
Developments in Television 1945–1965

It will be recalled that the B.B.C. television high definition service began in 1936, using Marconi transmitters and antenna and an E.M.I. modulator and studio equipment. The complete system had been provided by a company registered in 1934 as the Marconi–E.M.I. Television Co. Ltd., a fusion of the television interests of both manufacturers.

Upon the outbreak of war, the London (Alexandra Palace) station, which was the only one in the British Isles, closed down for the duration. The final pictures were those of a Mickey Mouse cartoon, the closing words of which, appropriately enough, were 'I t'ank I go 'ome' – a catch-phrase of the time deriving from the famous Hollywood actress Greta Garbo. There was no closing-down speech. Just 'I t'ank I go 'ome'. Then silence for the next seven years. The blank screens were symbolic of the trading aspirations of Marconi–E.M.I. Ltd.

But when the end of the war approached, collaboration between the television engineering elements of Marconi and E.M.I. began again. One outcome of this was a proposal that the pioneering standards of 405 lines positive modulation should be abandoned for a higher line standard. In the U.S.A. a public service operating on 525 lines and using negative modulation had been operating since 1941 and it was argued by Marconi–E.M.I. that as only a relative handful of television receivers existed in the London area (all at least seven years old), the re-start of the service would be an excellent opportunity to raise the line standard, 525 lines, negative modulation, being favoured.

To give substance to this opinion, television equipment using negative modulation was built. It was assembled at the E.M.I. plant at Hayes, Middlesex, after the war at the time when a committee under Lord Hankey was investigating the future of television on behalf of the Government. Lord Hankey's committee was invited to inspect the operation of the equipment, which provided an improved picture with no white flashes from static interference. Strangely, the committee never made the journey to Hayes and when its report was published its main

recommendation was that the B.B.C. should recommence the service on the original standards. Thus was a golden opportunity missed. On 7 June 1946 the television service was resumed from Alexandra Palace, using the pre-war equipment.

It was at this time that the Marconi Company was experiencing a considerable internal crisis. Behind-the-scenes negotiations concerning the English Electric take-over had been going on for some considerable while past and within the Marconi senior management the issue was not seriously in doubt. The Company would come into the English Electric Group, and soon.

This situation necessitated some new thinking in many directions, one of which was the future role of Marconi's in television. The crux of the matter was this: the Company itself was debarred by prior agreement from offering thermionic valves or kindred devices for sale. If, however, it became a part of English Electric there would be nothing to prevent that Company from entering the valve market, which would naturally include the manufacture and sale of television camera tubes.

One important consequence of this would be to upset the pre-war Marconi relationship with E.M.I. The formation of Marconi-E.M.I. Television Ltd. was in no sense an amalgamation between the two companies as a whole; only their television interests were involved. These interests were complementary; Marconi's possessed the transmitter expertise, E.M.I. the Emitron camera and particularly the skills of camera tube manufacture; neither company was in active competition with the other and so a *mariage de convenance* was strictly logical at the time of its inception.

As a takeover was almost certain to take place the fundamental question was whether the Company should extend its activities to include television studio equipment in general and camera channels in particular, thus putting it in direct competition with E.M.I. Although (in the event of an English Electric takeover) Sir George Nelson would without doubt have the final say in the matter, he would be guided in his decision by the views of the Marconi management.

The decision involved too great an element of crystal ball-gazing to be an easy one to make. For one thing, there was at that time little or no indication that television would ever attain the popularity of sound radio. The three pre-war years had seen only about 2,000 licences issued – a painfully slow rate of growth. If this trend was maintained in the post-war period the inevitable outpouring of money into camera research would yield no significant return.

Another factor on the 'against' side was that although the Marconi valve laboratories were highly experienced in general thermionic work, the skills did not extend to camera tube manufacture. Even if camera tubes were 'bought in', the manufacture of cameras was an unknown area.

Last, but not least, the decision to gamble would inevitably mean the dissolution of the Marconi-E.M.I. television partnership which had served well enough in the building of the London station and would no doubt continue to do so. Dissolution would mean the automatic creation of a formidable competitor which already possessed the thoroughly proven Emitron and Super-Emitron camera designs.

As a probing exercise, Marconi engineers, sent to the U.S.A. to report on the current state of the art, returned with some moderately encouraging news. Television sales were showing signs of a boom, while, on the technical side, the orthicon camera tube which had been developed there before the war had undergone considerable subsequent improvement and had emerged as the image orthicon. This device, which embodies principles different from those of the iconoscope or Emitron type of tube, possessed certain advantages. Its cylindrical shape made a simplified camera design and housing possible. Electrically it eliminated the spurious shading effects associated with the early iconoscopes and it was more sensitive and could therefore be used at lower lighting levels. Unfortunately, however, these advantages could only occasionally be realized in selected laboratory tubes; quantity production was another matter. The first image orthicons were like the little girl in the rhyme; when they were good they were very very good and when they were bad (which, more often than not, they were) they were horrid.

As a stop gap expedient the Marconi Company utilized its cross-licensing agreements with the Radio Corporation of America and purchased existing camera designs and those of associated equipments from that source. These were re-engineered Marconi-fashion to become the Mark I camera channel. This used American three-inch image orthicon tubes.

In view of the hazards it is surprising to find that a decision was made to go into production with television studio equipment. This act of faith – for it seemed to be little else at that time – was followed by the English Electric takeover in August 1946. One of the consequences of this was the reconstitution of the Marconi valve laboratory as the English Electric Valve Company Limited. By 1947 work was in hand for the development of an image orthicon camera tube.

With the London television station in service again the B.B.C. invited tenders for the installation of a second transmitting station to be located at Sutton Coldfield near Birmingham. This brought the first crunch, for E.M.I. Ltd. had retaliated by actively moving into the Marconi home ground – the transmitter market – and tendered for the contracts as a competitor. In the event E.M.I. were awarded the responsibility for the high-power vision transmitter and Marconi's provided the high-power sound transmitter, the medium-power vision and sound equipments, the antenna and the feeder systems. The alliance was at an end; the Marconi-E.M.I. Television Company was officially dissolved in 1948. The Sutton Coldfield station came on the air on 17 December 1949.

The immediate prospect in the camera field was not encouraging. The B.B.C. had evaluated the Marconi Mark 1 camera and were not impressed with its studio performance. The Super Emitrons under the controlled lighting conditions of a studio were undoubtedly superior. The prospects for sales of the Mark 1 were, however, somewhat more hopeful for outside broadcasting work, for when dealing with a scene under natural lighting (and in particular under overcast conditions) the sensitivity of the image orthicon showed up to advantage. In this field the B.B.C. was at least interested.

The newly formed (1948) Broadcasting Division was not unduly despondent. Overseas, the market was showing some promise. In September 1949 the Division had staged the world's first public demonstration of 625-line large screen television at the International Television Exhibition in Milan. This had impressed the Italian broadcasting authorities and it was hoped that orders would be placed. (In due course they were, and on a large scale, both for transmitters and studio equipment.) Only six Mark 1 cameras had been made; these were guinea-pigs from which an improved strain could be bred. Much had been learned from them in a short time and already a Mark 1B, a considerable improvement, was on its way. Heartening too was the promise in the image orthicon approach and the thought that the camera's dependence on American tubes might soon be at an end with the development of English Electric Valve Co.'s model.

This feeling of optimism received a fillip in 1950 when the Mark 1B was accepted by the B.B.C. who began to make increasing use of these cameras in their numerous outside broadcast exercises. On 27 August 1950 television spanned the English Channel for the first time with an outside broadcast from Calais and on September 30 the first live air-

to-ground television broadcast from an aircraft in flight took place. Marconi image orthicon cameras were used on both occasions.

By this time the B.B.C. were pushing ahead rapidly with their plans for television coverage of the British Isles. The service came to the North of England on 12 October 1951 when the Holme Moss station began transmissions. This station, at that time the most powerful in the world, was all-Marconi. The Corporation's plans were well advanced for further stations at Kirk o'Shotts (Scotland) and Wenvoe (near Cardiff) with others to follow at Pontop Pike (Yorkshire), Divis (Northern Ireland), Les Platons (Channel Islands) and Meldrum (near Aberdeen). Still more were in the planning stage.

On the studio front, a Mark II camera had been developed which, it was hoped, would break into that market. Its specification included a 4-lens turret, an electronic viewfinder and, for the first time, an English Electric Valve Co. three-inch image orthicon.

An early order for these cameras came from the United Nations organization for use at the U.N. Headquarters building. Three Mark II's were permanently installed. This camera was also chosen to provide large screen pictures at the Telekinema at the Festival of Britain. The great breakthrough into the studio market came in 1951 with overseas contracts for the supply and installation of complete television services (transmitters, antennas, cameras and associated studio equipment) in Canada, Spain and Bolivia. At home, the B.B.C. ordered six Mark II camera channels and associated equipment for their new Lime Grove studios. The Broadcasting Division were over the hump in camera manufacture and from this time onward orders multiplied considerably. By 1953, well over £1,000,000 worth of camera channels had been sold.

A heavy demand for transmitters was also being experienced. The Kirk o'Shotts station which came into service on 14 March 1952, used Marconi sound transmitters, medium-power vision transmitter and antenna system. Wenvoe (Cardiff), the fifth B.B.C. station, was similarly equipped when it came on the air on 15 August 1952. A month earlier an all-Marconi station (transmitters and studio equipment) was ordered for Venezuela. Other equipments were being exported to Canada, the U.S.A., Italy, Yugoslavia, Siam, Australia and Japan.

On 21 August 1953, the B.B.C.'s Studio E at Lime Grove came into service, using the six Mark II cameras mentioned earlier. This was a significant occasion, for it was the first on which the B.B.C. had relied solely on image orthicon cameras in a studio. The provision of the Mark

It was a temporary measure, pending delivery of a new type of camera which embodied a radical development in image orthicon camera tubes. Behind this lies an interesting facet of technical history.

The story goes back to 1947 and a visit to the U.S.A. by G.E. Partington, a senior engineer of the Company. At the Radio Corporation of America's Lancaster plant he saw an experimental image orthicon which had originally been developed for the United States Navy; the tube incorporated a light-sensitive mosaic of $4\frac{1}{2}$ -inch cross-section instead of the standard 3-inch. This tube had considerable disadvantages; it was physically unwieldy, demanding a long camera housing and long lenses, while its sensitivity was considerably lower than that of a 3-inch tube. Its only merit was its low-noise performance.

At that time R.C.A. had just developed the Vidicon photo-conductive camera tube, a device which was much simpler in construction than an image orthicon. High hopes were entertained for this new tube and as a consequence work on the $4\frac{1}{2}$ -inch image orthicon had been all but abandoned.

One man at R.C.A., O. Schade, had been carrying out work on image processes, using sample $4\frac{1}{2}$ -inch tubes, of which a few had been made. These had given Schade a firm belief in the latent possibilities of the $4\frac{1}{2}$ -inch tube and during a visit by another Marconi engineer, L. C. Jesty, the R.C.A. man demonstrated the device to his visitor, who was considerably impressed.

Later that year Partington again visited R.C.A. and also saw the $4\frac{1}{2}$ -inch tube demonstrated by Schade. It was microphonic; it had a poor target; but Partington stated in his subsequent report that it was the finest picture he had ever seen – at least, in areas where the target was good. It resolved 800 lines/picture height all over; it had a signal-to-noise ratio of better than 40 dB, while redistribution effects and electronic 'ghosts' were virtually absent.

Partington became a $4\frac{1}{2}$ -inch enthusiast on the spot and on his return he and Jesty urged their chief, L. H. Bedford, to authorize the development of $4\frac{1}{2}$ -inch camera tubes. But the domestic upheaval of complete Company reorganization, and in particular the creation of the English Electric Valve Co., delayed matters and it was not until 1951 that Bedford got agreement for E.E.V. to develop $4\frac{1}{2}$ -inch image orthicons and eventually manufacture them. Concurrently, Marconi's were to design a new camera around it.

Manufacture of the $4\frac{1}{2}$ -inch target proved a particular nightmare; rejects in the early stages were almost one hundred per cent. Other

problems arose because it had been ambitiously decided to lengthen the image section considerably in order to provide extra magnification, thus permitting the use of lenses of the same size as employed with the 3-inch.

There were many occasions when those involved in the project wished that Schade of R.C.A. had kept the prototype tube to himself and all the time (recalled Partington) there was the chilling thought that the excellent picture quality he and Jesty had witnessed might have owed as much to the genius of O. Schade as to the construction of the tube itself.

The camera design also posed major problems, most of them deriving from the dimensions of the long, thick tube it had to accommodate. In these matters the advice of the B.B.C. had been sought at an early stage and the camera design proceeded in close collaboration with the Corporation's engineers.

Gradually the problems, both with tube and camera, began to sort themselves out and after three years' intensive work the day arrived when a realistic demonstration could be given. As a result of this the B.B.C. ordered the cameras for use at Studio E, Lime Grove, but as the opening date for the studio was in advance of manufacturing schedules, Mark II's were installed as a stop-gap. The new cameras, designated Mark III's, became available at the end of 1954.

Unfortunately, teething troubles predominated. The early tubes of the production run did not repeat the performance of the prototype in terms of sensitivity, resolution and signal-to-noise ratio and (as if this were not enough) they were also prone to microphony. The first batch delivered to Lime Grove had this defect and the B.B.C. were not amused. 'Thereafter,' wrote Partington wryly, 'the great industry of dropping dustbin lids began.' The 4½-inch tubes were withdrawn and the Mark III cameras were converted to use the standard 3-inch (fortunately the Mark III had been designed to use either type).

It was a desperate time at English Electric Valve Co., but by May 1955 the concentrated research effort had succeeded to the point where the B.B.C. removed the ban. By June 22 the 4½-inch image orthicons were on the air.

Microphony was still something of a problem in production batches for a while, but this was eventually dealt with. In the studios the production teams gradually got the feel of the new equipment and as they did so the picture quality improved to the point where the 3-inch could no longer compete. Early in 1956 nearly all existing Mark III cameras

were housing $4\frac{1}{2}$ -inch tubes, which were now consistently meeting the desired specifications.

Those engineers who had contracted ulcers in the hectic research and development phases had their reward in 1957, when the B.B.C. decided to standardize on the $4\frac{1}{2}$ -inch camera tube, both for studio and outside broadcast work. A further honour came in 1961 – this time from the U.S.A. – for English Electric Valve Co. and the Marconi Company jointly shared with the Radio Corporation of America, the coveted 'Emmy' award of a gold statuette for outstanding contributions to electronic technology in respect of the $4\frac{1}{2}$ -inch image orthicon and the Mark III camera. Today, the $4\frac{1}{2}$ -inch tube is recognized as a world standard for black-and-white pictures.

In the early 1950s considerable discussion arose in this country as to whether a colour television service should be started. It was strongly felt in some quarters that Britain, which had pioneered black-and-white, should not lag too far behind the U.S.A. where a colour service was already in being. A Television Advisory Committee had been set up to provide recommendations for the future of television and, as one facet of it, the question of a colour service. One of the findings of this Committee was that any system which was eventually adopted should be fully compatible – that is, that the colour transmissions should also be capable of being received as black-and-white pictures on a conventional receiver.

Following on this report the Marconi Company staged a complex demonstration of compatible colour television at English Electric House in the Strand, London. The demonstration, which opened on 11 May 1954, was the first of its kind in Britain. It did not set out to influence opinion as to which system to employ; on the contrary, three different approaches were shown side-by-side. Visitors were able to compare the respective picture qualities afforded by a full bandwidth, three-channel (red + green + blue) system, an N.T.S.C.* type of transmission (in which the colour information is contained in a sub-carrier within the main carrier envelope) and a system in which the colour information is contained in a separate carrier external to that which carried the luminance (black-and-white picture) information.

In addition, two types of colour camera were shown (one a three-tube equipment and the other a two-tube experimental camera) and a considerable variety of ancillary colour equipment.

* National Television System Committee, the American authority which laid down the standards used in the U.S.A. where compatible colour television was introduced as a public service in 1953.

The exhibition created very considerable interest among the hundreds of invited guests, which included the technical and lay press. It underlined the concentration of research effort which even at that early stage, the Company had put into the subject. In the event another thirteen years were to elapse before a national colour service came into existence, but in the interim a considerable business in colour television equipment was built up in overseas markets, particularly with the U.S.A.

On 6 June 1954, Eurovision, the network of microwave radio links and coaxial cables which permits programme exchanges between participant countries, was inaugurated. This featured the Fête des Narcisses at Montreux and also a camera tour of Vatican City. Marconi equipment played an important role in these exercises.

Another first was on September 26 when a B.B.C. programme was transmitted 'live' from a ship at sea. This was radiated from the British Railways car ferry *Lord Warden*, which carried Marconi transmitting equipment for the occasion. The experiment was entirely successful.

By 1953 British television, which had got off to a slow re-start in 1946 was steadily gaining viewers, largely because a large area of the British Isles was now covered by B.B.C. stations. The number of licence holders had topped the 2,000,000 mark. The B.B.C. decided that the time had come to replace the veteran (1936) installation at Alexandra Palace with a much more powerful station, to be sited at the Crystal Palace. Marconi's were awarded the contracts for the provision and installation of the entire transmitting equipment.

The Crystal Palace station provided an excellent example of the rapid technological progress which was being made. It was to have an effective (vision) radiated power of 200 kW – twice as much as any other B.B.C. station – which would make it the world's most powerful Band I transmitter. This was effected by the parallel operation of two Marconi 15 kW vision transmitters, feeding into a high-gain antenna system. Encouraged by the success of parallel-operated sound transmitters at Daventry two years earlier, Marconi engineers had tackled the much more difficult problem of phasing two vision equipments and a method of doing so had been perfected. The Crystal Palace installation was the first to use this approach.

The transmitters were newly-designed, built around a new type of tetrode manufactured by English Electric Valve Co. These equipments, while providing an effective radiated power which was twice that of Holme Moss, only occupied one-quarter of the floor space of those at the northern station.

Programme service (using a temporary antenna) began from the Crystal Palace station on 28 March 1956 and Alexandra Palace ('Ally Pally' to all its friends) closed down. Part of the original vision transmitter was eventually moved to Chelmsford where it was added to the Company's collection of historical exhibits. On 18 December 1957 Crystal Palace officially came into full-power service using its main antenna system.

The B.B.C. had begun colour test transmissions from a studio at Alexandra Palace in October 1956. On November 5 of that year the first series of experimental colour transmissions to include 'live' pictures were radiated from the Crystal Palace station. The cameras used were supplied to the B.B.C. by the Marconi Company.

The most important single event in the history of British television in the 1950s was the formation of the Independent Television Authority. This followed on the report of the Broadcasting Committee (1949) which in May 1952 recommended the introduction of an alternative service to that provided by the B.B.C. In the following year the first report of the Postmaster-General's Television Advisory Committee recommended that the new service should operate on Band III frequencies. In November 1953 a Government memorandum made specific proposals for independent television and the Royal Assent was given on 30 July 1954. A few days later the Independent Television Authority was set up by the Postmaster-General under the chairmanship of Sir Kenneth Clark. Shortly after, Sir Robert Fraser was appointed the Authority's Director-General.

The framework of independent television seemed to many at the time to be cumbersome, but the subsequent years have shown it to work well. The Independent Television Authority owns the transmitting stations and has jurisdiction over the programme and advertising content. It derives its revenue from the programme contractors it appoints and the programme contractors in turn derive their revenue from advertisers. Unlike the approach employed in the U.S.A. and other countries, the Independent Television Authority does not permit the direct sponsorship of programmes and limits the amount of advertising time, which may only be inserted in 'natural breaks' in the programme – usually at intervals of fifteen or thirty minutes.

The technical story of the inauguration of the new service is one with which the Marconi Company was closely connected; the magnitude of the effort needed to put independent television on the air at short notice can only be outlined here.

In September 1954 it was announced that the I.T.A. had placed a contract with Marconi's for three vision and three sound transmitters to operate in Band III. At the same time, very large orders for camera channels and other studio equipment began to pour in from programme contractors appointed by the Authority.

At Chelmsford, this promoted something of a crisis, for although some preparations had been made as soon as it became likely that a commercial service would materialize, heavy contracts already existing with the B.B.C. and overseas customers were loading the Works almost to capacity.

Accordingly, established procedures and working hours went by the board. Research and Development departments, confronted with problems peculiar to the hitherto little-used Band III (the phasing of parallel-operated transmitters at those frequencies, for instance), worked around the clock to solve them. The Propagation Department set about the task of recommending suitable transmitting sites and the preparation of theoretical field-strength contour maps, while the Works floor and associated areas tackled the seemingly impossible production targets. Unable to recruit specialist installation engineers in sufficient numbers, recently retired veterans were invited to return to active service, while those already on the strength voluntarily abandoned all thoughts of annual holidays.

On 22 September 1955 the first I.T.A. station, situated at Croydon, came on the air to serve the London area; the installation comprised one prototype vision transmitter and its associated sound transmitter and antenna system (the permanent equipment, including standbys, was installed a little later). The station, Marconi-built, was completed in seven months from the clearance of this site. It is perhaps of interest to record that the engineer in charge of the work was that same Christopher Caspard whose exploits in China in the mid-20s are mentioned in Chapter 34. He was one of the old brigade who came out of retirement at the Company's invitation.

In June of that year the Company established a Television Centre at St Mary Abbot's Place, London, to provide training facilities for the personnel of various programme contractors. This service was extensively used; later, when the main flood of training requirements had abated, the Centre was used as a temporary studio by the B.B.C. The 'Tonight' programme was one of those which started life at St Mary Abbot's.

It says much for the courage of those responsible for the I.T.A.'s

organization that plans for national coverage were well advanced even before Croydon came on the air. It must be remembered that the coverage area of a Band III transmitter was very much an unknown quantity and that the great majority of domestic receivers in use in the country were incapable of tuning to anything but a Band I station. Not a few wagged their heads and gloomily forecast a brief inglorious existence for commercial television. New domestic television receivers with wavechange switching to cover Band III were now available and also converter units which could be used with the older models, but the question was – would the public buy? And having bought, would they respond to the advertising? For if they did not, the advertisers would soon return to their old-established media and without their support independent television could not survive.

The Croydon (London) station was therefore very much the guinea-pig. But long before the health of this animal could be established other stations were coming on the air. These included:

Litchfield (Midlands) Opened 17 February 1956. Marconi antenna and feeder system.

Winter Hill (Northern, Lancashire) Opened 3 May 1956. An all-Marconi station.

Emley Moor (Northern, Yorkshire) Opened 3 November 1956. An all-Marconi station.

Black Hill (Central Scotland) Opened 31 August 1957. An all-Marconi station.

St Hilary (South Wales and the West) Opened 14 January 1958. Marconi antenna and feeder system.

Chillerton Down (Southern) Opened 30 August 1958. An all-Marconi station.

Burnhope (North-Eastern) Opened 15 January 1959. An all-Marconi station.

Thus (with the inclusion of the Croydon station), six out of the first eight I.T.A. stations were wholly supplied by Marconi's, as well as the antenna systems for the remaining two. Add to this the new B.B.C. stations which were being built at that period and the heavy overseas orders which included three stations for the National television service in Australia (Brisbane, Adelaide and Perth), and some idea can be gained of the strenuous life lived in the Broadcasting Division at that time.

Orders for other B.B.C. and I.T.A. stations, too numerous to detail here, followed, while in the studio field the Mark III camera was in due

course superseded by improved models. The Division has continued its tradition of making history, as for example on 11 July 1962, when the first transatlantic transmissions via the Telstar satellite employed Marconi cameras, as did the colour transmissions five days later.

CLOSED CIRCUIT TELEVISION

Television is so closely associated with broadcasting that one tends to forget that the early workers in the field thought of it in terms of visual line telegraphy. It was not until 1911 that the distribution of the video signals via a radio carrier was suggested by A. Sinding-Larsen (a prophetic utterance as the generation of radio waves by thermionic valves was unknown and television pictures having light, shade and movement had never been produced). Then, by the time television had arrived, sound broadcasting had become so widespread that the obvious thing to do was to provide vision entertainment via radio also. The original concept of transmission over wire conductors fell into oblivion.

It was revived in the U.S.A. in the late 1940s and in the early 1950s the Marconi Broadcasting Division also began to explore the possibilities of using the television camera for industrial, professional and commercial purposes. Experimental demonstrations were given to various potentially interested parties, including large gatherings of medical students and nurses; the 'remote eye' of the camera enabled these to watch surgical operations being performed, giving them close-up views which would not have been possible if they had been in the operating theatre itself.

Closed circuit television made the world's headlines in June 1951 when observers aboard the Admiralty vessel *Reclaim* saw, on television screens, the nameplate of the submarine *Affray*, lying in forty-seven fathoms in the English Channel. The submarine had vanished without trace two months previously and the identification was the climax to a systematic examination of wrecks over a wide area, using a television camera lowered to the sea-bed and connected by cable to the monitor screens in *Reclaim*. The camera was of Marconi manufacture and had hurriedly been adapted by the Admiralty to operate under water. Not only was *Affray* positively identified but the television camera also disclosed the fault in the schnorkel equipment which had sent the vessel to the bottom.

As a result of this success the Company entered into an agreement

with Siebe, Gorman and Co. Ltd., the specialists in underwater apparatus, to pool their respective skills and design equipment specifically for underwater work. This bore fruit in 1954 when the Marconi-Siebe, Gorman camera provided positive identification of pieces of the Comet aircraft which had mysteriously disintegrated in mid-air near the island of Elba in January of that year. By examination of the recovered wreckage, aviation experts were able to determine the cause of the tragedy and to safeguard against it for the future.

Although underwater television equipment has only a limited market, its use in these two tragic circumstances underlined the value of closed circuit t.v. in instances where first-hand human observation is dangerous, inconvenient or impossible. In the early days of its development as a tool, standard cameras were used, but before long relatively small, simple and robust camera channels were being designed; these bore a similar relationship to the broadcast camera as the photographic box camera does to the expensive professional model in that they could be handled by the lay operator after only a brief period of instruction.

As a deliberate policy the Company concentrated its main effort into the production of high-quality equipment for use in heavy industry, particularly in steel works and electrical power-generating stations, but, in general, for any environment in which rigorous ambient conditions exist. Other types of camera are manufactured for use in educational establishments. Gradually the volume of business built up to a point where it became expedient to hive it off from the Broadcasting Division and this was done in 1959 when it became the Closed Circuit Television Division.

Colour equipment is not extensively used for closed circuit work, partly because it is expensive, but mainly because the additional complication is, in a great number of cases, unnecessary – for example if the remote observation of dials and gauges is being carried out, the information is complete in its black-and-white form. Colour is, however, of value in certain instances such as hospital work or in aircraft flight simulator equipment.

Since Closed Circuit Division became a separate entity the volume and range of its business has continued to expand steadily. Although it is, strictly speaking, outside the dateline boundary to refer to 1968, it might perhaps avoid confusion to mention that in that year its title was changed to Electro-Optical Systems Division as better expressing the enlarging scope of its activities.