

REPORT OF D.E.'S VISIT TO U.S.A.

4TH - 11TH APRIL 1964

Accompanied by Mr. D.A.V. Williams I visited the N.A.B. Convention in Chicago 6th - 8th April. This report is to make observations on the Convention and to record observations during the subsequent two days in New York.

A. Convention Papers

The complete programme of papers is as set out below:

C.B.S. Broadcast Center

Some Recent Improvements in Vidicon Tubes and Associated Camera Circuitry

Audlok - Synchronization of Television Picture by an Audio Frequency

Sound Pickup and Reverberation

WNBC/WCBS Shared Antenna System

How to Make an FM Stereo Proof-of-Performance

Radio Automation

Exciting Several AM and FM Stations on a Single Series Fed Tower

Vertically Polarized FM Antennas and Power Divider

An Automatic Transmitter Switching System

Magnetic Core Memory Concept in TV Automation

Lighting for Television

New Approaches to Genlock and Color-Monochrome System Integration with same Sync Source

Electro-Photographic Recording

The 'Plumbicon' - A Camera Tube with a Photoconductive Lead-Oxide Layer

A Report of Color TV Camera Development

A Higher Level of Performance in Video Tape Recording

Cartridge Tape Design to Meet NAB Recording & Reproducing Standards

Vertical Interval Test Signals

A New Ultraportable Television Camera

Copies of these papers were not available during the Convention but I have been promised a set in due course. We were able to hear comparatively few of the lectures but found the following particularly interesting:

(1) C.B.S. Broadcast Center

I will deal with this later when reporting on a visit to these studios.

(2) Audlok - Synchronization of Television Picture by an Audio Frequency

This is a very interesting development.

(3) Vertically Polarized FM Antennas and Power Divider

There is quite a move in the U.S.A. to improve the coverage of FM transmitters by radiating also on vertical polarization on the broad assumption that a blind spot is less likely to exist in the same location for both horizontal and vertical polarization. It might be worthwhile considering this possibility ourselves. In the exhibition there was a number of aerials to do this.

- (4) Electro-Photographic Recording
This seems a most interesting development and I will deal with it in describing a visit to A.B.C.
- (5) Report of Color TV Camera Development
This is dealt with fully in the Appendix.
- (6) A New Ultraportable Television Camera
This was a rather complex device using a vidicon tube and did not seem particularly worth emulating.

B. Convention Exhibition

The following points of particular interest were noted:

- (1) R.C.A.
The four-tube camera is as reported in the Appendix. Additional particulars of this camera and of the four-tube film recorder are given in Broadcast News for April, a copy of which is available. Further copies will be coming in due course. The R.C.A. professional film recorder is also said to give good results.

Of particular interest, however, is the R.C.A. klystron transmitter, especially the arrangements for replacing the klystron. It was demonstrated that it is possible to replace a klystron in less than five minutes and that the arrangements show it is unnecessary to have a high ceiling height or to have any special provision for taking the klystron out of its travelling case and putting it into the holder.

Also of interest in R.C.A. equipment is the module type construction that they are using for video frequency, and, for that matter, other frequency amplifiers. This same approach was seen on the stands of other manufacturers also.

- (2) Dual Polarized Antennas
The Gates brochure on this is available.
- (3) UHF Cables
The Andrew Company were showing a 5" diameter coaxial cable for 825 kW peak power rating. The cost was said to be 14 dollars per foot and it can be supplied in any length. As an alternative to the German type cable this might be interesting. Data on the loss and general characteristics etc. is given in the Andrews brochure which I am sending to P.I.D. Also, attached to this brochure, is an Andrew Parabolic Antenna System Computer and Transmission Line Selector which P.I.D. might find useful.
- (4) Transmitters
P.I.D. may find interesting the attached brochures from the Standard Electronics Corporation for FM and TV transmitters having a large amount of transistorisation.

The Collins Company were showing a 1 kW transmitter completely transistorised except for a single valve acting as a linear amplifier in the final stage.

- (5) Ampex
Ampex showed a VTR 2000 which was actually our machine and it was on view for one day only with a note that it was about to be shipped to the BBC. In view of this note I thought there was no point in complaining to Ampex that they had not fulfilled their promise to ship it to us as soon as possible. Ampex showed their VR 1500 which was giving a good quality picture.
- (6) Machein
Machein was also showing a portable tape recorder which gave a good quality picture.
- (7) Sony
Sony were showing their two-headed machine which costs something less than 10,000 dollars and was giving quite a reasonable standard of reproduction.
- (8) Mitchell
The leaflet for the Mitchell SSR-16 16mm professional camera is available.
- (9) Electronicam
A form of electronicam made by an associate of M.G.M. and called the Gemini tape film system was demonstrated. This had a 16 mm blimped Auricon mechanically and optically coupled to an I.O. camera. The 16 mm runs continuously but a marker is put on the film when the picture is being taken from the I.O. camera. The I.O. is used for all focusing, view finding etc. This type of operation is receiving increased attention in the U.S.A.
- (10) Visual
The Visual Zoom camera on show is a copy of a C.F.T.H. camera. Visual showed demonstrations of equipment for modernising existing V.T.R. machines. In this connection, the representative on the stand said that they would shortly be replying in detail to an enquiry that they had had from Mr. Griffiths.
- (11) C.B.S. Professional Test Records
C.B.S. are putting out a series of test records for monophonic and stereophonic testing, as described in bulletin TR-1.
- (12) Level Indicating Devices and Limiting Devices
There seemed to be considerable interest in all devices for increasing the apparent audio output of a signal. Brochures of the Collins Auto level limiting amplifiers and the Collins 26U-1 limiting amplifier are available together with the new CBS Audimax II RZ control and the CBS Volumax automatic peak controller.

Demonstrations showing that the apparent loudness of a signal can be appreciably improved were mounted but, as the listening conditions were not good and it was not possible to assess the amount of distortion being introduced, it was not entirely convincing. It was said, however, that all the major networks and V.O.A. are taking a very great interest in these devices and it would seem that we ought to look further into them.
- (13) Stereophony
There was very little interest in stereo and the only exhibit really making a point of this was on the Collins Stand. Collins brochure gives details of their stereo generator and also a specification of a device for determining stereo performance.

C. Discussions at Zenith

Colour questions, which were the main reason for the visit to Zenith, are discussed in the Appendix. Other information of interest obtained was however:

- (1) Zenith said that 100% of their radiograms are fitted for stereo and 60% of their normal FM receivers, i.e. receivers excluding pocket portables, are suitable for stereo.
- (2) The tests at Hartford were going satisfactorily. They had 3,000 subscribers. The average income was a little better than \$1.75 per week and they thought that over the year it would amount to about \$90 per subscriber. This they thought was just about the break even point with about 10,000 subscribers. They said they were very satisfied with the results of the Hartford tests but had not yet finalised any proposals for further tests. The general impression I had was that things were not going awfully well.

D. Visit and Discussions with C.B.S.

In a discussion with me, Mr. Paley said that C.B.S. would go into the colour field in a big way when colour was available in about 10% of the U.S. homes. According to C.B.S.'s prediction of colour sales, this will be by about the middle or the end of 1965. (Copy of curve attached) This prediction is supported by statements made in other quarters. C.B.S. have, however, not yet ordered any appreciable amount of colour equipment but think they will possibly do so fairly soon.

Bill Lodge said that he thought that for final use a four-tube type of camera was essential; although they might use a three-tube type camera initially, he thought this was only a passing phase.

At the new studios, commissioning work was well in hand and equipment was in some places being tried out. The layout was pleasing. The control rooms had no view into the studio and were on the ground floor immediately next to the studio for quick access. The picture monitors used were small size monitors compactly located. Computers were installed for the control of switching and mixing facilities, and were undergoing initial trials. Shortly, these will be tried out for six weeks, working in parallel with the existing manual facilities to ensure that all operates satisfactorily before being put into use. In the apparatus room there is a large area containing quite a number of telecine machines, recording machines, Marconi slide projectors and the like - all completely in the open and with no acoustic separation between them. It was said that in these areas there was no attempt at sound quality control but that the operating staff are only verifying that an output is being obtained. For audio switching light sensitive resistors are used.

The whole installation is of very considerable interest and breaks new ground in many directions. I said we would very much like to send a team to study this installation in detail. They said they would be very glad to welcome such a team as soon as their commissioning work was further advanced and suggested that the team might go either towards the end of July or end of August. They thought this time would be desirable, not only because the programme load on the studios would be reduced then by reason of the great activity at the conventions, but also there would be a possibility for our people to see something of the work involved in a political convention. I said we would write and make a proposal to them.

E. Discussions with A.B.C.

At A.B.C. Mr. Frank Marx also expressed confidence that the four-tube camera was the right answer. We also discussed the vacuum type recording work carried out by Mr. Al Malang. It was said that, following on an adverse report by C.B.S. on the need for this type of recording, Kodak had abandoned the project. A.B.C. had, however, taken it up again in cooperation with G.E. Syracuse. The machine has an outer chamber in which the pressure is reduced to the order of 10^{-1} mm of mercury in which the film spools are placed. From this chamber the film goes into a second chamber, through slits, with a pressure of the order of 10^{-3} mm of mercury, and from this again through slits into the vacuum chamber where the pressure of the order of 10^{-5} mm of mercury. There is very little leakage of air past the slits and it was said that new spools of film can be put into use in less than three minutes. The film used is a very slow speed film so that the whole machine can be handled with a normal level of illumination of yellow light. The film can be low speed because the energy in a beam of electrons is so very much higher than the energy in a beam of photons. The gun of the cathode ray tube is that developed by the G.E. for their thermal plastic recording system which now seems to be abandoned. At the present time, it has a short life of only some hours but can be readily changed. The gun produces a very fine spot said to be capable of producing 800-line definition on a 16mm film. The cathode ray beam causes the film to fluoresce and focusing is done in this way. We saw some samples of test cards and wave forms reproduced by this process and they showed a remarkably high definition and good contrast range. A.B.C. are very optimistic about this process and we must undoubtedly keep in close touch with it.

Later, I saw some NTSC colour pictures transmitted by A.B.C. at Mr. Frank Marx's home and they were of good quality.

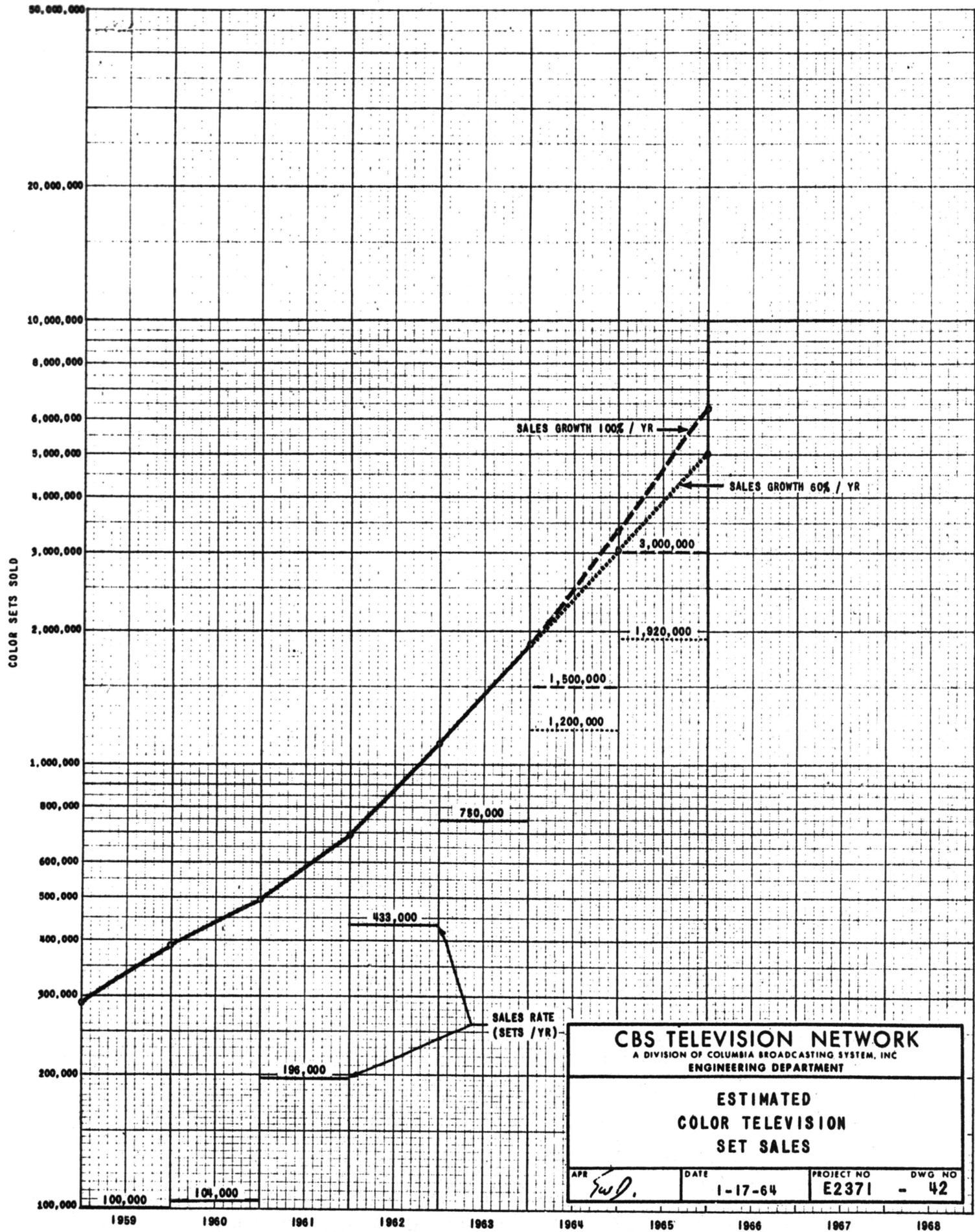
F. Visit to N.B.C.

We saw some pictures at the N.B.C. studios in the R.C.A. building. The visit was however depressing. The equipment was all very old and of very poor performance and the pictures being shown were very bad indeed.

We then visited the N.B.C. colour studio at the World Fair site. This has been installed with four 3-tube colour cameras and is a good-looking installation with nothing particularly special about it. Again, however, small size picture monitors are used and at the main control position black-and-white monitors are used for cutting and mixing etc., but colour monitors are available for reference. At the World Fair there was also a very large colour O.B. vehicle with three 3-tube cameras, mixing position etc. There was nothing very special about this. At the Fair they will feed the colour pictures into 300 line-fed monitors spaced out over the 100 or so acres of the Fair. These are to operate for 12 hours per day and keeping them in good condition will be a real problem.

JSW
21.4.64
Att.

F.C. McLEAN



CBS TELEVISION NETWORK
 A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC
 ENGINEERING DEPARTMENT

**ESTIMATED
 COLOR TELEVISION
 SET SALES**

APR <i>SwD.</i>	DATE 1-17-64	PROJECT NO E2371	DWG NO - 42
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APPENDIX

Report on R.C.A. Four-Tube Camera

This Appendix summarises observations and discussions at the N.A.B. Convention in Chicago 6th-8th April and in New York on 9th April.

The R.C.A. camera was installed at the Convention. The subject offered for viewing was two girls dressed in blue space-suits with gilded shoes and gloves and with a bright V-shaped pattern on the space-suits. It was actually a rather difficult subject for colour television and perhaps showed up shortcomings in the system rather more than the more conventional good-looking girl in a normal dress together with flowers etc. would have done. When we first saw the camera, observations were difficult because of the great number of people around at the Convention and the fact that continuous adjustments were being made to demonstrate various effects to the visitors, and our first impression of the camera was very disappointing. We then, however, arranged to have a half-hour session with the camera before the opening of the Convention on the last day when we had more opportunity to see the camera in detail and to have it adjusted. This time we got a better impression.

Overall the impression is still somewhat disappointing and the pictures viewed on the colour monitor are not as good as those from the 3 I.O. camera as seen on the G.E. camera, or from three vidicons as seen on the Marconi stand.

R.C.A. recognises that this camera is not yet fully developed and wish to carry out further work before any actual appraisals are made. The performance of the camera will be discussed later in this report but it was said by Dr. Kozanowski that further adjustment is required in the optical side of the camera; that he is to put some trimming filters in various optical paths and to make some adjustment to the circuitry. They said it would take them up to the end of April before they could complete this and they could not receive the BBC appraisal team before May 1st and would have to confirm to us by what date they could receive such a team. When ready, however, they said they would very much value any examination that our people could make. We suggested, that we might have a tape recording of the machine as it stood but they were very reluctant to do this and we did not press the point.

It was quite clear, and was in fact said so by them, that the camera had been got ready for the Convention only immediately before the date. The work of complete transistorisation of the camera had clearly been found very time consuming. The camera as demonstrated includes a Taylor Hobson Varitol III zoom lens together with an early model of a beam splitting device and Mr. Cook of Taylor Hobson said that the design work for the eventual zoom lens and beam splitting device was still in hand and that the final model would not be available until the end of the year. He said that the final model would give a considerable improvement in colorimetry, but would not commit himself as to what would be the degree of improvement.

R.C.A. have produced a brochure B 2000 of the TK42, which will be the production version of the proto-type which we saw. In as much, however, that the design is not yet finalised, this specification is to be regarded as very tentative for the time being. R.C.A. said that they would hope that they could start some production work on this camera in the fairly near future and that the design work would be completely finalised by the end of the year and production models should be available by the middle of next year. They said they were considering putting a quantity of sixty into the shops. The above timetable does, however, seem to be somewhat optimistic in the light of the work still to be done.

We talked to various other people on this three or four-tube camera question and they all seemed to think that the four-tube camera was inevitable. All stressed the great importance of the compatible black-and-white picture. The G.E. representative, however, said that he did not think that the time was yet ripe to go ahead with a four-tube camera on a vidicon basis and that his company proposed to do nothing in the development of the four tube camera until the plumbicon situation was clearer.

Of the users, N.B.C. said, of course, that the four-tube camera was essential. C.B.S. had no decision to do anything definite in deciding on the type of camera until they had decided in principle what they were going to do on colour transmissions. Later Lodge said he thought that the four-tube approach was essential in live and telecine operation. It was said that to keep up good quality in a three-tube unit required constant careful adjustment but that the four-tube arrangement called for much less careful adjustment. Frank Marx of A.B.C. said that he thought that the four-tube camera was correct.

The following replies to the questions put forward in P.I.D.'s questionnaire of 23rd March and Designs Department's memorandum of 18th March are largely based on the appraisals made during the short private demonstration given to us. Dealing firstly with the P.I.D. questionnaire, the answers are as follows:

- (1) The tubes used in the camera are the three-inch field image orthicon type 7513. The design of the camera is such, however, that a $4\frac{1}{2}$ -inch image orthicon could be used. This would increase the weight by about ten pounds. We thought they would have liked to have put a $4\frac{1}{2}$ -inch I.O. in in the first place but the difficulty of transistorising a $4\frac{1}{2}$ -inch I.O. compelled them to go forward with a 3-inch I.O. at the present time. The chrominance channels used three vidicons type C74132, which have a gamma of 0.65. I.O. is operated up to half a stop above the knee and external gamma correction is put in to give an overall gamma of 0.7 for indoor use and for outdoor use overall correction to 0.5. The vidicon camera tubes have electrostatic focusing and magnetic deflection. Initially, they did try to use electrostatic deflection in the interests of quick setting-up also but had experienced trouble in the accumulation of electrostatic charges and had to abandon this proposal for the time being. In the optical system 80% of the light goes to the vidicon and 20% to the I.O.
- (2) The sensitivity of the camera is such that the demonstrations reported on below were made with an aperture of F8 and a lighting intensity of 200 feet candles. The signal-to-noise ratio at this aperture and lighting averaged about 37 db. Observations made gave also a noise level of about 37 db with light intensity of 275 feet candles and lens aperture of F11.
- (3) The depth of field of the chrominance channel was not measured and seemed to us as not important. The bandwidth of the luminance signal was approximately 4 db down at five megacycles with a lens aperture of F11. It was said that this response would be improved with improved optics. The chrominance channel amplifiers were wide bandwidth and no restriction is put on the bandwidth of the chrominance channels other than that which occurs in the colour plexer, and the loss due to the small scanned area which had a diagonal of only 0.32 inches. The arrangements of the lenses and spacings are as shown on the attached sketch. The statement was made that the limiting resolution of the vidicon with a normal scanned area was 700 lines and with the area actually in use 400 lines.
- (4) No accurate measurements were made regarding the registration of the various signals one to another. Displacements greater than about $\frac{1}{16}$ th of an inch in the images seen on a 21-inch monitor became apparent. The noise figures in the individual channels which we measured were as follows:

Green channel - 27 db
Red channel - 26 db
Blue channel - 20-21 db

A 17 db weighting factor was used in obtaining the measurements. The vidicon beam current for the above conditions were as follows:

0.02 micro amps in the blue channel

0.06 micro amps in the red and green channels

It was mentioned that blue vidicon has approximately 0.1 feet candles intensity on the face.

- (8) Details of the optical system. This is shown in catalogue B2000 but as mentioned in the foregoing is subject to amendment.
- (9) Physical details. Dimensions and weight are given on this sheet. It should be noted that the weight includes camera and view-finder. We were at various times given various figures for the weight of this camera and it was quite clear that the figure is subject to some amendment when the final design is completed. In spite of its weight, the camera seemed to handle quite smoothly and was nicely balanced. Flexible cable drives were used for operating the zoom lens. All the supplies are brought in on a single cable of about one-inch diameter. The power supplies consist of 110 a.c. volts fed down the camera cable for the filaments and fan and 0.5 amps at 200 volts d.c. which is converted by a transistor arrangement in the camera to 4.0 amps at 25 volts for feeding the transistor circuits. Voltage control circuits are included in the camera on both a.c. and d.c. supplies to allow 1000 feet camera cable to be used.
- (10) It was said that the time taken to re-align the camera after a tube change was comparable to that in a black-and-white camera.
- (11) We could not see any real restrictions on the freedom of movement of the camera in panning horizontally or vertically. It could be, however, that the accuracy of our observations was nothing like good enough to consider such effects. Test patterns such as those used in Lime Grove were not available and would be required. When panning there was, however, an appreciable lag visible in the green chrominance channel which gave a green shading immediately following the movement. It was we thought a very definite limitation on the performance of the camera. We were, however, very impressed with the camera in its ability to handle a very wide range of contrast. Swinging the camera round from the brilliantly lit demonstration stand into areas of the Exhibition Hall which were in semi-darkness, the colour values were retained over the whole range of brightness and in the very dark areas true black was maintained.
- (12) The present design is based very solidly on the use of a zoom lens and the present Taylor Hobson lens goes from 1.6 inches to 16 inches in two ranges (Varitol III). It was said that an adaptor could also be fitted to the zoom lens. They said it might be possible at some time in the future to provide a camera for use with the normal lens turret but clearly this would be quite a major development. A turret will, therefore, very definitely not be offered in the sixty production cameras which they say they intend to make. The new zoom system will be based on the Varitol V.

Designs Department's memo of 18th March

- (1) The signal specification. We got this quite clearly from Dr. Kozanowski. The luminance signal is taken directly from the image orthicon without any modification except gamma correction.

The chrominance signal is produced by matrixing the RGB signals from the vidicons in the standard NTSC form. No corrective signal component whatsoever was introduced. We talked to them about the possible modification of the NTSC signals. They said that all sorts of things had been considered but in the end they had decided that the best thing to do was to produce the signal in the above way and to make no attempt to modify the signal at the camera end or to make any correction to the receiver. All pictures were seen on normal NTSC decoders.

- (2) The illumination is dealt with in the replies to P.I.D.
- (3) Individual figures for noise are given in the replies to P.I.D. questionnaire. The general impression was that with the light values used the noise compared well with noise on colour cameras at Lime Grove or as seen on the 3 I.O. camera on the G.E. stand or perhaps even slightly better.
- (4) The appearance and lag of the colour picture. The lag on the colour picture was seen when swinging the camera and was chiefly shown up as a green shadow. Looking at the blond girl's head, if the camera was panned so that the shadow followed the blond hair it was fairly marked. Moving the camera the other way so that the green shadow followed the face the effect was much less marked. The shadow effect was more or less the same on horizontal panning as on vertical. In any case the effect was noticeable rather than objectionable.
- (5) This is answered in the P.I.D. questionnaire.
- (6) There were no gross errors in this respect.
- (7) The smallest size of picture which can be shown by the camera. Three small objects in the field having a height of two inches or so were reproduced at about the same size on the picture monitor at a spacing of about four or five feet.
- (8) As stated above, this would be impossible for a long time.
- (9) The camera can go over immediately to black-and-white operation.
- (10) This is given above.
- (11) The over-shoots produced did not seem to be abnormal.

General Assessment

Our general feeling was that this camera at the present time does not give as pleasing a colour picture as does the 3 I.O. type of camera. The lag caused by the vidicons is noticeable although perhaps not worrying and the colour definition seems to be somewhat down. On the other hand, it will handle a much wider range of light values within the 3 I.O. light picture and it gives an absolutely first-class black-and-white picture.

In all our tests we used the research department multi-colour bar flag. Colour fidelity was fairly good in all the colours except yellow which was slightly greenish and the red which was markedly deficient. Electrical colour bars on the monitor screen, however, also showed considerable red deficiency presumably in the display tube. The red obtained from the colour bar flag was, however, of a more incorrect hue (orange) and was also appreciably desaturated.

Colour Standards

We had talks with a number of people on this and the answers are briefly as follows:

R.C.A. recognise that in producing the signal in the way stated above they are introducing distortions but think that it is not worthwhile at the present time endeavouring to correct these distortions. The argument for this is that in any case the NTSC parameters ought to be modified to take account of the phosphors now in use. They said, however, that there may be further developments in phosphors which would mean further modification of the parameter. They thought, however, that there was no urgency on this question and no pressure anywhere to make a change. It was also said by R.C.A. that they did not wish to upset the general climate for colour by proposing changes which were not absolutely necessary.

In talking, the receiver industry, noticeably Zenith, said that they too saw no need to change the parameters at the present time. Eventually some change in the parameters might be necessary but they thought it would be of fairly small extent and were clearly not at all worried by the fact that the signal put out was causing some distortion on standard NTSC receivers.

One F.C.C. man, admittedly not a television specialist, said that he saw no prospect of a change. If a change was to be made then it would have to be discussed within the industry so that both the origination and the receiver side of the industry were agreed and the proposal would then have to be made to the F.C.C. As far as we could find out, not even the preliminary steps towards industrial consultation have taken place and it would seem that it must be some time before there could be any change in the NTSC standards in the U.S.A., if at all. In the F.C.C. Regulations the note on Page 192 of paragraph 3682 would seem to allow adequate tolerance to cover the type of signal being used.

Colour Telecine

We asked why in telecine work, with the advantages of fixed size of image and adequate light, they had gone to a four-tube arrangement rather than three-tube. They said a four-tube arrangement had the following justifications:

- (1) Again they had to have an absolutely first-class black-and-white picture.
- (2) They felt that four-tube telecine could deal much better with colour films of varying quality than could the three-tube and, in particular, the four-tube camera could produce an acceptable black-and-white signal even from a very bad colour film. Incidentally, the vidicon used is a $1\frac{1}{2}$ -inch vidicon and not a 2-inch.

A novel method of monitoring the output signal was used which enabled the operator to see the signal as it would be after decoding in a domestic receiver. This ensured that the overloads of the luminance channel did not occur.

Colour Receivers Generally

On many sides we got the impression that colour reception is now definitely going forward at a good rate. C.B.S., however, have still not decided to go ahead with plans for large scale colour production. At Zeniths, we saw a large colour tube factory which was said to have cost \$10,000,000 and certainly looked like it. This was producing 1,000 colour tubes per day and it was hoped that production would be stepped up shortly to around 500,000 colour tubes a year. Zeniths are said to be doing very well in colour receiver sales and they gave us their forecast of further overall sales by the industry. Recorded sales in 1963 were 750,000 and it is anticipated that there will be 1,200,000 in 1964 rising to 2,000,000 in 1965. We queried both R.C.A. and

Zenith as to the reason for the delay in the introduction of the ninety degree rectangular tube. It was suggested by Zenith that the reason for the delay was largely economic rather than technical. The industry at the present time is unable to produce all the seventy degree round tubes which are needed. To make a change at the present time to the reproduction of rectangular tubes would reduce the overall output while the changeover was being made and would clearly result in very serious loss. Zenith thought that the ninety degree tube would not be introduced until there was a surplus capacity within the tube manufacturing industry. This they thought was fairly imminent as, until a few months ago, R.C.A. was the only producer; now Zenith were producing and they mentioned that a third big manufacturer was now entering the production stage. It is said that the potential colour tube production in 1965 will be $2\frac{1}{2}$ million colour tubes a year which would perhaps give the necessary surplus. Zeniths were, however, most optimistic about the rate at which the percentage of colour receivers sold would grow. The Zenith people thought that we would be wise in the United Kingdom not to get started on the round tubes but to try to persuade people to get started on the rectangular tubes. We saw a number of rectangular tubes which had been made on the pilot run at Zeniths. Zeniths said that their price for seventy degree tubes to a set manufacturer was \$99 each. They thought that in the not too distant future this might well come down to \$60.

Plumbicon Cameras

There was considerable interest in the plumbicon type but also considerable scepticism.

- (1) C.B.S. said that they had an open order on Philips for five colour cameras but that this order would not be firm until they had an acceptable performance guarantee from Philips and until Philips had also confirmed the price. They thought that an acceptable camera was still some time away and were not planning any of their immediate developments to take account of this camera. One Philips proto-type has, however, just been delivered to C.B.S. for assessment and they will let us know what they think of it.
- (2) R.C.A. say that they are following the plumbicon closely but have doubts as to whether it can be made satisfactorily. If these doubts were resolved then they themselves would have the right to manufacture this tube and would do this. If they used plumbicons in the chrominance side of the colour camera then they thought they would make a special one-inch plumbicon as they thought it would be unnecessary to have such a large tube as the $1\frac{1}{2}$ -inch plumbicon.
- (3) G.E. thought that the plumbicons would be successful one day and did not propose to take any steps at the present time on a new design of camera until the plumbicon was satisfactory.

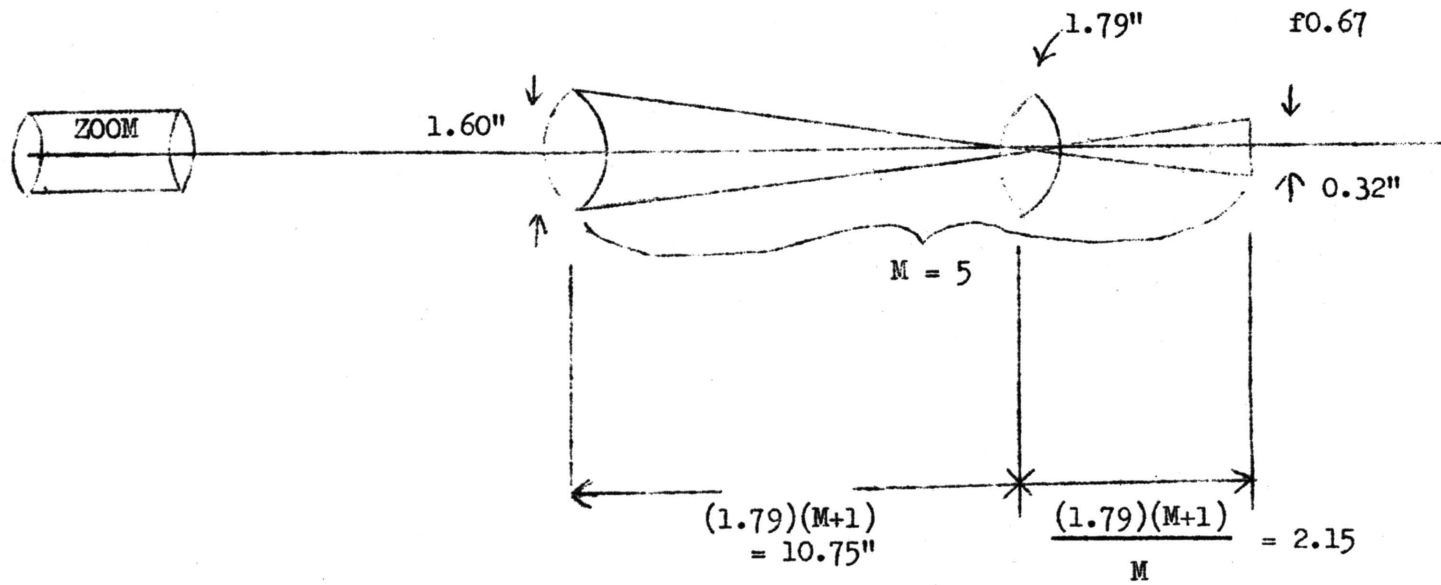
Black-and-White Operation

Both N.B.C. and C.B.S. considered that it is essential that studios should be capable of producing both black-and-white and colour pictures. They thought that in their operation, black-and-white and colour programmes were likely to follow each other in fairly quick succession and would be quite impracticable, considering the amount of equipment involved, to have the colour cameras pushed to one side in the studio and a black-and-white one produced.

The U.S. outlook seems to be that the colour camera must be multi-purpose.

FCMcL/JSW
16th April 1964

Att.



INFORMATION ON VIDICON PATH SUPPLIED BY MR. SADAGIGE
 AT THE N.A.B. CONVENTION