VISIT TO U.S.S.R. 13th - 20th February 1966

by

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C O N T E N T S

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1. INTRODUCTION

This account of the visit made by D.E., S.S.E.Tel., H.R.D., and H.D.D. to the Soviet Union is largely concerned with the information obtained about the proposed new Television Centre in Moscow. Section 6 deals with the technical information which we collected during a rather short visit to the experimental colour group at the existing Television Centre in Moscow.

D.E. has written a report entitled "The Colour Situation in the U.S.S.R." which has been circulated on a restricted basis. This report is not included in this document.

Television has been operating in Russia for the last fifteen years or so, mainly with equipment which, by now, is somewhat old-fashioned. About two years' ago, the decision was taken to expand television activities throughout the U.S.S.R. and to provide up-to-date facilities. In Moscow the expansion will take the following form :

(a) The three existing programmes, with 16.4 hours of output per day, will be expanded to five programmes with 50 hours of output per day. One of these programmes will be in colour. Later a sixth "inter-Republic" programme will be added.

(b) To facilitate this increased output a new All-Union Television Centre, comprising fourteen main studios with comprehensive facilities and ancillary areas, is being built. Its main function will be to produce television programmes to be broadcast throughout the U.S.S.R., and it will produce about 40 of the required 50 hours per day mentioned above.

(c) A large O.B. and film base will be built.

(d) The existing Moscow Television Centre will be modernised and used for programmes for Russia.

(e) Existing fixed facilities in central Moscow will also be modernised. These include a 900-seater Television Theatre, fixed facilities in the Kremlin Congress Hall, the Bolshoi and various other theatres, and the main airports.

(f) A new 1,700 ft. television tower is being built. Five high-power transmitters will be provided to increase the present 25-35 mile range to 100 miles and to permit the use of indoor aerials in Moscow flats.

(g) In addition, a new radio centre is planned. It will be a thirty-storey building adjacent to, and interconnected with, the existing Moscow Television Centre. It will be a glass, aluminium and concrete building, and construction will start in 1967. Amongst other facilities, it will have a 1,000-seater concert hall.

New, or improved, broadcasting centres are being provided in the thirteen Republics of the U.S.S.R. and all these centres will be connected to Moscow. (Only some are so connected at present). Communications satellites will be used increasingly for programme exchange. Molniya I and II are already being used for three to four hours daily to interconnect Moscow and Vladivostock.

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As a result of all this activity, the present potential television audience of 70-80 millions is expected to increase substantially (the population of the U.S.S.R. is about 240 millions).

There is no television licence. Black-and-white receivers cost from £60 to £170 and can be bought for cash, on credit, or hired.

All transmissions will be in the twelve channels available on VHF (Bands I and III). Band III converters are available for the older Band I-only receivers. There are no plans at present for using UHF (Bands IV and V). Similarly, there are no plans at present for broadcasting direct from satellites to people's homes, but they say this possibility is being studied.

Television hours are from about 5 p.m. until midnight, except on Sundays when programmes begin at about 10 a.m. There are no programmes for schools but there are some for correspondence students. We saw a mathematics programme at about U.K. G.C.E. "A" level which was handled in a very simple way - one lecturer, one blackboard, two cameras, and no frills.

Radio

Moscow Radio originates 250 hours of radio programmes in every 24 hours. Much of this is for overseas transmission.

There are three or four radio programmes in Moscow. Programme 2 - Mayak - is a light music programme with regular brief news bulletins. It runs for 24 hours a day and is broadcast throughout the U.S.S.R. Another programme is aimed at youth, and consists of music, education and culture. Its intention, we were told, was to help avoid the kind of teenage problems which other countries are experiencing.

There is no stereophony, apart from a weekly recorded experimental transmission. All new radio stations will have provision to enable stereo to be added later.

2. ALL-UNION TELEVISION CENTRE

The Centre is being built on a site 8 miles from central Moscow, in grounds which will provide plenty of space for expansion. At present there are two large parks and a 20-acre lake in the grounds. The main studios and technical areas are housed in a four-storey block 450 yds. long and 110 yds. wide. Building construction has already reached the fourth floor level. Above this will rise a thirteen-storey office and central technical area block, measuring about 200 yds. x 110 yds., and located centrally above the studio block. There will be restaurants and shops for the staff.

The cost of the Centre will be about £35,000,000, of which approximately £10,000,000 will be for building work, £11,000,000 for equipment, and the remainder for technical services, including scenic workshops, etc. The nearby transmission tower will cost about £5,500,000.

About half of the four-storey section of the Centre will be devoted to studios, and the remainder to ancillary facilities, such as telecine, recording, scenery, wardrobe, etc., and there will be dressing-room accommodation for 1,500.

There will be fourteen main studios, two of 11,000 sq.ft., seven of 6,600 sq., five of 1,650 sq.ft., an 800/1,000-seater

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television theatre, and "several tens of very small studios".

Concept

Because the main requirement of the Centre is to produce programmes to serve the entire Soviet Union, nearly all the output will be recorded in one way or another. The programmes will divide themselves roughly into two categories:

(a) Those programmes which it will be important to keep and replay over a number of years and which, therefore, should have a "long reserve" of quality. These programmes will be recorded on film which, in their experience, is the only medium which gives good enough quality. In their opinion, all forms of television recording suffer quality degradation in one form or another. Their experience of video tape recording has been most unsatisfactory and only a few video tape recorders, using 3" tape, are in service. Russian video tape recorders are being re-designed and improved, and 2" video tape machines will be installed in the Centre. Russian video tape is of poor quality, and EMI tape is preferred.

(b) Those programmes which are wanted only for a few days or a few weeks. They will be recorded on the new 2" video tape machines, plus a few film recorders for special requirements.

Of the fourteen main studios being built, four will be equipped for video film recording, and the remaining ten for direct electronic recording.

Video Filming

One 11,000 sq. ft. and three 6,600 sq. ft. studios will be equipped for video filming. One of the 6,600 sq. ft. studios will be lit for colour. Video film recording has been chosen, rather than direct filming, because productivity must be high. They say that in the entire Soviet Union orthodox film studios are producing 120 hours of film a year (which, incidentally, can be shown on television six months after cinema release). In these four studios and associated smaller puppet and cartoon studios, which are mentioned below, 200 hours of film a year will be produced.

The four video film recording studios will each have four cameras and will be equipped for 16 mm. working. The electronic tube in the camera has not yet been decided upon. They would like to use the plumbicon, because of its small size and its sensitivity, but are not happy about selecting a tube which is at present made in only one factory in the world, and that factory is, of course, outside the U.S.S.R.

The details of the video film recording system are still being worked out. They intend to operate under as near television studio conditions as possible, to reduce the amount of editing which will be necessary afterwards. They intend to make a control video tape recording to help editing. Their aim is to produce a one-hour film in nine six-hour shifts. This may be compared with, it was stated, thirty six-hour shifts to make one-hour of film by photographic methods.

In addition to the four main studios, the following areas will also be devoted to video filming, and to servicing video films :

5 studios for making cartoons
2 studios for making 3-dimensional puppet films
50 editing rooms
11 film review theatres

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3 television review theatres
7 sound dubbing theatres
1 3,300 cu.yd. studio for music dubbing

In all, about one-third of the area of the four-storey technical block will be devoted to video film production.

Electronic Recording

The remaining ten studios in the Centre will be equipped with 4½" image-orthicon cameras and used mainly for making video tape recordings. Associated with the studios will be five 16 mm. film recorders, five 35mm. film recorders and large video tape recording areas.

Before visiting the BBC, France and Italy, it was the intention to install a total of 103 video tape recorders, but - after visiting us and, in particular, in view of the efficient working methods of the BBC, they said - they hope to be able to reduce the number of machines to something like 80! There will be six large blocks of video tape recorders for recording purposes. Sound and picture will probably be recorded separately to facilitate editing. Four video tape editing rooms will be provided, two of which will have audio studios attached to permit additions to the recordings. Each main studio will have its own video tape reproducer and one or two telecines for inserts.

Continuity and Central Facilities

The thirteen-storey office block will contain the central technical facilities and seven 550 sq.ft. studios for presentation and continuity purposes. Each of these small "announcer" studios will have its own control room, telecine room and video tape reproducer room. Initially, only six of these seven continuity areas will be equipped, i.e. one for each programme.

There will also be a number of "interpreting studios" to permit the presentation of a programme in more than one language simultaneously. Translations are usually made on the air and are not normally pre-recorded.

Scenery Production

Scenery production and storage will occupy three floors. The main woodworking shop will be underground with a ramp up. There will be workshops to produce items in metal, in wood, in papier mâché, in plastic, and in foam. All scenery preparation will be done outside the studios, which are on the first floor, with the scenery stores beneath.

For quick handling of scenery, there will be large, heavy-duty lifts, one of which will be capable of taking a lorry and trailer, and a number of smaller lifts. The studios will be equipped for quick removal of scenery and two of them, one of 11,000 sq. ft. and one of 6,600 sq. ft., will have half their floors capable of being lowered in sections to ground level, equipped with scenery and raised to the desired working level, which may be above or below the main studio floor level. Scenery hoists will be fitted in all studios, and it will be possible - in the larger studios - to gang together up to ten barrels for raising or lowering scenery.

Cycloramas will be fitted and the usual practical services will be available in every studio, i.e. water, gas, compressed air, smoke and drainage.

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The areas allocated for scenery manufacture and storage are :

Dry Workshops	70,000 sq.ft.
Wet Workshops	66,000 sq.ft.
Stores (including wardrobe)	50,000 sq.ft.

The scenery areas are 30 ft. high.

We saw an interesting technique for making lightweight scenery. A 2" wide paper honeycomb is sandwiched between thin plastic sheeting. It is available in a number of standard sizes and, as well as being lightweight, appeared to be strong and durable. For acoustic purposes the honeycomb can be filled with foam plastic.

Lighting

The lighting facilities, which were described by the woman engineer responsible for planning of lighting and power facilities (Section Head!), will be similar in both video film and electronic studios. Lanterns will be mounted on telescopic supports, formed of triangular sections which will telescope into each other as the lantern is raised. The largest triangular sections will have sides 20 inches long. The power cable will be in the form of a spiral within the triangular section. It is intended to automate the lighting operation completely, and it will be possible to raise, lower, rotate, focus and incline the lanterns remotely. When required, the telescopic arms will be used to mount remotely-controlled cameras.

The studio ceilings will be equipped with mono-rails at 8 ft. spacing, and it will be possible to move the telescopic supports along these mono-rails by hand. A wide variety of lanterns will be used, and light sources will include internally-silvered bulbs, quartz-iodine lamps, etc. Dimming will be by means of magnetic amplifiers. Each studio will have an electronic programming unit with a memory section to store information on lighting changes. It was said that the lamps operate at a temperature of 3,100°K.

The maximum lighting load in the large studios will be 450 kWs. There will be 10 kW sockets at 6½ ft. centres on the studio ceilings. Power will be at 220v. and lanterns will range from 500 W. to 10 kW. The internally-silvered bulbs are in the range 300-500 W. and will normally be used in banks to provide broad sources of illumination. Lighting levels with 4½" image-orthicons are likely to be 100 ft. candles for monochrome television, 250-300 ft. candles for colour television, 250 ft. candles for monochrome film and 400 ft. candles for colour film.

Technical Equipment

4½" image-orthicon cameras will be used in the studios for monochrome working. No decision has yet been taken on the type of colour cameras to be employed. They were impressed with the plumbicon colour cameras they saw on their European tour, but are nervous about standardising on a tube which is not yet freely available and is not manufactured in the U.S.S.R.

Semi-conductors are scarce in the U.S.S.R. and all electronic equipment will be of the valve type.

They are not at all satisfied with existing film cameras and hope to develop a better 16 mm. camera, both for video filming and for normal use, e.g. news, etc. Some 35mm. film is used,

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mainly for programmes other than for news and current affairs.

It was made clear that only U.S.S.R.-manufactured equipment would be used in the Centre, which is obviously intended to be a show-place.

A research and development group will be accommodated in the Centre, with an experimental workshop employing 200 staff. This unit will be engaged in developing and improving technical facilities in the Centre. Elsewhere in Moscow a 100,000 sq.ft. building is being erected for research, development and equipment manufacture.

Colour

All studios will have lighting and ventilation capacity for colour, but only one of the electronic studios will be equipped initially with colour cameras. One of the video filming studios will also be equipped initially for colour film working.

Building

The Moscow Television Centre was of particular interest for the building methods employed. When we were there there was some 8-10 degrees of frost and it is normally at this sort of temperature for most of the winter. In spite of this continuous pouring was going on in the concrete tower and pouring on some concrete beams was also in progress. We were told that electrical heating is used on important concrete beams. Brickwork was going on quite normally with what looked to be a rich mixture of mortar which was being mixed with water that was warmed so that it was gently steaming. They said brickwork laid in the frost was quite sound and they did not seem to be taking any special precautions to cover up such brickwork. The main building was done very much on a modular basis. All the main beams and pillars of the building were of pre-cast, reinforced concrete construction with the metal work projecting. These beams, which were very heavy, were welded together at the projecting studs. In the 4-storey high building the main vertical pillars were therefore welded together from four separate pieces, each one-storey high. Correspondingly, for the horizontal beams. We saw this type of construction being used on other buildings in Russia and it seems a very good way of avoiding difficulties due to site conditions. There was little shuttering used on the building but in one or two places shuttering was up and concrete was being poured. The floor beams were very interesting; they were like inverted dishes, about 12 ft. long, about 2 ft. 6 ins. wide and made of concrete which was about 5 ins. thick. It seemed to make a very strong floor in that in the large studio of 10,000 sq.ft. there was a very heavy crane running on rails. The total weight of the crane was said to be 300 tons and looked like it. The building work generally seemed to be well organised. The bricks arrived on pallets and were loaded straight from the crane on to motor-operated trucks that distributed them round the various floors.

A feature of interest in the building was that the main operating floor was up on first floor level. This gave plenty of space on the true ground floor for scenery storage, general operations, and so on. One of the 10,000 sq.ft. studios was to be arranged so that half of the floor could be raised or lowered.

On the outside the building is to be aluminium and glass. The heat insulating material is in the aluminium panels and of course with double-glass windows. All the heating, which is to be circulated warm air, comes from a separate building.

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At the time we were there there were said to be 900 men working on the site and it was certainly impressive to see such a large job going forward apparently very smoothly in spite of the weather conditions. There seems little doubt that the Television Centre will be a most impressive affair when it is completed.

Planning

The Centre has been planned within the State Committee for Radio and Television by a planning committee which represents programme and technical interests. Specifications have been prepared by a planning staff of about 50. The various requirements were then discussed with other appropriate Ministries, e.g. the Ministry of Building, which is a very large building group doing work for many Government departments, i.e. like our Ministry of Works.

Electronic equipment is being developed by various research groups in the Ministry of Radio Industry, the Ministry of Electronic Industry, the Ministry of Broadcasting Industry - which deals mainly with transmitters - and the Ministry of Cinema Industry - which provides film equipment and telecines.

A great deal of discussion appears to go on between these various Ministries before the final specifications are agreed. Cost is an important factor in all the discussions, and prices are agreed before contracts are placed. The entire project is supervised by the State Committee for Radio and Television, which uses critical path planning to control the time scale of the job, particularly in respect of the building work.

3. TELEVISION TOWER

This 1,700 ft. tower is being built about 900 yds. away from the All-Union Television Centre and in the same grounds. The lower sections are of ferro-concrete and the upper part will be of steel. The total weight of the tower will be 40,000 tons, but a high proportion will be at, or below, ground level. Construction has reached about 200 ft. and is proceeding at the rate of about 2 ft. per day. There will be a slowly rotating restaurant at 1,100 ft. above ground level and the tower is obviously intended to be a prestige feature of Moscow.

Five 50 kW VHF transmitters are being installed at ground-floor level, and the effective radiated power of each transmitter will be about 300 kW.

There will be facilities for ten receiving aerials on the mast for the reception of O.Bs., theatre programmes, etc. by micro-wave link.

4. TBILISI

General

Tbilisi is the capital of Georgia, one of the thirteen Republics of the U.S.S.R. Radio and television are run by a Committee, and there are local committees in three or four other towns of the Republic which have facilities to originate their own radio programmes. There are no television studios in Georgia, other than at Tbilisi.

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Two television programmes are radiated, the first for eight hours daily - six or seven hours of which are originated in Tbilisi and one or two hours in Moscow. The Moscow programmes are chosen locally and there is no control from the capital. The second television programme is entirely from Moscow and runs for nine or ten hours daily. As in Moscow, programmes begin at about 5 p.m. and run until midnight or 1 a.m.

Tbilisi occasionally originates television programmes for the remainder of the U.S.S.R. and less frequently for Intervision.

The Committee for radio and television programmes in Tbilisi is responsible for its own finances. Their income is in the form of a grant and can be spent as they please. Administrative staff are paid directly by the Committee. Other staff more closely connected with the programmes are paid for out of a Programme Allowance. Expensive programmes can be balanced by cheaper ones and any remaining balance can be used either for staff bonuses or better plant, etc. The Committee pays for scripts, but any other costs associated with programmes are paid for out of the Programme Allowance. The Committee collects royalties from other Republics for programmes accepted from Georgia.

Radio and television staff employed in Tbilisi number about 900.

Present television facilities are old-fashioned and the only studio seen was one of about 400 sq.ft., equipped with two super iconoscope cameras. It is intensively used for extremely simple programmes, such as interviews, piano recitals, etc. There are a few telecines, but no video tape or film recorders.

There is not much interchange of staff between radio and television and, as in the U.K., the tendency is for staff to drift from radio to television. There is no difference in salaries for similar posts in radio and television.

There are no programmes direct to schools, but there are regular television programmes for students taking correspondence courses. These programmes are under the aegis of the Ministry of Education and the lecturers are professors from universities, etc.

The programmes are transmitted in the mornings and on Sundays and are aimed at students who live a long way away from university or high school. In addition, the Ministry of Health provides regular programmes on surgery and medicine so that doctors can keep up-to-date with the latest techniques. Some language programmes are transmitted and are usually pre-filmed.

Georgia has a population of about 4 millions and there are 200,000 television sets in use. Coverage is approximately 90% and additional relay transmitters are being provided, mainly in mountainous country.

There are no special techniques of audience measurement, but viewers are regularly encouraged to write either about programmes in general or about particular programmes and substantial numbers of letters are received.

Georgia Broadcasting Centre

Georgia, like Russia, is developing its own television facilities with a view to expanding its television output. The first stage of a new radio and television centre is under construction

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and will contain three television studios and eleven radio studios. An additional section will be added later for colour television. When colour comes, it will be in the form of a new programme, and a separate educational programme is also envisaged.

The new Radio and Television Broadcasting Centre is well-advanced and, when completed later this year, will have the following facilities: three television studios, one 6,600 sq.ft., one 3,300 sq.ft., and one 1,650 sq.ft. - plus eleven sound studios.

Television

The television studios will be equipped with 4½" image-orthicon cameras. There are no film or film editing facilities, but there is a small amount of storage space for O.B. equipment. The main 6,600 sq.ft. television studio is simple but effective. It is at first floor level, and a seven-layer floor is being laid, with acoustic protection very much in mind. The lighting facilities are rudimentary, consisting of a few fixed barrels on hand-operated winches. Most of the lanterns are already installed. An interesting one is a stack of fifteen internally-silvered bulbs of about 300 W each. The bulbs are protected by a simple metal grid. Two galleries are provided, one at high level for access to the lighting controls, and one at a lower level on which lanterns will be clamped and beneath which a Cyclorama may be hung. The television studio walls are panelled in Formica, or some similar plastic. A 2" gap behind the panels will be filled with slag wool.

A very simple, but effective, combined central apparatus room and central control room is being provided. The main feature is a long desk, equipped with a waveform monitor and six routing positions. Each routing position has simple push-button facilities for routing any one of eight sources to one destination. Normally, only two of these six positions will be in use and the total staff in the area will be one engineer and one operator.

Three 70 mm. video tape recorders are being installed, and they say they will use all three when making a recording. They have a video tape splicer which was not seen, but which they say "is not entirely satisfactory".

Radio

The main sound studio had a number of interesting features. The walls were broken up with various forms of panelling at various angles and curved in various ways. Decoration was quite elaborate and the effect was oriental. There is space for an audience of 50-70 and, during the visit, television cameras and lighting were installed in preparation for a special programme to Moscow.

The smaller "announcer" and talks studios were simply, but effectively, equipped. Each had a control room adjacent with double-glazed window, and space in which tape recorders are being provided.

5. COMMENTS AND RECOMMENDATIONS ON TELEVISION OPERATIONS AND NEW FACILITIES

The U.S.S.R. is expanding its television activities in a very big way. The new All-Union Television Centre in Moscow has a

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number of features which are extremely interesting to us and which will repay further study as the Centre progresses.

The principal of these are:

(a) The video filming operation, which the Russians obviously intend to be as efficient as possible. If they do achieve their aim of producing a one-hour film in nine six-hour shifts they will reach a higher level of efficiency than has been achieved by any other video filming organisation.

(b) Studio lighting facilities : Fully-automated lighting facilities in studios are something of which we have dreamed for a number of years (i) to improve our studio efficiency, and (ii) to reduce our dependence on electricians. The Russians obviously decided after their European tour that they should have automated lighting, but they have not yet worked out the system. It will be very interesting to see the final result.

(c) Television studios at first-floor level : We have always maintained that studios must be at ground-floor level because of the problems of scenery and equipment handling. The Russians argue that there is every logic in providing studios at first-floor level, provided proper arrangements are made for scenery handling. Space at ground-floor level is given over to heavy plant, scenery storage, etc., and the general layout seems efficient.

(d) Building : The use of pre-fabricated building sections enables construction work to proceed rapidly. The end product appears to be very strong, and there are no problems about floor or roof loadings.

(e) Tbilisi : The combined central apparatus/central control room is extremely simple, but looks as if it should be quite effective. The arrangement is worth studying for application in our own Regional Headquarters.

(f) Colour : Information and evidence about the starting date for colour is conflicting. On the one hand, we were told at senior level that colour will begin towards the end of 1967, and will be widespread during 1968. On the other hand, only two studios (one film and one electronic) are being equipped for colour in Moscow, and none in Tbilisi. No decision has yet been made about the type of colour cameras to be employed. If they do start colour by the end of 1967, it will be in a very modest way, with a minimum of facilities.

6. TECHNICAL CONSIDERATIONS ON COLOUR TELEVISION

On the 15th February, we visited the existing Moscow Television Centre to see the results they are obtaining with the NIIR systems of colour television and to discuss the technical implications of their work. These discussions were held with Mrs. Averbuk and Mr. Tesler.

They have experimented with both the square root and linear versions of the NIIR system. It is clear that there is no significant technical difference between the systems they are using and those on which we have carried out experiments during the last two months. As is well known, an arbitary choice has to be made in the case of the non-linear system as to which of the colour bar signals shall be.

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used as the reference for the amplitude of the colour sub-carrier. Fortunately, from the point of view of comparing results, they have chosen to align their decoders on the same signals as we have done, i.e. the EBU 75% amplitude red and cyan, the amplitude of which is adjusted to be the same as in the NTSC system. In the case of the linear version of NIIR the signal is lined up, so far as amplitude of the chrominance is concerned, to be the same as NTSC.

The only difference between their arrangement and ours occurred in the decoders as follows :-

1) They were using a decoder for both forms of signal in which a double pole reversing switch preceded the chrominance demodulators as compared with our arrangement of using a single reversing switch between the two chrominance demodulators. We have had some difficulty in designing a switch of adequate performance for the type of decoder used in Moscow but in the subsequent demonstration, it was clear that their switch was working well. The two different arrangements should make no significant difference to the performance of the system.

2) In the case of the linear system, they were using a 10:1 difference between the level of the two signals applied to the demodulators as compared with 4:1 in our own arrangement. On the other hand, they are not using a chrominance pedestal so that the 10:1 ratio would undoubtedly be needed in order to avoid loss of colour information in lightly saturated areas.

The Discussions of Results Obtained During Experiments

It appeared that the Soviet engineers and ourselves have obtained very similar results for the tests conducted on the two systems. They have found that the linear NIIR system is about 1½ dB more sensitive to random noise than is NTSC, whereas our subjective results have shown that the two systems are about the same.

The Soviet engineers claimed that their results are in accordance with calculations. They agreed that the linear version shows effects of desaturation in the presence of high levels of noise and that this effect is not present on the non-linear version. They agreed that the linear version is more sensitive than standard delay line PAL in the presence of unwanted attenuation of the upper side-band of the chrominance signal but was better than NTSC. They volunteered a statement, without prompting, that the accuracy of the delay line for NIIR must be twice as good as is required for PAL and agreed that this was a disadvantage of the Russian system although no discussion took place in respect of the implications of this more difficult requirement. It was pointed out that, to offset this disadvantage, PAL requires equality between the direct and delayed signals to quite a tight tolerance whereas the ratio of these signals is not important in NIIR. (It has been pointed out subsequently that the levels in PAL are not critical; in any case the circuits concerned with the delay line are wholly passive).

The colour sub-carrier employed quarter line off-set plus 25 cycles, as in the PAL system. The frequency is believed to have been that now adopted as standard for the PAL system. It was stated that the length of the delay line must be related to an integral number of cycles of the colour sub-carrier. In fact,

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the system can use an integral number, either odd or even, of half-cycles of the colour sub-carrier.

It was agreed that the compatibility of the linear version is better than that of the non-linear version and that both are worse than NTSC. The subjective magnitude of those differences was not discussed.

Demonstration of Colour Systems

We were given a very competent demonstration of the performance of NTSC linear NIIR and SECAM III (not SECAM III B which is the latest version recently demonstrated in Paris). The effects of noise, compatibility and distortion of the upper side-band of the chrominance signal were shown. As far as we could judge the results obtained were very similar indeed to our own. Perhaps the most striking demonstration from our point of view was the effect of restriction of the upper side-band of the chrominance in the presence of noise. This test showed very severe degradation of the quality of the SECAM picture as compared with the other systems. The fact that they gave us this demonstration shows that they now appreciate the fundamental weakness of the SECAM system in the presence of this kind of distortion. It was also significant that the attenuation of the upper side-band which was applied was of a very extreme nature amounting to 6 dB at 4 Mc/s, 20 dB at 4½ Mc/s and 30 dB at 5 Mc/s. This is much the most severe distortion which, to our knowledge, experimenters have employed. Of course, this had a severe effect on the NIIR system; it is indicative of the non-partisan engineering approach they are adopting towards the examination of the performance of this system.

Future Action

It was said that although the non-linear version of the NIIR system had some advantages, on balance they preferred the linear version and that they hoped to choose between the two systems by the end of March. They have made about twenty receivers in which the chrominance circuits are built on a small sub-chassis so that they can be rapidly changed between the two systems. They are carrying out radiation tests and will continue to do so until the end of March.

New Versions of the Linear NIIR System

The Soviet engineers suggested that two further versions of the NIIR system are possible. These, together with the existing NIIR linear system, are shown in the table below as NIIR I (existing), II and III. It is of interest to note that NIIR II was also put forward by B.W.B. Pothers as version III in his original paper on this type of system.

In the Table θ_n is the phase angle of an NTSC chrominance signal taken at a given instant along scanning line n and Δ_n is the transmitted phase angle at a given instant during scanning line n for the third variant, referred to in the Table as NIIR 3. The last column in the Table, that is the one figuring the deltas, can be read downwards in the following sequence :

minus present NTSC type chrominance phase plus previous transmitted phase,
plus present NTSC type chrominance phase plus previous transmitted phase,
minus present NTSC type chrominance phase plus previous transmitted phase,

etc....

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Scanning-line number	NTSC-type chrominance phase of scanning line	Transmitted chrominance phase		
		NIIR 1	NIIR 2	NIIR 3
n-4	θ_{n-4}	0	θ_{n-4}	$\Delta_{n-4} = -\theta_{n-4} + \Delta_{n-5}$
n - 3	θ_{n-3}	θ_{n-3}	$\theta_{n-4} + \theta_{n-3}$	$\Delta_{n-3} = \theta_{n-3} + \Delta_{n-4}$
n - 2	θ_{n-2}	0	$\theta_{n-4} + \theta_{n-3} + \theta_{n-2}$	$\Delta_{n-2} = -\theta_{n-2} + \Delta_{n-3}$
n - 1	θ_{n-1}	θ_{n-1}	----------	$\Delta_{n-1} = \theta_{n-1} + \Delta_{n-2}$
n	θ_n	0	$\sum_{i=1}^{n} \theta_i$	$\Delta_n = -\theta_n + \Delta_{n-1}$
n + 1	θ_{n+1}	θ_{n+1}	----------	$\Delta_{n+1} = \theta_{n+1} + \Delta_n$
n + 2	θ_{n+2}	0	----------	$\Delta_{n+2} = -\theta_{n+2} + \Delta_{n+1}$
n + 3	θ_{n+3}	θ_{n+3}	----------	$\Delta_{n+3} = \theta_{n+3} + \Delta_{n+2}$
				Δ_i = -"present" + "past" Δ_{i+1} = "Present" + "past" "Present" means present chrominance phase "Past" means previous transmitted phase
Example:	(15° (15° (15° (28° (28° (28° (40° (40° (40°	0 15 0 28 0 28 0 40 0	15 30 45 73 101 129 169 209 249	-15 0 -15 13 -15 13 -27 13 -27

NIIR variants 2 and 3 were mentioned by both M. Remy of the O.R.T.F. at an E.B.U. meeting in Paris and by Mr. Tesler in Moscow, but subsequent discussions in the BBC have raised very serious criticisms of these last two variants and it is not felt that they need be given serious attention. The last two columns in the Table above reveal the reason for considering them. Unlike NIIR 1, NIIR 2 and 3 supply fresh hue (and saturation) information in every scanning line transmitted and thus have the capability of reproducing full vertical chrominance resolution.

The block schematic diagram of a coder for NIIR 2 contains a delay equal to one scanning line and in the case of a vertical bar of colour, the phase angles θ will add from line to line progressively down the field. Thus, to take a simple case, if a transmitted scene was grey on the left half and the right half was coloured with a colour whose NTSC phase was 100°, then after 300 lines of a field the chrominance signal would have to change phase in crossing the grey to coloured vertical boundary by an angle equal to $30{,}000^{\circ}$. The resulting chrominance transient as reproduced on a colour receiver screen can be imagined. Another criticism of both NIIR 2 and NIIR 3 is that the transmitted phase of either θ in the case of NIIR 2 or Δ in the case of NIIR 3 contain the past history of any previous transients throughout an entire television field. A further criticism that certainly applies to NIIR 2 and probably applies to NIIR 3 is that random noise power in the circuit of the delay line in the coder would be integrated successively line by line down the field, and therefore at the end of a field the resulting noise power would be 300 times that which would occur in the first line of the field. It is admitted that the receiver merely subtracts the phase of one line from that of the previous line and that the aleatory difference between the two lines in question contains only one unit of noise power, nevertheless there would still be a coherent pattern inside of which the wanted phase angle would be almost buried.

Mr. Tesler pointed out that a change of system from NIIR 1 to NIIR 3 would not affect the receiver in that both systems would need a commutating switch. On the other hand, one of the advantages of NIIR 2 is that it does not require a commutating switch.