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Sa qualité dépasse largement celle des récepteurs à 500 lignes entrelacées, car elle correspond pratiquement (note Schröter) à 700 lignes entrelacées.

On voit maintenant pourquoi nous avons estimé maintenir la position avancée du 1029 lignes, car une analyse à 800 lignes par exemple n'aurait formé, avec le même principe, qu'une trame de 400 aux récepteurs simplifiés. Il ne faut pas descendre au-dessous d'une certaine qualité car la critique de l'œil est beaucoup plus sévère, en ce qui concerne les détails dans une scène complexe, que celle de l'oreille envers les «harmoniques», que souvent, seuls, les spécialistes discernent.

On est arrivé à une économie de 4 lampes par rapport au récepteur complet de 1029 lignes, c'est-à-dire à une réduction de près de 20%, ramenant ainsi le prix des récepteurs populaires, de haute qualité au voisinage de celui du récepteur actuel — 500 lignes entrelacées.

L'argument économique développé contre l'analyse à définition élevée paraît donc éliminé.

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Nous nous sommes apparemment un peu éloignés, par cet exemple, de la discussion concernant l'entrelacement; mais n'était-il pas utile de vous présenter quelques faces de ce problème, qui n'est pas épuisé, et auquel vous apporterez, j'en suis persuadé, vos remarques éclairées et constructives, qui hâteront la création des normes internationales, un des buts de notre CIT.

Une anticipation

Si la télévision expérimentale a déjà une vingtaine d'années, nous ne sommes qu'au seuil de son développement industriel et, si nous défendons la thèse de la qualité maxima, compatible avec les moyens techniques et économiques actuels, c'est bien pour éviter un changement des caractéristiques dans un avenir plus ou moins proche, et donner à l'industrie et aux usagers la sécurité qu'exigent les amortissements d'outillage et les installations d'un certain prix.

Nous espérons donc que les standards proposés dureront quelques années, mais nous ne pouvons éviter de penser à l'introduction de facteurs nouveaux, comme la couleur.

Or, il se trouve que les conceptions actuelles sur la transmission des images colorées renforcent la position que nous venons de définir pour les récepteurs.

Il est évident que les dispositifs d'émission et de réception des images trichrômes exigeront d'autres appareils, mais on continuera, parallèlement l'envoi des images noir sur blanc pour la plupart des usagers, et la proposition qui semble devoir être adoptée et qui a été essayée est d'utiliser, pour ces images, la modulation fournie par la voie «verte».

On sait qu'on a obtenu de bons résultats dans divers laboratoires par la superposition de blanc, vert, rouge répétées chacune 50 fois par seconde; dans ces conditions, le «papillotement» coloré disparaît. Il a été démontré aussi, avec certains procédés de cinéma en couleurs, que des projections très satisfaisantes étaient possibles avec une trame de l'ordre de 500 à 600 lignes par couleur.

L'introduction des teintes complète largement, en effet, l'information que l'œil recherche dans la finesse.

Il est donc probable que l'on préparera trois voies parallèles d'émission; une solution pratique a déjà été expérimentée avec le cinéma, nous en avons proposé une il y a un an et demi concernant la prise de vues directes, avec intervention des accumulateurs d'images. Nous reviendrons plus tard sur ces sujets. Contentons nous aujourd'hui d'observer qu'avec de telles hypothèses, la transmission noir sur blanc sera reçue sans aucun changement d'appareillage par les récepteurs populaires puisqu'on leur fournira 50 images de 500 lignes par seconde issues de la trame verte.

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Toutefois, il serait prématuré de vouloir discuter à fond ces anticipations, qui font l'objet d'efforts considérables dans les laboratoires de recherches; la prudence qu'un long passé nous a enseignée dans ce domaine nous incite à attendre, avec optimisme certes, les résultats pratiques, surtout du côté réception, dans un délai qui se compte par années. Le programme du CIT ne risque donc pas de s'épuiser.

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Studio and Outside Broadcasting Television Practice in Great Britain

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Introduction

Two years of post-war operating experience, together with the knowledge accumulated during the 10 years preceding 1939, have now, in a sense, brought British Television to the cross-roads. Hitherto few major changes have been made to the high-definition system introduced in 1936, but now we are beginning to have firmer ideas as to the direction in which television broadcasting can and should progress. For this lecture the author has selected that aspect which may be described as "picture-making" technique and attempts to review the trend in the design of associated equipment.

Pick-up Tubes

Pick-up Tubes form the heart of any television system and all techniques are fundamentally built on the basis of their performance.

In the Studios the standard Emitron (roughly equivalent to the American Iconoscope with which it was developed in parallel) has held its own since 1936. It is noted for high resolution and has not yet

been seriously challenged despite its defects of low sensitivity and "shading" distortion. There is, of course, a demand for a tube of increased sensitivity in order to:

a) improve depth of focus,
b) reduce the degree of illumination.

Any new tube which has this quality, and for this purpose it needs to be at least ten times more sensitive, must at the same time be as good, if not better, in respect of resolution, geometric distortion, tonal range, spectral response as well as general uniformity of characteristics between tubes. A departure from the present basic equipment will therefore only be made with caution. Meanwhile some of the other and newer types of pick-up tubes now in use for outside broadcasts are being closely studied with an eye to their possible application to studio needs.

It will be appreciated that for use outside the studios the paramount need is sensitivity, and some relaxation of other qualities has therefore been tolerated: the consequent defects are in any case often less evident than in the studio especially when the interest of a topical event overrides any technical features.

Thus when in 1937 the standard Emitron was found to be too insensitive the Super-Emitron (the parallel American development of which is known as the Image-Iconoscope) which had been developed by EMI[1]) was brought into use by the BBC. This immediately yielded three advantages:

a) Sensitivity effectively improved by a factor of some 4 or 5 times.
b) A smaller photocathode (30 mm diagonal compared with approx. 140 mm) made possible proportionately smaller lens angles and thus better views of scenes distant from the camera.
c) Improved depth of focus.

The new tube greatly enhanced the technique of outside reporting and made possible the pick-up of remote indoor events, such as theatres, boxing, etc., though not without some increase of their normal lighting. Although a little difficult to handle and despite some geometric distortion this tube has given excellent service and is expected, in a smaller and improved form, to remain in use for some years to come.

Meanwhile, and since the war, research has been resumed in Great Britain on the "low-velocity" type of scanning tube in which the absence of secondary emission gives rise to some interesting features. One outstanding advantage, the absence of "shading", can happily be combined with a sensitivity several times better even than from the "Super". These features are embodied in the EMI "CPS" (Cathode-Potential-Stabilised) Emitron tube which was first used publicly by the BBC in November 1947. This tube as well as the Super-Emitron was employed extensively for the recent televising of the London Olympic Games (Fig. 1). The "CPS" possesses a remarkably high signal-noise ratio since the tube itself, like other Emitrons, does not generate any inherent noise. Although it is still undergoing development and is expected to be further improved, it already shows much promise and should prove particularly valuable for use out of doors in bad light as well as for theatres and other indoor subjects under their normal lighting conditions.

Fig. 1
The new «CPS» cameras in action at the Olympic Games
(Swimming events)
The camera on the left is fitted with short focal-length lenses while that on the right has telephoto lenses for close-up views. Note the focussing control near the rear of the camera

Cameras and Mountings

1. *Studio Cameras*

Apart from minor alterations the studio cameras are still the same as those installed at the commencement of the high definition service in 1936. Despite their early vintage they have, on the whole, proved most satisfactory. The Viewfinder is of the optical (parallel lens) type and the image appearing on the ground glass screen is inverted. (This instrument has other drawbacks too, but the operators have adapted themselves and would probably be reluctant to see it replaced by the more fashionable CRT[2]).) There are no lens turrets, but this is not a major drawback since a variety of lenses is not technically feasible with the tube in its present form (6″, *f* 3 and 12″, *f* 4,5 only). In any case it is questionable how desirable are changes of lens angle on the same scene owing to the distortion of perspective caused thereby. The size of shot can more elegantly be varied by tracking the camera. Any major-re-design of the camera will probably coincide with the adoption of a more sensitive, and therefore a different style, of pick-up tube. In view of the intention to equip a new studio at an early date this problem is already being considered. Some of the new design points will be similar to those to be discussed in a moment in connection with cameras for Outside use. Others are peculiar to studio cameras but in general it seems probable that no radical alteration of existing operational facilities will be demanded so much as the need for perfecting the mechanics of many important details, e. g. smoothness of panning and tilting, lens movement, etc.

Camera mountings are of great importance. In addition to being thoroughly stable they must have

[1]) Electrical & Musical Industries Ltd., Hayes, Mddx.

[2]) Cathode Ray Tube.

variable elevation and be mobile. Ordinary tripods or other mountings not easily moved are useless in the Studio. "Dollies" or trucks (carrying the cameraman as well as the camera on its stand and pushed by another operator) are popular and effective but in practice are not possible for all cameras owing to necessity for economy in staff and studio space. Other cameras are therefore on stands whose height can be varied and which are mounted on wheels so that they can quickly be pushed when out of use into new positions. Small stands of this kind also have the advantage of fitting easily into cramped spaces in the midst of scenery, etc. "Dollies" mounting a "crane" (providing continuously variable elevation from 2 ft. up to 7 ft. and swivelling) are extremely versatile and, although at present the numbers in use are limited for the reasons mentioned above, it seems likely that they will be used extensively in the future (Fig. 2). Self-propelled dollies and cranes, whose movements will be directly under control of the cameraman have been considered: but it is generally thought that the cameraman has his attention too fully occupied in the exacting business of following and focussing to take on any further tasks.

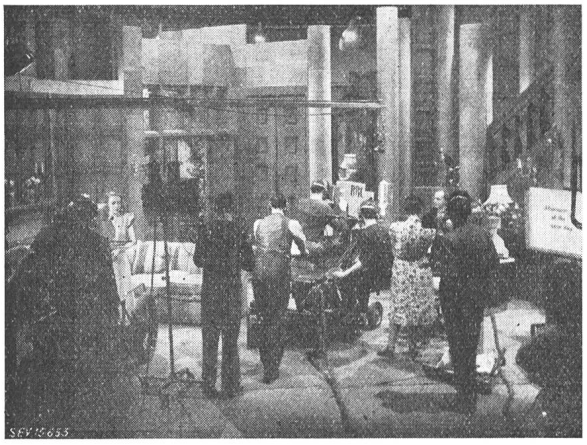

Fig. 2
Three types of camera mountings in use in the Studio
Left to right: Simple «dolly», crane (with crew of three) and movable Stand

Meanwhile for a new medium-sized studio the following would be a typical distribution of cameras mountings: 4 cranes; 1 Ordinary camera mounting on dolly; 2 camera stands on wheels.

2. *Outside Broadcasting Cameras*

The introduction of the Super-Emitron pick-up tube (referred to earlier) necessitated some alterations and complications to the camera structure, though the operation of the camera remained substantially the same, except that the viewfinding became much more difficult owing to the reduced size of the image. The latter became only 30 mm diagonal — the same of course as the photo-cathode of the tube, and only $^1/_{20}$th of the former area. These cameras are in use up to the present day though they are due for early replacement. The variety of possible lens angles (since the small photo-cathode permitted the use of the standard range of 35 mm film lenses) brought the need for quick-change facilities (especially as with the type of optical viewfinder used two lenses had always to be changed when altering the angle) and this is leading to the introduction of lens turrets. These, mounting 3 and

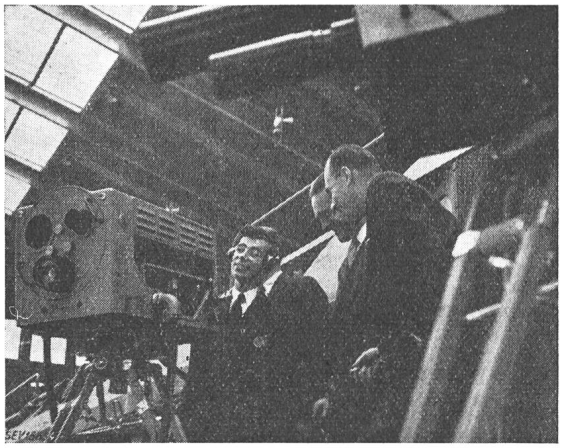

Fig. 3
Illustrating the lens turrets on the new cameras

4 lenses, have just appeared in service and are shortly to be used on all outside cameras. Note that the criticism of changing lens angles on studio cameras is not applicable to Outside Broadcasting, or rather is outweighed by the advantages of achieving closer views of a subject from a fixed camera position (Fig. 3). The existing range of lenses used in conjunction with the Super-Emitron Camera give a choice of angles between 2,5° and 40°.

It is hoped soon to introduce also a "zoom" lens, i. e. one whose focal length is continuously variable. This could not replace the need for lens changing since its maximum variation is not likely to exceed 2 or 3 to 1, but it is thought to have some useful applications to outside work.

Television cameras have always lacked the perfect viewfinder and the use of lens turrets accentuates the problem since the old style of parallel optical viewfinder (with duplicate lens) ceases to be practicable. The solution being immediately adopted is a CRT built into the camera and showing the cameraman the television picture from his camera, but despite several obvious advantages this falls short of the ideal in at least the following respects:

a) Resolution on a small screen (about 3″ diameter) is unlikely to be as good as the system is transmitting and may therefore obscure small inaccuracies of focus which the cameraman ought to be correcting.

b) The scene outside the area being transmitted is not displayed to the cameraman and he is thus robbed of useful knowledge.

c) The bulk and weight of the camera is appreciably increased.

d) With the many valves and components involved there is the liability to breakdown and the effect of this would be nearly as upsetting as a failure in the main picture channel.

e) Possible eye-strain on the cameraman. Our operating experience with this type of viewfinder has not been sufficient to draw conclusions, but there appears some evidence of strain and this is being studied.

Although the CRT viewfinder will not necessarily be superseded for all types of work, some form of purely optical viewfinder capable of use in conjunction with a lens turret is still considered highly desirable and is being actively followed up. It may not prove possible to realize the required bright, large erect image and at the same time indicate the focus. The possibility of removing the focussing function from the cameraman and giving it remotely to the operator at the camera control position is therefore being considered as one possible approach to the problem. For many types of event, especially with the depth of focus to be expected from the more sensitive tubes coming into use, it is thought this principle may be valid and experiments will probably begin shortly.

The question of control of lens aperture is also receiving special attention. Nearly all the types of pick-up tubes used for outside work operate best at a particular value of light and when the local light level changes it is almost essential to compensate by appropriate adjustment of the lens iris. As it is quite impracticable for the cameraman to reach to the lens itself to turn the iris a remote control of the latter is now being fitted to the back of the camera. It is being found however that the cameraman is too pre-occupied either to notice variations in light or to operate this control effectively and many consider that it should be adjusted remotely by the engineer at the camera control position. The latter would then use this as the main level control, once the amplifier gain had been suitably pre-set. This idea is expected to be adopted experimentally in the near future.

There are so many desirable features which could be incorporated in an Outside Broadcasting camera that if all are there at the same time the resultant bulk and weight of the camera becomes considerable. As there are often situations requiring the use of a small lightweight camera it is being found impracticable to standardise on one universal design and preferable instead to have two or three models of varying sizes and performance suited to specific purposes.

Outside Broadcasting calls for great versatility in the matter of camera mountings. Here the problem is one of setting up the camera in positions where there may be no ground space or only a small area, often far from level. Special fittings, such as an attachment for mounting the panning head on a scaffold rail, small low stands for cramped positions and other adaptors of one kind and another are always being developed as new situations arise.

Lighting

1. *Studio*

As is well known most television pick-up tubes and amplifiers respond better to a scene which inherently gives rise to an A.C. rather than a D.C. signal. Large areas of uniform brightness are therefore avoided as much as possible. "Shading" difficulties are particularly eased by an "A.C." scene and with the present studio tubes it is desirable in addition to keep any dark subject matter away from the lower edges of the picture. Scene constructors and painters co-operate closely with engineers to ensure the most favourable conditions. The subject as finally seen by the television camera can be appreciably modified by the style of lighting. The latter is planned according to the type of scene to produce the most realistic effect. The general limitations of pick-up and receiving tubes require that the total useful contrast range of the scene be restricted to about 30 to 1, or even less, otherwise some part of the tonal range is bound to be compressed or lost. On the other hand this limitation of contrast cannot be carried too far or the scene will approach a D. C. rather than an A. C. type.

For subjects of moderate tones a typical average illumination value to suit the standard Emitron would be 200 ft. candles incident, giving a typical brightness of reflected light at the camera from medium tones of some 50 ft. lamberts. This can be achieved with a power consumption averaging about 170 watts per sq. foot of illuminated area (for tungsten-filament gas-filled lamps). In order to be ready to create the right atmosphere for every different scene televised an extensive range of luminaires and fittings are held available for use in various combinations. The following are the more usual types of luminaires used by the BBC:

Apparatus	*Wattage*
Lens spots	5, 2, and 0,5 kW
Broads	5 and 1 kW
Special soft overhead	5 kW, made up of 100 W lamps spread over 12×4 feet.

Successful television lighting also calls for close liaison between lighting and circuit engineers. The latter can also assist with various "effects" e. g. a scene with large areas of darkness which would normally cause "shading" trouble, can be achieved by lighting the required areas to a greyish level and then electrically converting this to true black while at the same time increasing the contrast by additional amplification. This sort of artifice must, however, be used with discretion and in general, apart from helping the defects of the pick-up tube as in the example just quoted, there is no marked tendency to encourage electronic rather than purely visual or optical effects. This may represent a healthy attitude for if one thinks ahead to the advent of colour television it is almost frightening to imagine the possible metamorphosis which a skilful electronic engineer could apply to a television image!

Experiments with "discharge" lighting are taking place with a view to:

a) improving efficiency
b) reducing heat
c) enhancing picture quality as a result of confining the illuminating spectrum to the visual range, i. e. eliminating infra-red components.

The first requirement for this is a smooth D. C. supply to avoid ripple modulation. The most promising light source in this category is an arc discharging between tungsten electrodes in mercury cadmium vapour giving a highly concentrated basic source of

light, which can then be used either in the form of spot lights or diffused as required to give general soft lighting. The spectrum of the resultant light has the maximum energy in green with rather more in blue and less in red than the normal response of the eye. The lack of red is something of a drawback but some experimental luminaires of this type are already in use. More will be installed shortly as they become commercially available but it is too soon to say how far they can be expected to replace the normal filament lamps which, despite their inefficiency, have many practical points in their favour.

2. *Outside Broadcasting*

It is usually necessary to supplement the existing illumination at indoor events televised by the mobile units, such as theatres, dances, boxing, skating, etc. With the pick-up tubes normally used in the past (i. e. Super-Emitrons) this has entailed ideally an illumination intensity of some 100 ft. candles, giving a brightness at the camera from middle tones of say 20 ft. lamberts. In practice one often has to make do with less in order to cause the least local inconvenience. Other factors which add to the problem are:

a) The scene is not designed for television and so cannot take into account the limitations of pick-up tubes or the television system as a whole.

b) The luminaires cannot necessarily be mounted where they would give either sufficient illumination or the most artistic effect — they have to be put where space can be found, and also where they comply with the fire and safety regulations of local authorities.

c) The atmosphere is often hazy from tobacco smoke and or fog.

d) Rehearsals are often impracticable.

It is quite usual to add 100 kilowatts of illumination at an average theatre while at one ice-hockey event the total illumination was nearly 300 kw. (The size of the rink was so great however that this only corresponded to 13 watts p. sq. ft. and the results were in fact poor not only because of the low lighting level but because of a mist rising from the ice.)

The more sensitive tubes (e. g. CPS and improved Super-Emitrons) now coming into use will permit the televising of many indoor scenes under their normal lighting conditions or at least with only minor additions or alterations. A typical play at a London theatre could give a brightness measured in the Dress Circle of 20 ft. lamberts from high lights and 0,25 ft. lamberts in the shadows, and these values are within the capabilities of the CPS tube. (Note, in passing, that we generally refer to the brightness i. e. reflected light, rather than the illumination, i. e. incident light, owing to the usual difficulty in outside television of measuring the latter.)

At the Empire Pool, Wembley where the Olympic Games swimming events were recently held the artificial light by which the events took place after dark gave brightness values measured at the television cameras of

High Lights:	16	ft. lamberts
Medium tones:	6	» »
Darkest portion:	0,4	» »

The CPS cameras picking up these scenes gave excellent results working at an aperture of $f\,3$. The illumination was provided by incandescent lamps overhead averaging 15 watts per sq. foot of lighted area, or less than $^1/_{10}$th of normal studio intensity.

Studio Design

The present BBC Television studios measuring 70 ft. × 30 ft. × 24 ft. high and of which there are two in number are becoming increasingly inadequate for programme requirements. There is a pressing need for larger studios to:

a) Allow more rehearsal time on each production. (The present limitations only allow a play or other programme to be rehearsed in the studio with the cameras and operating staff for a few hours just preceding the actual transmission.)

b) Reduce the heavy congestion when, as sometimes occurs, 50 artistes, 30 staff, over 100 kilowatts of lighting, 4 cameras (including a crane and a dolly), microphone booms as well as the scenery and properties are all crowded into one of these existing studios (Fig. 4).

Fig. 4
A typical studio production employing all the available space

The design of new studios is a subject to which much attention is now being given and here there is time to refer only to a few general principles.

Apart from greater floor area an increase of height is also necessary to permit more uniform lighting as well as to improve the handling of scenery. It is necessary to allow for the maximum freedom and flexibility within the studio and perhaps the most important part of its design is simply that of determining the plan and elevation and thus creating a shell into which all the equipment and scenes can be free to group themselves in different ways from day to day according to the production needs. There are, of course, certain permanent fixtures such as lighting galleries round all the four sides but individual sets will often need special additional structures for mounting cameras, luminaires, etc. These can be built as necessary from rostrums and tubular metal scaffolding. Particular attention, of course, has to be given to means of getting scenery in and out with the least obstruction or delay. Another point of design is the positioning of the production control room. It is customary for the latter to be so situated

as to overlook the studio through a window set high in one of the walls since although not perhaps essential it is sometimes helpful to the Producer to have a general view of the studio floor. In this connection it may well transpire that no single position can ensure a view of the whole floor area. Opinion is divided as to the seriousness of such a limitation.

Possibly one of the most important principles to apply to the general equipping of a television studio is that of keeping as much apparatus and personnel as possible off the floor level. The latter must be left free for scenery and artistes and, of course, the unobstructed placing and movement of cameras and microphone booms. Thus anything which can be fixed and operated from a higher level, e. g. luminaires, lighting switchboards, etc. makes for simplicity and, in consequence, efficiency.

It is unlikely that the television studios will grow into the mammoth buildings of the film industry and it is more probable that future expansion will be on the lines of laying down a group of medium-sized separate studios each designed for and allocated to a particular type of programme material, e. g. drama, light entertainment, etc. This need largely arises from the unique and governing feature of television (as compared with film-technique) — namely its "continuity". It has to be remembered that television produces several hours of programme per day as compared with the same number of minutes in film-making. Moreover a television programme cannot be produced piecemeal, in the way that a film is made. It must run continuously from beginning to end without a break and during its run must be immune from interference of any sort. Thus each component of the day's programme, e. g. the play, the music, the talk, the Variety, etc. needs its own self-contained studio, insulated from the others, to allow rehearsals and programmes to proceed simultaneously without mutual interference. Also arising out of this "continuity" feature, and tending to restrict studio size, is the need for all the several sets pertaining to any one production to be grouped fairly closely within the studio to allow quick movements by artistes from one set to another. While obviously studios would vary in size according to purpose it is thought that dimensions of 130 ft. square × 40...80 ft. high would meet maximum requirements for some time to come. These dimensions do not however allow for "back projection" scenic effects. It is quite possible that at least one studio would need such a facility and a special tunnel would have to be built out from one side of the studio. This is a cumbersome arrangement and other possible ways of achieving a similar effect are still being explored.

Apart from the design of individual studios a good deal of thought is now also being given to the layout of a multi-studio Television Centre. Many factors must be taken into account but perhaps one of the most important is the need to economise in operating and supervisory personnel. Unnecessary dispersal must therefore be avoided and one proposal embodies a fanshaped grouping of studios which, while permitting effective access and supervision from the centre, allows ample space for the handling and movement of scenery at the circumference. The fulfilment of such a project is, however, still somewhat distant (on account of postwar difficulties) and the BBC's next step has perforce to be that of finding one larger studio. This will have to be a building already standing and remote from the present Studio Centre and there may be only limited scope for applying the latest design principles, though the additional space will have immense value for the improvement of productions.

Mobile Control Room Layout and Design

In the interests of simplicity and economy of space both the engineering functions and programme direction, which in the studios are separated, are combined for Outside Broadcasting purposes in a single mobile control room.

The two mobile control rooms which have been in use since pre-war days were fitted with exact duplicates of the technical apparatus that had already been designed and installed in the studios. In those early days of television this was the most certain way of achieving the object. The apparatus was, however, bulky and heavy and necessitated large vehicles weighing approximatively 11 tons laden. The general layout was not ideal for the purpose with the operating positions and controls somewhat haphazardly disposed about the interior in a manner which did not make for the comfort of personnel or the smoothest operating technique. To gain access, for maintenance purposes, to the rear of the apparatus racks the sides of the vehicles were made in the form of hinged flaps which could be raised and lowered outward (Fig. 5). These when

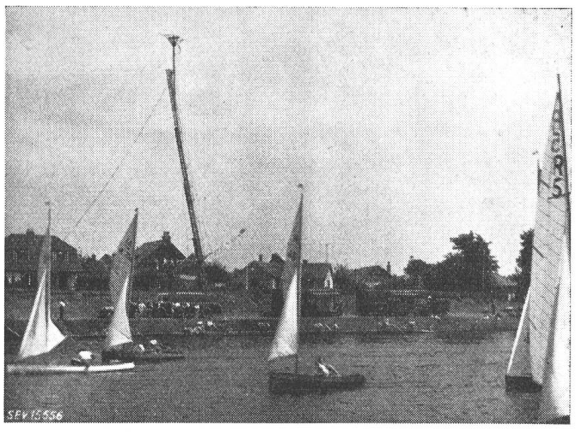

Fig. 5
The BBC mobile equipment in action by the Thames
Note the open flaps on the sides of two of the vehicles

opened on both sides increased the effective width of the vehicle to 15 ft. and led to parking and other difficulties. Moreover the associated external equipment, particularly cameras and camera cables, did not stand up well to the weather or to frequent handing — being designed for neither. Installation

and maintenance have in consequence taken up a fair amount of time which has had to be allowed for in the planning and spacing of commitments. Nevertheless, despite these limitations, over 450 outside locations, including every important topical event and sport within a 25 mile radius of Central London, have been visited since 1937 (not including the war years) and results have been generally very successful. Since the war, however, the desirability of modernising the mobile units became more pressing and in 1947 contracts were placed with the EMI and Pye companies for new mobile camera control equipment constructed according to a general layout and performance specification drawn up by the BBC. The basic requirements were:

a) All units of equipment to be light, compact and transportable and, although normally mounted and operated in a vehicle, to be capable of removal from the latter so that the complete outfit could be reassembled inside, say, a theatre building or other place where vehicle parking space is unavailable.

b) Apparatus to be laid out for maximum ease of operation, particularly having regard to the comfort of personnel who must all be seated and with clear views of the screens which they face.

c) A total of three cameras per mobile unit, and each camera and associated camera channel to be complete in itself with the resultant image continuously displayed. Thus, with an additional screen monitoring the outgoing picture at the "camera mixing" position and another for displaying the latter after reception by radio, a total of five screens are needed. With this operational arrangement, however, it becomes possible for a single camera channel, which might be adequate for certain urgent assignments, to be withdrawn and mounted in a smaller type of vehicle. Each camera can be remote from the Control point to the extent of 1000 feet of connecting cable.

Three separate mobile control outfits conforming with these precepts are under construction, while a fourth, to be known as a "Master Mixer", is also on order. The latter will fulfil the need for a programme selection position to be set up on important occasions when two or more (up to a maximum of 4) mobile control rooms are covering the same event or two simultaneous events closely related, e. g. the start and finish of a horse race, the Stadium and the Swimming Pool at the Olympic Games, Buckingham Palace and Westminster Abbey at the Royal Wedding, etc. The output signals from the several control rooms are all fed into this Master Mixer — the latter being connected via a single vision channel, either cable or radio, with the main Alexandra Palace transmitter.

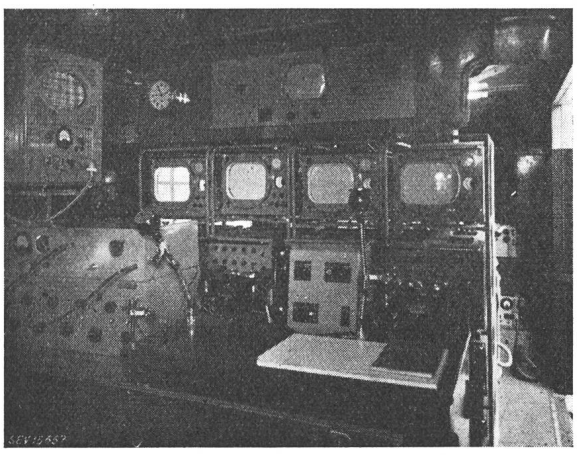

Fig. 6
Layout of equipment inside the new mobile control room
Note the small waveform oscillograph to the right of each picture screen

All the vehicles housing this new equipment will take the form of trailers, 17 ft. × 7 ft. 6 ins. in size each towed by a tractor which can if desired be unhitched and removed after delivering its load to site. One outfit complete has already been delivered and was in use for the first time at the recent Olympic Games in conjunction with the CPS pick-up tubes referred to earlier (Fig. 6).

Film Transmitters

Film transmitters are a necessary part of the Television Centre for at least two purposes:

a) Showing films of all kinds, including the BBC's own television newsreel as well as film recordings of television transmissions as a source of programme.

b) For "effects" in studio productions and for supplementing or linking studio scenes, e. g. to portray an exterior shot in a play.

There is thus a need for a film transmission unit to form part of each studio's normal facilities. One of these units is also used when a film is the source of programme, but there is then no need to be associated with any particular studio and, although not the present practice, in future it is likely that a separate film unit for this purpose will be installed and operated independently of any studio.

There is also a fundamental difference between requirements for film transmitters to fulfil the two purposes detailed above. For the former a projector operating at 25 frames per second only is needed, whereas for the second function it is necessary to be able to run at any speed from a stationary frame up to the full 25 per second. This requirement is most easily met by a "continuous motion" type of projector, and "Mechau" machines in conjunction with Emitron cameras have been successfully employed for several years. The same projectors are at present also used for transmitting "programme" films but "shading" distortion has been difficult to avoid, especially on films whose type of scene or density of printing has been unsuitable. Moreover the "cutting" from one shot to another inevitably alters the shading which there may barely be time to correct before the next change. Thus any form of pick-up tube which gives rise to shading is fundamentally unsuitable for films. Although there is more than one solution to this problem, including the use of a "low-velocity" type of tube, e. g. the CPS, that which is at present the most promising and is likely to be adopted soon is the old-fashioned "flying spot" scanner brought up-to-date. A CRT is used to produce the spot which is projected through a continuously moving film on to a photo-electric cell. Naturally the resulting signal is devoid of all such spurious effects as "shading", etc. and, with proper measures to ensure interlacing and mechanical stability, the results are technically unsurpassed.

Studio Production and Presentation Facilities

The general facilities necessary to ensure operational control of the cameras within each studio as well as the co-ordination of the outputs from all studios and other programme sources can be briefly summarised as follows:

a) A production position associated with and overlooking each studio, and, basically, controlling the selection of cameras (by cutting, fading or mixing) and microphones in that studio. In order that this can be done efficiently the producer views not only the transmitted picture but also that from each of the other cameras in use (a total of 4 in the present studio). With our existing facilities the "pre-viewing" can only be done, one camera at a time, by switching them in turn on to a single monitoring screen: in future designs, however, it is likely that there will be one screen per camera with all the separate pictures continuously displayed.

b) A comprehensive signalling and communication system which includes "Talk-back" from the Producer and Engineer to cameramen, studio managers and other operating personnel, and the use of small monitoring screens disposed as necessary in the studio so that starting cues and assistance in following the programme can be given to speakers, the orchestra conductor and others concerned.

c) A small announcing studio, shortly to come into operation, is necessary to ensure that announcements can be made at any time without disturbance to studio settings or cameras.

d) A Film transmitter associated with each studio as well as a second type, as already mentioned, capable of acting on its own as a programme source (present facilities are still short in this respect).

e) A "caption" transmitter associated with each studio for dealing with titles, credits, visual announcements, etc.

f) A Continuity Room into which all programme sources, e. g. Studios, incoming Outside Broadcasts, Film, etc. are fed for final selection before transmission. In this room the incoming programmes are previewed and proper co-ordination is achieved with the aid of adequate 2-way telephone communication with all sources including of course Outside Broadcasts.

Outside Broadcasting Operations and Problems

Outside reporting brings with it many problems, differing according to the event and place. In most cases however considerable advance engineering preparations are necessary before an effective broadcast can take place and also to ensure the minimum delay in getting into operation after the Mobile Unit and crew arrive on site, such as:

a) Arranging power supplies from public mains wherever possible. This is to ensure a frame frequency locked to the national grid.

b) Ordering land-lines for Sound and control purposes as well as for Vision at locations within the network area.

c) Planning the running of cabling from the mobile control room to camera positions, etc. (up to 1000 ft. distance) in a way which satisfies public safety regulations.

d) Careful choice of camera position. For this purpose, where a suitably elevated position is not available, it is sometimes necessary to construct a special platform, using scaffold tubing, and this on occasion has been as high as 30 ft.

The question of simplifying Outside Broadcasting installations and reducing the amount of preliminary planning is one which is constantly in our minds when designing new equipment with a view both to:

a) Increasing the total number of outside broadcasts and

b) Making it possible to undertake the reporting of urgent "news" items of which only the shortest notice can be given. There are, however, many fundamental technical difficulties, chiefly associated with the Vision and Sound links to Alexandra Palace, which for a long time will probably prevent television being "first on the spot" and the BBC has a newsreel reporting unit for dealing with urgent events in the first instance.

Although all existing resources are mobilised and adapted to enable the successful reporting of the widest possible range of interesting events certain limitations still exist. For example the popular University Boat Race cannot adequately be followed from the shore. A camera in a helicopter would go a long way to providing an ideal solution and this technique would also be useful on certain other events, but although the problem is being closely studied we do not yet possess light enough camera equipment or a suitable "air-to-ground" radio link to make this possible.

Another limitation at present is the maximum distance of Outside Broadcasting points from the main transmitting centre at Alexandra Palace. The long range vision pick-ups are all relayed by a radio link but, with the present power (1 kW), wavelength (63 Mc/s) and aerial height (80 ft.) it does not seem possible to exceed 30 miles range. Greater distances will therefore necessitate two or more "hops" which may be all-radio or combinations of cable and radio, and the extension of the service by the provision of extra facilities of this kind is now being considered.

Acknowledgement

Acknowledgement is due to the British Broadcasting Corporation for permission to give this lecture and also to my Television colleagues for much of the information.

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Evolution de la Télévision

Par *A. Ory*, Paris

621.397.5

Les vues que j'ai l'honneur de présenter à cette première réunion internationale sont certainement des vues personnelles, comme celles des autres congressistes, et je serais heureux si, combinées ensemble, elles pouvaient déjà donner des perspectives homogènes d'avenir. La Télévision, à peine née, a été en proie à de nombreuses vicissitudes. Ce fut tout d'abord son enfance, au cours de laquelle elle se transforma complètement en délaissant les systèmes du type à disque de Nipkow pour adopter le tube cathodique et l'iconoscope.

Ce fut dans cette dernière période que la guerre éclata. Or,