

## REPORT ON VISIT TO U.S.A.

20th - 26th March 1966

by D.E. and H.D.D.

Discussions on the points covered in this report took place with CBS, CBS Laboratories, Hartford, NBC, ABC, RCA Princeton, RCA Lancaster, and at the I.E.E.E. Convention. For convenience in reading the comments are being grouped together by subject.

### CAMERAS

#### 1. Plumbicon Cameras

CBS were generally very satisfied with the cameras. Philips had given them good delivery, had maintained supplies of plumbicon tubes and, through North American Philips, had taken notice of criticisms of the PC60, with the result that the PC70 was, they thought, a good camera. CBS did not seem to be worried by the coloured flare effect caused by failure of the beam fully to discharge high lights; the PC60's were being operated with a value of beam current such that highlights double those of normal interest were fully discharged. An incident lighting level of 200 - 250 ft. candles was being used in the larger studios for an average stop setting of f4, but for the news set-up an incident lighting level of 150 ft. candles was being employed. It was interesting to note, as exemplary of the difference between American and British production techniques, that nowhere was a lit area in use of more than about 1,000 sq. ft. in which, by British standards, very simple shows were staged.

CBS expressed great enthusiasm for the use of vertical aperture correction with plumbicon cameras. The development of these correctors is in an advanced stage at CBS Laboratories. Experience of the 3-tube camera appeared to have made them much less keen on the idea of a 4-tube camera than they had been.

At ABC, however, they were very critical of the plumbicon camera and said that they thought the colour rendition and sharpness were inadequate and that at their comparative tests they had rated the TK41, the TK42, and the PC60, in that order, for colour picture quality. Our own observations on the plumbicon cameras are set out in a separate memorandum to EDSC, dated 28th March. In terms of sensitivity the order was PC60 (150 ft. candle f4), TK42, TK41. ABC said that the operation of the PC60 was upset by opening the side doors of the camera.

#### 2. Marconi Plumbicon Cameras

CBS have placed an order with Marconi and have had delivery promises for two in July, two in August, four in September and four in October of this year. Great confidence was expressed that the Marconi camera would be a well-engineered design, and that in particular it would be much better shielded from the effects of external magnetic fields than the Philips cameras. With this in mind, Marconi cameras would probably be used in Studios 50 and 52 where there is strong field from a local power sub-station. In the interest of standardisation Philips cameras would be used exclusively for network transmissions at the Television Centre, the remaining Marconi cameras going out to stations.

#### 3. Other Plumbicon Cameras

Other plumbicon cameras are being offered by G.E. and Sarkes-Tarzian.

#### 4. TK41

This camera is now in the form of the TK41C and seems to be highly valued. ABC have recently ordered 23 of them. CBS have ordered a small number and NBC have also ordered a small number. The reasons for this seem to be doubts about plumbicon cameras and doubts about the availability and/or the performance of the TK42. Using the 4415 and the 4416 I.O.s. this camera takes appreciably more light than a plumbicon but is still apparently acceptable. ABC said they were not worried about the weight of cameras for either internal or O.B. use. What was important was the picture the viewer saw. They thought the TK41C was much better on registration than the TK41. It was, in their view, absolutely essential that all registration controls etc. should be back on the control position and not on the camera.

#### 5. TK42

So far about seven of these cameras have been delivered and none of them to places easily accessible. CBS criticised the camera and thought it gave a lot of difficulties, required a very high light value, (at one demonstration, an incident light value of 680 ft. candles was needed for a stop-setting of f8), and they did not like the two-range varotal III built in to the camera. ABC said virtually the same thing and thought that no camera ought to have internal lenses. It was said by several people including NBC that too many controls were on the camera instead of back on the control position. The NBC position on the TK42 was clearly one that was difficult for them to explain and it appeared that RCA had not taken advice from NBC in designing the camera. The TK42 is still designed for a  $4\frac{1}{2}$  I.O. + 3 vidicons, eventually to be changed to 3 selenicons. It was not possible, however, to get any idea as to when the selenicon will be available but it was quite clear that it will be some little time yet. RCA said that they would be delivering 300 TK42's this year and that their orders were already in excess of 500.

At RCA it was stated that the TK42 required an incident light level of 250 ft. candles for a stop setting of f8. The splitting of the light between the luminance and colouring channels is now in the ratio of 20:80, the working area of the image on the vidicons having a diagonal of 0.3 inches. With this arrangement it was said that "print-through" on movement was no worse than for TK41's. For normal exposure ( $\frac{1}{2}$  stop above "knee" of I.O.) the maximum signal currents of the colouring tubes are:-

Red 0.1 uA

Green 0.1 uA

Blue 0.03 uA

It was said that present colour analysis produces reasonably faithful colour fidelity with normal "Livingstone" coding. Measurements show that all colours within the triangle reproduced by the phosphors of the latest display tubes have an accuracy of 2.5 to 7.5 JND's, i.e. "slightly perceptible" on direct comparison.

#### 6. Film Cameras

U.S. practice with all manufacturers has swung to a 4-tube arrangement. The RCA TK27 using 4 vidicons will be shown at the I.E.A. Exhibition in May.

#### 7. Cameras General

a. Dr. Epstein of RCA said that he thought that for any camera to be successful it must have a bend in the characteristic similar to that in the I.O., as from the nature of things light intensities varied over such an enormous range. Dr. Theile supported him in this and doubted whether the plumbicon was suitable for O.B. use.

b. The isocon tube developed by Wierner in 1947 could give possible improvement. It has very good black level. It is chiefly of advantage in dealing with very low light intensities and seems unlikely that it

will be developed for broadcast use. It seemed that RCA had no intentions this way. The SEC (secondary emission conduction) vidicon developed by Westinghouse, but also made by CBS Laboratories, could perhaps give a tube which could be of interest to broadcasting and this ought to be looked into more.

### O.B. EQUIPMENT

ABC seem to have the most ambitious O.B. proposals and are making up O.B. units as follows:-

2 x 6 cameras in two 40 ft. trucks. The first truck has production facilities and a video tape recorder, the second the C.C.U.'s, pulse and power distribution and other technical equipment. If required a power supply will be provided by a third vehicle.

1 x 4 cameras complete with all facilities and self-contained power supply in a 35 ft. truck, associated with a second 35 ft. truck having two video tape recorders.

1 x 2 cameras in a 35 ft. truck to provide "isolated" camera facilities.

By using various combinations of the above units they will be able to do anything from the smallest to the largest shows.

CBS are providing six cameras, capable of being increased exceptionally to eight, in one 36 ft. truck complete with production facilities. A separate truck will provide video tape facilities.

### STUDIO DESIGN FEATURES

1. CBS's new studios were very impressive. The computer control was working very well and the installation seems to have settled down well. We were told that the job had been organised on the following basis:-

All basic design concepts were discussed and agreed at a committee of five people only, consisting of Lodge, Saxe, O'Brien, Benson and Flaherty. This committee approved the basic design and the amount of money to be spent on each part of the installation. The spending of this amount of money on the specified work was entrusted to various people who had to explain and obtain approval for any departure from the agreed programme in either cost or time. Part diagrams were used for planning time and cost. In carrying out the work about 15 to 20 people were used from the maintenance department, 150 were in O'Briens's department and three men from Flaherty's department. The above numbers included engineers, technicians and draughtsmen.

2. An eidophor colour equipment costing 100,000 dollars is in use. This uses three separate colour images combining to give 3,400 lumens on a colour picture compared with 4,000 lumens for black and white eidophor.

3. Nearly all monitoring is done on black and white monitors. It was said that having to make colour adjustments on a single monitor gave a more consistent colour picture. A studio control room had a total of five colour monitors; two 17" for video control, and two 17" and one 21" for the production team. The 17" monitors have Japanese tubes; the performance of the 17" monitors was not considered to be good enough and they are to be replaced by models using 19" tubes. The "one-man" video control position is modelled on that at the Television Centre; 5% variation of "master" black level and 10% variation of gain are provided.

4. CBS experience with colour is that it takes no more time to produce a colour show than it does to produce a black and white show. They do, however, allow extra time for initial camera line-up in the morning taking one hour for this instead of half an hour for black and white. A further half an hour is allowed just before going on the air for a final line-up of the cameras, but it was emphasised that the adjustments required during this period were of a very minor nature. NBC also follow the practice of leaving a half an hour period for adjustment just before programme time.

As a point of interest, CBS said that they had tried the experiment of running the PC60's continuously in the hope that the equipment would settle down to the degree that line-up periods could be eliminated, but in fact this hope was not realised because, although slight, drift in settings was continuous.

5. ABC suggested that there ought to be standard scenes, china dolls and the like, to get a correct picture for lining-up colour cameras in order to make comparison between one camera and another. This would be equivalent to the standard slides that we have for comparing colour systems.

### TRAINING FOR COLOUR

#### 1. CBS

CBS said that they gave selected technicians engaged on black and white television 35 to 40 hours colour theory with internal lectures, most of them by their own staff. Then they had about one month's training on the job in the studio. There were no schools run by CBS. A small number of men were sent separately to Ramo Wooldridge for training on the computer; a small number had been sent for two weeks to Ampex, and another small number sent for two weeks to RCA. They had paid for 60 men to go to a General Science course in the evenings and for 60 men to go to a computer course in the evenings. These fees were only paid if the men satisfactorily completed the courses. CBS are testing all people who work on colour for colour blindness with the Japanese Charts.

#### 2. NBC

NBC did all their training on the job and had found this adequate. They did not send men to RCA factories.

#### 3. ABC

ABC also did their training wholly on the job.

### SATELLITE COMMUNICATION

#### 1. At Princeton Mr. Gruber of Satellite Developments said the following:-

a. It was now envisaged that it would be possible to produce 18kW by a solar battery which would produce, for example, high tension by having an appropriate number of cells in series.

b. It was desirable to use a frequency in the upper part of the UHF band, where a transmitting antenna 50 ft. across supplied with a peak power of 5kW of standard television broadcasting signal would produce a beam width of 1.75 and illuminate an area of 500,000 square miles at the latitude of New York.

c. Using two of the latest Somerville transistors at the receiver, amplifiers having a gain of 15dB and a noise factor of 4dB were commercially achievable; reception with noise just perceptible is possible at the 30dB contour and reception suitable for colour is possible at the 33dB contour, with the better type of domestic receiving aerial.

d. The performance of the satellite could be improved by using a frequency in the 12Gc/s range and frequency modulation, but much more power than is at present available in this frequency range would be required in the satellite and the receiver and aerial would cost something in the region of 3,000 dollars.

e. The development cost of a first satellite would be 40 million dollars. A Titan III rocket required to lift it (the weight of the satellite would be 3,500 lbs.) would be 18 million dollars, making 58 million dollars for the first satellite launched. A second satellite would cost 15 million dollars; the cost of firing would be the same, making 33 million dollars.

f. The Meantime Between Failure of the components of the satellite would be ten years, corresponding to a probability of 90% that the satellite would last one year and 80% for two years.

g. He thought that a satellite would be in operation before the end of the decade.

h. A point of interest that he mentioned was that earlier expectations of a vacuum in space would be sufficiently good and that valves could be operated without a vacuum type container had proved incorrect because, due to continual de-gassing of the satellite, there was always a cloud of ionised gas in the vicinity of the satellite.

2. At the I.E.E.E. Convention Mr. Kiesling said very much the same thing but was rather more optimistic about receiver performance and thought this could eventually be brought down to a noise factor of the order of 1dB, requiring about 4kW of vision power. He thought that with 800Mc/s an area of half a million square miles could be served.

#### VIDEO TAPE RECORDERS

1. There is general trouble with the RCA tape recorder but RCA are confident that their new tape recorder, the TR70, will be fully adequate. They said that on the experimental model they had good quality vision on the sixth generation of tape. It was emphasised that this machine is the product of an entirely different approach. The limits of distortion are so low on individual units of the machine that they are incapable of measurement in isolation. The machine is therefore lined-up as a whole; consequently it will not be possible to interchange modules between machines. Moreover, it is possible that the recordings will not be interchangeable with those made on Ampex machines. They said a first machine would be shown at the N.A.B. and that regular deliveries will start in the fourth quarter of this year.

2. The report generally on the Ampex machine was satisfactory. CBS said that they were obtaining a head life of better than 100 hours and they thought it would be optimistic to expect anything more than this. New head wheels were just being delivered which had a tip penetration of 1.0 mil. as compared with those used up to the present of 1.8 mil. It was stated that experience had shown that very high quality men were needed to maintain the recorders in the best working condition. Even then, it was possible to achieve good quality only so far as a second generation recording, a third generation showing distinct signs of head banding. This was confirmed by observation of a third generation recording at the CBS Television Center.

3. NBC said that because of the difficulties with colour recording they had reverted to the practice of using the recording head for play back and shipping these from Los Angeles to New York. As a result they had about 200 heads in stock in New York and a further 200 in Los Angeles.

#### TRANSMITTERS

At Princeton it was said that they were embarking on a four to five year period of development of a new range of transmitters. These were intended for unattended operation, would have an order of magnitude of improvement in performance compared with present day equipment, improved

reliability and "maintainability". The transmitters would automatically test themselves at routine intervals. It was expected that the transmitter would be solid-state except for the output stage which would probably be a klystron, the biggest of which would have an output power of 75kW, giving 150kW for two in parallel. Further developments of tetrodes were not, however, ruled out but lives of the order of 100,000 hours must be achieved.

Aerial gains of 40 at UHF were as high as could be satisfactorily used, particularly as American practice aimed at filling in the service area fully as possible and not extending the area to the largest possible extent. There was a tendency to move to "antennae farms" where a tower 800 ft. to 1,500 ft. A.S.L. carried all the aeriels, VHF and UHF for all services. There was very little sharing of aeriels for more than one transmission.

Other points of general interest were:-

1. RCA were trying to get agreement to remove, or at least alter, the group delay correction applied at the transmitter to compensate for the high frequency cut-off of the receiver. The shape of this group delay correction had been decided more than twelve years ago when it was expected that colour receivers would have a flat response to  $\Delta Mc/s$ , referred to video frequency. Now, all receivers were 3dB down at  $\Delta Mc/s$  and the group delay correction was undoubtedly of the wrong shape.
2. In reply to a question, it was stated that no delay correction was applied at the transmitter to compensate for the Nyquist slope of the receiver, nor was any quadrature correction fitted.
3. The upward radiation of UHF transmitting antennae will have to be controlled in future in the interests of protecting links to broadcasting satellites.

#### TRANSMITTING VALVES

At Lancaster RCA said:-

1. They thought that up to about 10kW power tetrodes were the preferred solution to 5kW valves being used in parallel for this power. Above this they thought possibly klystrons were desirable but were not sure and were considering further sizes of tetrodes. They said that, by adding resonant canisters to tetrodes, they thought they could get a gain of 20 to 30dB and that they would be able to get 50kW from two of the so-called super-power tetrodes. They thought that the tetrode could be developed to give a long life, equivalent to that of a klystron.
2. They thought the steam-cooling was desirable for transmitter powers of 10kW and upwards and for special purposes valves were being made for steam cooling at a power of 1kW.

#### TRI-COLOUR TUBES

The following was said at Lancaster:-

1. All tubes at present made were  $90^\circ$  tubes but they saw no fundamental difficulty in eventually going to  $110^\circ$  shadow-mask tubes. They thought it was unlikely that any other type of tube would replace the shadow-mask for a long time and it was clear that an enormous investment is being made in shadow-mask tube production.

2. Shadow-mask tubes are being made in three sizes with the following characteristics:-

	<u>15"</u>	<u>19"</u>	<u>25"</u>
EHT	20	27.5	27.5
Beam current	0.75mA	0.75mA	1.0mA
Watts per square inch	0.14	0.1	0.085
Triplet Centres	25 mill.	22 mill.	27 mill.
No. of Triplets	130,000	408,000	417,000
Depth front to back	18"		
Highlight brightness	37 ft/L	30 ft/L	30 ft/L
Resolution of Test Card	200 lines	300 lines	300 lines
Colour Temperature	9,000° K		
Light Transmission through Faceplate and Bonded Safety Screen	40%		

The 19" size appeared to be the most generally attractive.

### CBS LABORATORIES

A visit to the CBS Laboratories at Stanford proved to be most interesting. For some years these laboratories have been largely engaged on work other than that concerned with television but are now devoting an appreciable part of their efforts once again to this subject. For example, they designed all the video amplifiers used in the CBS Television Center. The items of principal interest seen at Stanford were:-

#### 1. Vertical Aperture Corrector

A demonstration was given of the effect of a vertical aperture corrector which was nearly fully developed. No circuit details of this corrector were discussed, but it was said that it followed well-known techniques. The demonstration was unfortunately marred by the very poor quality of the pictures being produced from a Philips PC70 colour camera. This camera was outside and was looking at a quite difficult scene, in which a girl in the foreground was illuminated by the rays of the setting sun with a fairly dark background. The camera was not at all well registered, nor was the beam setting sufficient to discharge the highlights of the picture. Consequently any movement of the subject or of the camera caused violent colour trailing; moreover the pictures were extremely soft. In these circumstances the effect of the vertical aperture corrector was not easy to assess. There was undoubtedly a considerable, indeed, quite marked increase in the sharpness of the picture but the effect on the camera noise was similarly rather marked. The amount of aperture correction was obviously more than would normally be considered good practice. Altogether this was a somewhat disappointing demonstration, largely because of the poor picture quality, for which the personnel at the Laboratories apologised profusely and explained that at this rather late hour of the afternoon no-one was present who really knew how to operate the Plumbicon camera.

#### 2. Miniature Hand-held Colour Camera

A demonstration was given of a prototype of a small hand-held colour camera. This operates on the sequential principle at a total of 180 fields per second; 60 each in red, green and blue. The size of the camera was no greater than the volume required to hold a Plumbicon tube and its scanning yoke with 16 millimetre zoom lens attached to the front. The rotating colour disk holding the analysis filters was naturally quite small and driven by an equally small motor. The physical shape of the analysis filters appeared from recollection to be the same as those normally employed in a sequential colour camera.

The picture was displayed on a sequential type receiver of which the picture area was rather smaller than a post card. As far as could be judged

on this small picture, the camera was giving good quality pictures under quite normal colour television lighting conditions - probably about 150 ft. candles incident on the scene. As far as could be detected there was no colour trailing with movement, although the scenes were not critical in this respect. The colour fidelity appeared to be satisfactory, with no sign of contamination from one colour field to the next, but, again, the pictures were not critical.

It is the intention of CBS that the field sequential pictures from this type of camera should be conveyed to the base receiving point by radio in their sequential form. At the base they would be converted to normal N.T.S.C. standard by a chromacoder which has not yet been developed, although they said that a rather rough experiment had given promising results. This is a very interesting development of which the progress should be carefully watched.

Equally interesting are the control facilities which are envisaged for this portable colour camera. CBS believe that in order to make a success of the use of portable cameras it is necessary to employ quite a number at any one site. Until this is done, they said, the techniques of using such cameras will not be properly developed. Accordingly the control system is designed to handle a number of such cameras. They are developing a pulse code type of system, capable of transmitting quite a large number of pieces of information simultaneously. All the functions of a number of remote cameras will be controlled from the base station, eg. zoom, focus, transmitter on or off, indicator light on the camera, beam focus, iris, and so on. CBS consider it to be very important that the camera man should be freed from all responsibility for the technical performance of the camera, and pointed out the usefulness of the ability to switch the individual transmitters on and off, since, of course, the duration of the batteries powering the portable equipment is determined very largely by the time which the transmitter is on the air. They also thought that the inability in the past of a camera man to know precisely when his pictures were being used had been a big drawback, and that the switching of the camera indicator lamp, although apparently a small thing in itself, was a most useful innovation. The control signals would be conveyed simultaneously to all the cameras in use on a frequency around about 170 Mc/s, the particular signal for any one camera being determined by time division multiplex of the complete coded signal. The pictures returning from the camera to base would be carried on a link at about 4,000 Mc/s, employing an omnidirectional transmitting aerial. It was said in reply to a question that they found this frequency quite satisfactory for use out of doors, an experience which is contrary to that obtained in the BBC. For use inside a building it was said that a more useful frequency was 12,000 Mc/s.

The control system was being developed in integrated circuit form. CBS Laboratories have facilities for making integrated circuits, but now apparently they buy most of these circuits from outside sources and only use their own facilities to modify them when required. Apparently they frequently lay one integrated circuit on top of another, thus making an extremely compact assembly.

### 3. Colour Recording of Film By Means of Lazer Beams

CBS Laboratories have done some work on the possibility of recording colour pictures on film by means of lazer beams. This subject was only briefly discussed and no equipment was seen by D.E. and H.D.D. On a previous visit, C.E.(Tel.) was shown one of the mirror drums which he describes as quite small, some two to three inches across, having the appearance of highly polished metal with eight or so reflecting surfaces. Apparently CBS Laboratories have developed, for other purposes, the technique of making high precision mirror drums which are an essential ingredient of a system



employing lazer beams. (The Laboratories are equipped with quite amazing machinery for precision mechanical work). They offered to provide the BBC with a precision mirror drum if it was felt that development along these lines could be usefully undertaken.

Dr. Goldmark is in charge of CBS Laboratories, the Chief Engineer of the laboratory which we visited being Mr. Randal McMann.

#### NBC PRACTICE

1. NBC colour is still entirely dependent on TK41's and TK41C's. Their recent order is for 23 of the latter cameras. They said they obtained the same output per studio as a black and white but that the TK41C has to be re-lined-up about every two to three hours. The time taken for this re-line-up is of the order of five minutes.
2. NBC were not so strong on 4-tube cameras as previously but still seemed to have some preference. They thought in any case that the lens should not be built into the camera body.
3. The TK41 colour cameras used by NBC in New York were still exclusively using Type 5820 Image Orthicons, although the NBC stations were using other types of pick-up tube, eg. wide-spaced Type 4415 for red and green with Type 4416 for blue, or close-spaced Type 7513 for red and green with Type 4513 for blue. In New York, the cameras using 5820's required 400 to 500 ft. candles incident illumination at a stop setting of f8.
4. It was confirmed that the quality of the colour film of the specially made Hollywood programmes is still being carefully assessed by two skilled and experienced men before being sent to New York. These assessments are made in terms of the quality of the film from the point of view of television; it was said that there would be no hesitation in rejecting a film if the observers in Hollywood advised that this should be done. This had happened on a number of occasions. A standard "questionnaire" was used to record the observers' opinions, a copy of this being shipped with the film. The adjustment of the colour film scanner for a particular film is determined at a rehearsal prior to transmission.
5. NBC are using both 3 vidicon and 4 vidicon film chains; the performance of both types was regarded as being much the same. A line-up of the chain, taking 30 to 45 minutes, took place before every important evening showing of a film.
6. It was said that NBC observers had seen the ABC demonstration of the comparative performance of the TK41, TK42 and PC60. In their opinion the order of preference in terms of colour quality of the pictures was TK41, PC60 and TK42. They were generally critical of the quality of the Plumbicon pictures seen in New York, but thought that the quality of the pictures from the PC70 used by CBS in Washington was the best of any on the air.
7. Use of Stable Oscillators for Synchronising Remote Sources

NBC were using highly stable colour sub-carrier oscillators, manufactured by the Sulzer Laboratories of Silver Springs, for maintaining synchronism between Washington and New York. It was said that the stability of these oscillators was sufficient to maintain colour synchronism to allow the use of "special effects". It was also said that the drift of the oscillator was about one micro-second per day, a frequency accuracy of about one part in  $10^{11}$ . This rate of drift corresponds to a drift of about  $64^\circ$  of colour sub-carrier phase per hour. It was understood that the price of the precision oscillator was about one thousand dollars.

## MISCELLANEOUS POINTS

### 1. Production of Programmes on Colour Film

Joe Flaherty of CBS was most emphatic about the unchallengeable position of Hollywood in the production of colour programmes on film. Hollywood was able to produce a one hour show in five and a half days of shooting with a 5:1 ratio of shot film to that eventually used. When pressed, a one hour programme could be on the air in three weeks from its initial conception, although five weeks were more usual. He thought that the use of Electronicam would inevitably increase the time required for production. He said that it was an eye-opener to see Hollywood at work and strongly urged anyone thinking of competing with television or electronicam techniques to pay a visit before committing himself.

### 2. The Gutless Wonder

The G.E. 11" colour receiver which sells for 200 dollars is known as the "gutless wonder" on account of the extraordinary streamlining of the circuit design which has been achieved. There is no D.C. restoration and no regulation of E.H.T. Nevertheless, the receiver is said to produce acceptable pictures.

### 3. Colour Film Recording

At Princeton, RCA said that they were working on the problem of colour film recording. They would use an improved form of shadow-mask tube as the display device and a fast pull-down Milliken camera, which latter, they thought, had completely solved the problem of film transport for recording purposes.

### 4. Reference White

CBS said that they had nearly reached agreement with NBC, (ABC was not mentioned but perhaps the same applies to them), that both networks should standardise on a colour temperature of 6000°K for the lining-up of colour monitors in technical areas and programme producing points. If it materialises this agreement is important. It represents a return to the standard adopted at the beginning of the colour service and could be an encouragement to commercial receiver designers also to standardise at this colour temperature. For some years the commercial receiver has been set up to a colour temperature of 9000°K or even more, on the grounds that the black and white picture on the colour receiver should have approximately the same colour as that of standard black and white receivers. CBS certainly feel that 9000°K is much too high a temperature for pleasant colour pictures and, now that colour represents so high a proportion of total programme time, they feel that the black and white picture is no longer so important.

### 5. Clean Conditions for Manufacturing Processes

At Lancaster, RCA have created an area of remarkable "cleanliness" for special manufacturing processes concerned with pure materials. Air enters the working area under pressure through the floor after thorough filtering, and is filtered again after extraction at ceiling level. The greater part of the air is re-circulated but, of course, sufficient new air is constantly added to maintain its freshness. Thus, there is a constant "washing" action of people and materials due to the upward movement of the air. Personnel working in the area are as "clean" as possible when entering but it was said that the lack of contamination of the working conditions due to the inevitable particles brought in by the personnel was almost wholly due to the "washing" action of the moving clean air. Apparently, clean conditions are restored remarkably quickly after people have entered the area to begin work. It was said that the clean area usually contained about two particles

of less than 0.3 microns size per cubic foot of air. As a basis of comparison, "clean" air in the conditions established for the manufacture of image orthicons contains about 10,000 particles per cubic foot.

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