: C.C.I.R. Study Group XI London, March 1964, document 33, page 4 section 6.4.3.
Note 12: "Report of E.B.U. Ad Hoc Group on Colour Television" page 32, section 4.3
Note 13: BBC Research Department Technical Memorandum No. T.1060/3 page 6, section 3
Note 14: Com.T.(E) 79 Table I
Note 15: Com.T.(E) 114 page 5 Table 2
Note 16: Com.T.(E) 115 pages 25-31.

The BBC 625-line transmitter network is being completely engineered for colour and when a service starts colour signals will be available over large parts of the U.K. Initially colour will be produced from three studios in London but in 1967 we plan to introduce two mobile colour outside broadcast equipments and from the beginning of 1967 we hope that colour will form an important part of our output.

Timetable

Our timetable, subject to confirmation, is:

- a. Order basic R.G.B. equipment - November 1964
- b. Order coders and decoders - April 1965
- c. Complete installation of equipment - mid 1966
- d. Train staff until the end of the year
- e. Open service - end of 1966/early 1967.

APPENDIX 2: LIST OF WRITTEN QUESTIONS AND ANSWERS GIVEN BY MR. KAZANSKY

PART I: Questions from the BBC delegation to the Soviet television representatives

1. What are the intentions of the Soviet engineers on the introduction of a colour service?
 - a. On what date
 - b. Included in the existing service or a separate service
 - c. How many hours per day.
2. What importance do the Soviet engineers attach to compatibility and what are the measurements made by them?
3. What is the opinion of the Soviet delegates as to the colour picture quality of the three systems?
4. What is the estimate of the Soviet engineers as to the relative cost of the receivers for the three systems?
5. What factors do the Soviet engineers regard as the most important in the choice of a system and how do they evaluate the system on these factors?
6. Do the Soviet engineers intend to press for a decision on the system to be used at the Vienna meeting?
7. What is the approach of the Soviet engineers to the problem of recording colour pictures?
8. Will the U.S.S.R. send delegates to the London meeting from 26th - 29th October? If so, may we know their names so that we can book accommodation and obtain visas.

PART II: Answers to the above questions given by Mr. Kazansky were as follows:

1. Before regular services start the U.S.S.R. would like to see a single system adopted for the whole of Europe and it would then take its decision on the start of a regular service. The main factors affecting the choice of a system in the U.S.S.R. would be:
 - a. black-and-white compatible pictures should be acceptable.
 - b. colour receivers should be cheapest and simplest possible.

- c. the system should afford the possibility of exploiting the existing lines of communication.
 - d. It should be possible to record colour television in Moscow and Leningrad. The U.S.S.R. has carried out experimental service on NTSC so they have a good experience with this system. Now their aim is to select the right system and start production of receivers.
2. This was really answered by Mr. Kazansky in his reply to No. 1.
 3. Mr. Kazansky thought that there was not much difference in the picture colour quality but with the present display tube NTSC is somewhat better but he said that SECAM and PAL were better when transmitted over obsolete lines.
 4. The Soviet engineers estimate that, taking the cost of a NTSC receiver as 100, SECAM and PAL would both cost of the order of 103.
 5. This was largely answered as far as we could get much detail in Mr. Kazansky's reply to No. 1.
 6. At the present time U.S.S.R. engineers have not yet reached a unanimous decision as to what system should be chosen but intend to do so by the end of 1964 so that they would be able to make their position known by the Vienna meeting. In reply to questions Mr. Kazansky repeated the two main questions which influenced his opinion:
 - a. the colour receiver should be the simplest and cheapest design
 - b. that under any conditions the U.S.S.R. could use existing communication links.
 7. The U.S.S.R. prefers to use magnetic recording for colour pictures.
 8. The U.S.S.R. would do its best to send delegates to the London meeting. (Since that time we have been informed of the names of these delegates)

At subsequent meetings with other people we received statements generally similar to those given by Mr. Kazansky but with certain, perhaps important, differences. These were:

1. A Committee has already been set up including all the interests involved and charged with making recommendations to the Government by the end of the year.
2. The performance of some of the existing long lines seems to be unacceptable on any system and a statement made that a line was acceptable on SECAM but not on NTSC was denied. We were told by the Telefunken representative that in some tests he made the colour sub-carrier disappeared so that all systems would be unusable.

APPENDIX 6. LIST OF PLACES VISITED

1. State Scientific Co-ordination Committee, Gorki Street 11.
2. Ministry of Communications, Gorki Street 11.
3. State Committee of Radioelectronics, 7 Kitaysky proezd.
4. State Committee for Radio and Television, Pyatnikskaya ul.25
5. Radio Institute
6. Television Centre

APPENDIX 7: LIST OF PEOPLE WE SAW

State Committee of Radioelectronics 7 Kitaysky proezd, Moscow

G.P. Kazansky - First Deputy

Mr. Lobov - Deputy to Kazansky

Mr. Nemtsov

Mr. Vinogradov

Mr. Zahvatoshin

Radio Institute: S. Novakovsky

Mr. Simenov - Chief Engineer

Mr. Savkin

Mr. Chlebaradov

Mr. Sitnikov

Mr. Denisenko -- expert on colour recording

Ministry of Communications

Mr. Dombrowski - Head of Long Lines Department

Mr. Kuzman

Mr. Varbanski - Lines Engineer

State Committee of Radio and Television Pyatnikskaya ul.25 Moscow

M. Kharlamov - Chairman

H.O. Zrishnevsky - Head of Television Department

Mr. Maksakov - Deputy to Kharlamov

Mr. Sarkisov - Chief, Foreign Relations Department

Madame Averbuch - Senior Engineer, Colour Laboratories, Television Centre

Mr. Tezler - " " " " " "

B.S. Borosin - Interpreter

State Scientific Co-ordination Committee

Mr. Streljchenko - Chairman

Mr. Chernevich

Viktor Rjazantsev - Foreign Relations Department

Other Names and Addresses

Mr. D.M. Gvishiane - Vice Chairman of State Scientific and Technical Committee, Gorki Street 11. Telegraphic address: Gosknir. To be written to for research reports.

APPENDIX 9: CONDITIONS APPLYING IN THE BBC TO THE ASSESSMENT OF
COMPATIBILITY OF SECAM III AND PAL EMISSIONS COMPARED
WITH THAT OF NTSC EMISSIONS

1. Scale of subjective criteria: impairment scale (i) on page 1 of Com.T.(E)32.
2. Test observers, presentation of results, viewing distance, ambient illumination and peak-white brightness all to be in accordance with Com.T.(E)32.
3. Colour picture generator: to be any well aligned and adjusted three-tube colour camera.
4. Material to be used in the scene:
 - (i) EBU Colour test fabrics of shiny (not matt) material obtainable from:

The Administrative Secretary
The Television Society
164 Shaftesbury Avenue
London, W.C.2
England
 - (ii) Large areas of coloured material giving rise to chrominance vector amplitudes (in NTSC coded signals) in the range from 80% to 90% of the amplitude of the chrominance vector given by a red colour bar of 100% saturation at 100% amplitude of E_p^1 (see Com.T.(E) 81, pages 6,7, and 8). These large areas of reflecting material of high "luminance x saturation" product should be broken up with sharp edges such as might occur in patterns on women's bright, coloured garments.
5. Movement in the scene: there shall be either movement in the scene being televised or the camera shall be panned and tilted in such a way that the image seen on receiver display tubes is typical of various kinds of television programme such as talks, discussions, plays, outside broadcasts and so forth.
6. SECAM III specification: to be in accordance with Com.T.(E) 108 and "Record of Investigations Undertaken by the EBU Ad Hoc Group on Colour Television".
7. PAL specifications: to be in accordance with "Record of Investigations Undertaken by the EBU Ad Hoc Group on Colour Television" modified, if necessary, to accord with monochrome television standard of the country undertaking the test of compatibility.
8. Receiving equipment:
 - (i) Professional decoders and monitors having zero electrical attenuation of 4.43 MHz relative to the attenuation at low video frequencies such as 200 kHz. The monitors shall possess

monochrome (black-and-white) display tubes of good electron-optical design having good focus. In so far as the overall modulation response is concerned the radio receiving equipment used in conjunction with the professional decoders and monitors shall have the same attenuation at 4.43MHz as at low video frequencies (200kHz).

- (ii) Present-day domestic monochrome (black-and-white) receivers in new condition having display tubes of not less than 48cm. diameter or diagonal. Any receivers having attenuation of the overall modulation response at 4.43MHz, relative to that at low video frequencies such as 200kHz, in excess of 4dB shall not be used because they will not be representative of future domestic receivers for monochrome television standards having a sound-to-vision carrier spacing exceeding 5.5MHz.

9. Receiver tuning:

- (i) The professional equipment shall be accurately tuned for monochrome reception of a monochrome emission.
- (ii) The domestic receivers shall be tuned in the presence of the colour emission, the tuning to be such that a compromise is achieved between picture impairment due to the beat pattern between sound and chrominance carriers on the one hand and picture impairment due to inadequate horizontal resolution on the other hand.