History of Designs Department 1947 - 1972

This brief history of the Designs Department of the BBC has been written to mark the 25th anniversary of the formation of the Department. This occurred in May 1947 when parts of Lines, now Communications, Department and Station Design and Installation Department, now SCPD and TCPD, joined forces under H B Rantzen in Brock House (near Broadcasting House; now relinquished by the BBC).

1947 - 1957 The First Decade

The new Department was quickly reinforced by the arrival of personnel who were to be in future years among its leading members. F G Parker and T Warswick joined in 1948 and commenced work in a ground floor room of Broadcasting House on the transmission of television studio equipment. F Stringer was Head of Sound Transmission Section, with G Stannard and, later, of M Chorley as his second in command; the latter eventually became Head of the Section until his regretted death following illness in 1972.

H Davies who had been engaged on the development of recording equipment as a member of Research Department at Nightingale Square, Balham, moved to accommodation at Maida Vale as a member of Designs Department and there led a section devoted to sound recording, which was joined during the ensuing years by J Haulgate, G V Buckley, J T B Percy and W R Hawkins among others. To provide the essential mechanical and testing services required by a Designs Department , Test Room and the Model Shop were established in Bentinck House.

The programme of work on which the Department embarked had as its objectives the establishment of new design standards, the introduction of automation and operation planning into the Sound Service so far as possible, and the development of the Television Service, which had recently re-opened following closure during the war of 1939-1945. There was considerable scope for action on these lines; during the war years new control rooms and transmitters had been improvised everywhere and much of the apparatus was now not only obsolete but of a makeshift nature, unacceptable in more normal times. The Television Service was using equipment of practically pre-war design, and there was a need for the development of apparatus to update the system and also to extend it.

Unattended stations were being introduced in order to allow operators to be used more profitably on other duties. To make this development possible, automatic equipment had to be devised to monitor the performance of the equipment and lines, and the production of such a device for radio, the Automatic Monitor Minor, was among the earliest projects undertaken in 1947 by the newly formed Department. H B Rantzen, F A Peachey and C Gunn-Russel designed apparatus, suitable for short distance working, which gave an alarm if the signal-to-noise ratio or programme level deviated significantly from pre-determined values.

In 1948, attention to magnetic recording began when the Department received two EMI recorders, type BTR/1, for evaluation; these were among the first magnetic recorders of professional quality to be manufactured in this country. In the same year, a new disk reproducing desk was designed, coded DRD/1. This was suitable for either 78 r.p.m. or 33 ⅓ r.p.m. standard groove recordings on disks up to the maximum size then used 17¼ inches diameter. The pick up, which by the standard of the times was of light weight, was carried on a parallel-tracking arm fitted with a groove-locating facility.

In 1949 the television coverage of the universities annual boat race from Putney to Mortlake was carried out on a hitherto unattempted scale, with nine cameras in use including some on board the launch "Consuta" following the competing boats. Prior to this occasion only shots of the start and finish of the race had been possible; now, the improved coverage described was made possible by

the use of VHF link equipment provided by Designs Department and by the participation of a team of Designs Department staff under the leadership of T Warwick.

In December 1949 the first regional television transmitting station was opened at Sutton Coldfield. The planning of this station had involved Designs Department in negotiations with the Post Office regarding the cable from London to Birmingham via which the station received its signal and in setting performance standards and making measurements of the performance achieved.

In view of the development of a nation-wide network of television transmission circuits, it became necessary to develop a range of test equipment to ensure that the performance of the individual links, of which as many as four might be used in tandem, was maintained at a required standard. The apparatus was designed by S H Padel, A R A Rendell and S N Watson, and comprised a video frequency oscillator, a video frequency amplifier detector, a test pulse generator, a waveform monitor and group delay measuring equipment.

In March 1950, following a secondment to the United Nations Telecommunications Department, H B Rantzen left eh Corporation's service to take u a permanent post as Director of Telecommunications at the UN. He was succeeded as Head of Designs Department by Dr A R A Rendall, who had been his second in command both in Designs Department and, before that, in Lines Department to which he had come from Standard Telephones and Cables Ltd.

Also in 1950, the original EMI repeaters and equalisers of the "EMI balanced pair" were replaced by Designs Department equipment. This cable was the first ever manufactured for the transmission of high definition television signals. It was laid in 1937 from various OB points to Broadcasting House and thence to Alexandra Palace, and was used on the occasion of the coronation procession in May of that year. The cable was 23 mm in diameter, paper insulated, with twin air spaced (kinked) conductors having a characteristic impedance of 186 ohms. The new ancillary equipment, which was developed by S Padel and D Savage, gave improved performance and complete flexibility of function. Sets of this equipment were installed at Broadcasting House and Alexandra Palace and also at Lime Grove which had been connected into the system by a length of cable laid after the 1939-1945 war. It its improved form the cable was used for the vast majority of central London outside broadcasts for some sixteen years, including a second coronation procession - that of 1953; during this period it was further uprated for 625 line operation. Eventually, however, the requirements of colour transmission proved too stringent for the thirty year old cable and the sections in central London were replaced in the mid-1960 by 9.5 mm co-axial cable. The terminal equipment for the new cable was produced by Designs Department and is currently (1973) in daily use in the switching centre at Broadcasting House.

Also in 1950 the Department began to assist in a series of television outside broadcasts, notably of sporting events taking place at Wembley. Personnel involved S N Watson, S Padel, T J Shelley and W N Anderson; the last named subsequently left the Corporation's service and joined the staff of the Independent Television Authority, now the Independent Broadcasting Authority.

In 1951, H B Rantzen left the Corporation's service and was succeeded as Head of Designs Department by Dr A R A Rendall.

In 1952 a prototype of an improved EMI magnetic recorder (BTR/2) was received; among other advantages, this machine was capable of being controlled remotely, and was widely used in later years in central recording and reproducing rooms. As recently as 1966, after internal redesign, including the transistorisation of the electronic units, by the Department, the BTR/2 was still considered to be "equivalent to the best up-to-date machines".

Also in 1952, the first Automatic Monitor Major, developed for use over long links, was installed at the Start Point transmitter. In this monitor, the signal with which the programme signal was compared was transmitted in coded form on a 7 kHz - 8 kHz carrier, over the programme circuit.

It was during this year that L E Weaver joined the Department. He came from Standard Telephones and Cables and began work with the BBC by designing a portable receiver to be used for monitoring

purposes by commentators. He was later to play a part in the arrangements for the first full scale Eurovision project, and to become the first Head of Measurements Section.

Meanwhile, the Television Service was outgrowing its original premises at Alexandra Palace and expanding into the old Gaumont-British film studios at Lime Grove, Shepherds Bush, now taken over by the BBC. To meet the needs of this expanding service, a variety of special facilities and apparatus were being developed in Designs Department; one such facility, the "inlay" process, was introduced into service in mid-1953. This process enables the signal from one picture course to replace that form another over a selected area of the raster, determined by means of a mask placed on the screen of a flying-spot cathode-ray tube. A development of this, the "overlay" process, in effect used the silhouette of the inset scene as the mask, so enabling that scene to consist simply of an object or performer against a plain background. These effects were much used for monochrome television until the later "colour separation overlay" process was devised in 1959 to meet the needs of colour television.

A method of tele-recording on 16 mm film, the "suppressed frame" system, was developed by J L Bliss, and extensive use was made of this to provide a record of the Coronation ceremonies of 1953. to facilitate the synchronisation of wider signals from a number of outside broadcast sources, a system was devised by B Shore whereby a frequency divided tone was distributed to the various points and the timings of the synchronising pulses derived from it adjusted manually by mans of phase-shift transformers, resembling gravimeters, in the individual tone circuits.

In 1953 a beginning was made to the gradual transference of the Department from Brock House to more spacious accommodation in Western House. This move was necessitated by a steady expansion in the volume of activity, notably in preparation for the equipping of the new Television Centre at Shepherds Bush, to be opened in 1960. Among the first sections of the Department to settle into the new premises were Television Group, under the leadership of S N Watson; this group immediately began work on the development of equipment required for the coverage of the Coronation in June 1953. As part of the removal process, the whole of the Department, with the exception of Model Shop, which remained at Bentinck House, was concentrated under one roof; Sound Recording Section moved in 1957 from Maida Vale into accommodation on the fourth and fifth floors of Western House.

The removal was a slow process because the upper floors of Western House were occupied by other departments of the Corporation and the ground floor was used as a motor car showroom. It was not until 1958-1959 that the other departments had all been displaced and Designs Department occupied the whole of the building except part of the ground floor, which became the Recorded Sound Effects Library.

In 1954 the first of a series of television outside broadcast vehicles known as the "Roving Eye" came into service. It was constructed by Designs Department personnel, led by G W H Larkby, and comprised a standard image-orthicon camera-channel, radio links for video, sound and control circuits, and a motor generator set installed in a 30 cwt Morris van. The camera was mounted in a gun ring on the roof of the vehicle, and the orientation of the aerial was maintained when the vehicle was in motion by means of a gyro-compass.

During this year developments took place in methods of appraisal of the performance of television links (e.g. the introduction of "pulse-and-bar" techniques) and a need was foreseen for new apparatus to be designed to make the measurements involved. To meet this need a new section of the Department (Measurements Section) was formed, under the leadership of L E Weaver, to carry out the necessary design work.

Also during 1954 a member of the Department (F G Parker) was seconded to the Marconi Wireless Telegraph Company for three months to work with that company's engineers on their experimental colour television equipment.

Following this, work was begun in the Department on the construction of some experimental colour monitors and coding equipment, and colour equipment was borrowed from the Marconi Company so

that extensive experiments could be carried out, leading in the Autumn to the transmission of an experimental colour signal to NTSC 405 line standards from the standby transmitter at Alexandra Palace. The work continued into 1955 with the construction of further apparatus, notably a vector scope and an NTSC colour signal encoder for installation at Alexandra Palace. Broadcast tests were carried out in co-operation with BREMA to establish compatibility and other factors concerning the NTSC colour television waveform.

An important event of 1954 was the first full scale Eurovision hook-up in May of that year, when pictures were received from the annual Spring Festival at Montreux. The incoming terminal in this country was at Swingate, near Dover, where RAF radar masts afforded a convenient support for the aerials of the cross channel radio link. L E Weaver of Designs Department acted as liaison officer on the site for contact between BBC and ORTF engineers.

In 1955 the results of the design activity during the preceding years began to appear in new sound installations and equipment. A sophisticated disk reproducer was produced, specifically designed for the reproduction of long-playing gramophone records, to replace the modified pre-existing 33 ⅓ r.p.m. reproducers which had been used since these records were commercially introduced. The new reproducer incorporated a high-quality commercial three-speed turntable, with the 78 r.p.m. facility removed, and a then highly regarded crystal pickup cartridge on a well-engineered arm which actuated a mechanical/optical groove-indicating device. A quick starting facility, based on the "drop-start" principle but designed to avoid damage to the delicate fine groove records, was incorporated. In the same year, advantage was taken of the progressive miniaturisation of electronic components to produce the first "radio microphone", with a transmitter and battery-container each comparable in size with a large cigarette packet. This device was of particular use in television, where the freedom of movement which it gave to an artist made a significant change to the pattern of programme planning. As part of a trend towards the miniaturisation and increased portability of equipment, a successful light weight portable tape recorder, the EMI type L/2, was still further reduced in weight, and its facilities improved, by the transistorisation of its circuits. (Later, in 1957, it was adapted for the recording of a synchronised sound in conjunction with a motion picture camera.) All the apparatus required for a simple, single-channel outside broadcast was successfully fitted into a small leather-covered hand case of conventional appearance.

During the year, the Designs Department experimental outside broadcast team, which had been formed the previous year and included G W Larkly, J Incan and F Berrisford, undertook as their first assignment the carrying out of a series of broadcasts from an aeroplane in flight, using apparatus in which printed circuit construction had been used on an experimental basis. For the purpose of the assignment, the co-operation of the Royal Air Force was obtained and a series of trial flights from RAF Watton took place over several months, culminating in a series of four broadcasts at the end of August. Subsequent assignments undertaken by the team included broadcasts from a submarine at sea and from a helicopter in flight (both in 1956) and the early testing of a later version of the "Roving Eye"; by the end of 1957, fourteen outside broadcast assignments had been carried out; in the light of the information obtained the weight of the equipment was reduced by a factor of two thirds and improved transmission was achieved by the use of a band V FM transmitter. Some tests were made with the French CSF radio camera.

The problems of television reception in areas of uneven terrain, where pronounced "shadows" occur, were mitigated by the installation in such areas of the first television translators, (essentially, amplifiers which receive at one frequency and transmit at another). These can be used to receive a relatively weak signal and retransmit it locally, in a different channel, with increased field strength.

1958 - 1964 Expansion and Growing Complexity

Until 1958 the recording of television was necessarily on photographic film, which could not be re-used and required time-consuming chemical processing before the recorded material could be viewed. A television equivalent of the magnetic recorder was clearly needed, but its advent was delayed by the necessity to achieve a very high tape-to-head speed in order to record the upper frequencies included in the spectrum of a video signal. Research Department's experimental Vision

Electronic Recording Apparatus (VERA) which recorded on a very fast moving tape, with the higher video frequencies as frequency modulation of a 1 MHz carrier, was considered disappointing.

However in 1958 the Ampex Corporation of America demonstrated a machine operating on their now well-known principles. A two inch tape, moving at the normal speed of fifteen inches per second, was scanned transversely by four heads set in the periphery of a rapidly spinning wheel with which the tape was curved into contact under pneumatic pressure; the signal was in the form of the single sideband of a frequency-modulated suppressed carrier and was thus largely immune to the effects of level fluctuations due to commutation, irregularities of head-to-tape contact, etc. The tape speed, head wheel speed and, during reproduction, the accurate tracing of the recorded tracks were maintained by an elaborate system of servo circuits.

The demonstration was witnessed by Sir Harold Bishop and F C Maclean (then Director of Engineering and Deputy Chief Engineer, respectively). On their recommendation machines were ordered and the first went into service at Lime Grove in October of the same year. For BBC use, the machines were modified by Designs Department, notably to enable approximately synchronous operation to be achieved; the servo mechanisms and FM signal circuits were also investigated. Work on the Ampex machines continued over a number of years, resulting in a steady improvement in their performance and adaptability and, as might have been expected, video tape recording has become a very important part of television operations.

Another important front on which development began in 1958 was stereophonic broadcasting. Research was started on every aspect of the subject and included a series of full-scale field trials from Wrotham, using the Zenith-GE pilot tone system. Designs Department put into practical form many of the results of the research, as well as contributing some original ideas.

Owing to the propagation characteristics of UHF and VHF signals, the long distance transmission of television signals was not possible until 1959, unless a chain of relay stations were available. Thus transatlantic television, for example, involved the physical transport of tape or film. Now, however, a means was devised, known as "Cablefilm", whereby a short length of film could be transmitted slowly (i.e. at one hundredth the normal projection rate) via the transatlantic cable by facsimile process. This project was a joint undertaking by Research and Designs Departments, with S Padel and I J Shelley taking a leading part in the Designs Department effort. To speed the process as much as possible the information content of the transmitted signal was reduced to a minimum, and the resulting film at the receiving end was of inferior definition, but the urgency of an important news item could justify acceptance of this deficiency. The system was of practical use until outmoded by the advent of communication satellites in 1962. Among the outstanding events covered with the aid of "Cablefilm" was the Royal Tour of Canada.

In 1958 - 1959 the Department was gradually transferred from Brock House to more spacious accommodation in Western House. This move was necessitated by a steady expansion in the volume of the activity undertaken, notably in preparation for the equipping of the new Television Centre at Shepherds Bush, to be opened in 1960 and then under construction.

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Also in 1959, a new form of the overlay process, already mentioned on page .. , was first used. This was known as colour separation overlay, and depended on a difference in colour, rather than

brightness, between the foreground object and its background to produce the switching signal. It was first used in a monochrome programme and subsequently developed for extensive use in the colour television services.

It was at about this time that transistors began to be used extensively in designs for new equipment.

In 1960, development was completed of a remotely controlled camera, and the construction of eight such cameras was put in hand for use in the News Studio at Alexandra Palace and the Presentation Studio at the new Television Centre. In co-operation with SCPD (then designated P & ID) a desk was devised from which four such remotely controlled cameras could be operated by two men.

In 1961 an extension to Broadcasting House was opened; its construction had involved, for Designs Department, the production of sound control desks, despatch positions, a radio newsreel studio, a mixer suite and continuity suites. This was the last major installation of sound equipment to be based on valve amplifiers.

In August, the Department provided equipment for an exhibit of 405 line colour television at the annual Radio Exhibition.

In 1962, newly designed transistorised sound equipment, designated the "type C", was installed in the drama studios in the basement of the new extension to Broadcasting House. Other transistorised items produced during the year included a new radio microphone, considerably more compact than the valve model which it superseded, and an associated FM receiver of improved sensitivity and stability.

In July of the same year the first active communications satellite "Telstar" was used to transmit video signals across the Atlantic Ocean. The signals originated in the USA, and after reception at Goonhilly, Cornwall, were distributed to nine European countries. Designs Department was involved in three aspects of this exercise. Firstly, collaboration took place with the Post Office and with BBC programme and operational departments over engineering planning and technical arrangements for the Corporation's participation in the event. Secondly, the Department provided, at short notice, two remotely controlled cameras for the coverage of events in the Goonhilly Down technical areas, where there was insufficient space for camera operators to be accommodated as well as 525 line colour equipment. Thirdly, a member of the Department, I J Shelley visited Washington, USA to take part in the first international meeting of a CCIR study group to determine standards for the transmission of television signals over satellite communication systems.

Another journey abroad by a member of the Department was that made to France by T Warswick for the purpose of studying the SECAM system of colour television.

At the year's Radio Exhibition, 625 line colour television was shown, equipment for the purpose being provided by Design's Department.

In 1963 an electronic standards converter, on which work had been proceeding since 1959/1960, was brought to a successful practical realisation and demonstrated to members of the EBU Colour Group. This converter was intended to provide a feed of BBC 1 video signals to 405 line standards when the BBC 2 service was introduced and most programmes were originated to 625 line standard.

During the same year, the relative performance of the three colour television systems, NTSC, SECAM and PAL, was studied by the television group of the Department. In July demonstrations were given in London to an international gathering of the colour experts of the EBU. The staging of these demonstrations entailed the close co-operation of P&ID, Television O & M and Designs Department. Unhappily, no one system was agreed upon for the whole of Europe; in parts of the Continent the PAL system is used, and in the remainder the SECAM system.

In 1964 Dr Rendall retired from the Corporation's service and was succeeded as Head of Designs Department by S N Watson.

During this year a team of Designs Department personnel, under the leadership of R Petrie, completed the development of a sound control desk which was installed at bush House for use by External Broadcasting Services. This desk replaced, by a single multi-control position, the four continuity positions at each of which a separate operator had formerly assembled the programme for one of the eternal broadcasting networks. During the same year, a new set of outside broadcast equipment, built in four plug-connected transportable units based on standard transistorised amplifier modules, came into service. This equipment offered a number of facilities hitherto available only in studio equipment.

At the Oxford unattended transmitting station, commercially produced fault reporting equipment was installed experimentally, after suitable modification by Designs Department. This equipment initiated a telephone call to the Regional Centre at Sutton Coldfield in the event of a fault occurring at the station, the existence of a fault being indicated in plain speech reproduced from a disk recording.

Investigation continued into the relative merits of the various systems of colour television, and during the year four series of demonstrations were given. The first of these, in February, was to a special meeting of CCIR Study Group XI; the performances of all these systems in the presence of various distortions was demonstrated, as well as video tape recordings. The second series of demonstrations were staged in Hamburg in collaboration with members of the EBU; pictures originating at Lime Grove to NTSC standards were displayed in Hamburg using a prototype NTSC decoder. The third series of demonstrations, in May, were to an EBU committee and featured the latest developments in video tape recording. The fourth series took place in October and were given to an EBU Ad-hoc Colour Group and representatives from OIRT. Among the features shown were radio tape recording, including the process of transcoding to PAL standards, the use of a differential phase corrector for NTSC signals and the long distance transmission of the three systems over a loop via Rome.

Colour television tests were also made between London and Moscow. Four members of Designs Department staff travelled to Moscow, with equipment, to demonstrate to leading engineers and politicians an improved NTSC system side-by-side with the PAL and SECAM systems.

It was in 1964 that the "Natlock" system of video signal synchronisation was developed by a team of designers led by J L Bliss (now retired). This system enables video signals from sources remote from a production centre to be synchronised with those from sources local to that centre. The synchronising pulse generator at the remote source is controlled by means of coded error signals sent from the mixing point. The error signals are derived by comparing the timing of the video signals from the remote and local sources, and the timing at the remote source is adjusted by digital methods in discrete steps too small for their effects on the displayed picture to be observable. This use of digital methods renders the behaviour of the system independent of normal variation of component values and, within wide limits, of the characteristics of the error signal circuits, which can be of telephone grade. The system will operate over long distances and an unlimited number of remote sources can be used.

The Natlock system is suitable for colour operation, the error signals then controlling the sub-carrier phase as well as the timing of the remotely originating signal.

The year 1964 is notable, in particular for an increase in the complexity of apparatus design, made possible by the compactness and reliability of the solid state devices now used, compared with valves and even with individual transistors. Circuits in which, because of the multiplicity of components, the probability of failure would formerly have been considered too great for their use to be practicable, could now be introduced, and even developed to still higher levels of complexity with complete confidence.

1965 - 1969 Stereophony, Colour and Improved Signal Processing

In 1965 the first two solid state UHF translators were installed at Hertford and Tunbridge Wells. In conjunction with the development of this type of translator, it was necessary to produce a special

series of filters, and the "comb-line" configuration was devised, of which only two variations are required to cover the whole of the Band IV/V range. The Department took part in further comparative tests of the colour television systems, and as a result of these tests the Television Advisory Committee made a firm recommendation to the Government that the PAL system, with 625 line definition, should be adopted as standard. Accordingly, colour test transmissions began to be radiated to PAL standards.

A second expedition was made to Moscow for the purpose of taking part in further test transmissions of colour signals between there and points in eastern and western Europe.

Following the launching of the "Early Bird" satellite the first live colour programme transmission took place from Europe to the USA. Signals from London were routed to Raisting in Germany, via a link tested and equalised co-operatively by Designs Department and NBC engineers, before being relayed via the satellite to New York.

In 1966 the occasional transmission of stereophonic programmes began from the Third Programme transmitter at Wrotham. This development made necessary the adaptation for stereo working of two of the four continuity control positions in Broadcasting House, London. Also in the domestic sound service, a start was made on the up-dating of the BTR/2 magnetic recorders, in service since 1952, to enable the lower tape speed of 7½ inches / second to be used and to effect a general improvement in the performance of these machines. The conversion involved the replacement of valve apparatus by equivalent solid state units, the fitting of ferrite heads and a new type of tape drive motor, and improvement of the tape tensioning arrangements.

For colour television, a complete range of testing equipment to meet the immediate requirements of colour transmission had to be designed. One unit, the Non-linearity Test Signal Generator, included an unusually large number of functions and covered a complete range of tests on both monochrome and colour transmission.

1966 was the year of the World Cup Football championship, and in connection with this important, in the world of sport, event a means was sought of reproducing pictures in slow motion from a standard video tape recording. P Rainger, now HRD but at that time a member of Designs Department, devised an adaptation of an Ampex machine in which the tape was fed at one quarter of its normal speed. By means of a mechanical addition to the machine, a loop in the slow moving tape was drawn past the video head assembly with an intermittent motion, so that each field of the recorded picture was replayed at normal tape speed, and this was followed by a three-field-period interval during which the tape was not replayed and might be stationary or moving either backward or forward with varying speed to maintain the quarter-normal average speed through the machine. During the initial replaying of the single field, the reproduced signal was recorded on a magnetic disk store, and this stored signal was replayed four times to form the output signal of the equipment. Two tracks on the disk were used alternatively, and the timing of the system was such that while each quadruple reproduction of the signal stored on one track was taking place, the other track was being erased and recorded with the next picture field from the tape. Thus each field in turn was displayed four times, giving the required quarter speed reproduction of the tape on display equipment operating at normal 624 line field and line rates. The system proved to have considerable application subsequent to the World Cup Championship, especially in programmes covering sporting events, but unfortunately its performance was not adequate for colour operation and it has been superseded by equipment of Ampex design.

In 1967 the first operational sound control desk to use a new system of modular units, type D, went into service in Studio 8 at Television Centre. These units were developed as part of an effort to standardise the equipment of desks for both radio and television. All the modules are twin units, carrying the equipment required to control two channels, groups or other circuits. They are of narrow configuration, so that a maximum number are within reach of an operator, and the use of inter-changeable sub-panels gives a degree of flexibility in the nature of the facilities provided.

Also introduced into operational service during 1967 was the Programme Effects Generator. This consists of an assembly of four or six magnetic tape reproducers constructed as modules to nest

together. Each can be loaded with a small cassette of tape carrying the required sound effect; loading takes two seconds and re-winding is automatic after reproduction. Thus a range of effects can be immediately available and repeatable as required.

A stereophonic decoder unit was designed in modular form so that it could be integrated with a version of the FM rebroadcasting receiver redesigned for stereophony or used separately. The decoder was intended largely for monitoring and checking purposes.

During 1967 the Department co-operated with EID and the British Radio Equipment Manufacturers' Association to provide a series of public demonstrations of colour television reception in various towns. Among the more attractive items shown were transmissions in colour from the tennis championships then in progress at Wimbledon; for this assignment coders, decoders, mixers and test equipment was supplied by Designs Department.

The most important new facility introduced during the year was the field store standards converter, designed to convert the 60 fields/second American video signal to the 50 fields/second signal of European television. The equipment was colour capable, and its availability made possible the decision to provide coloured pictures from the 1968 Olympic Games. For the production of this device, the Queen's Award to Industry for 1967 was granted jointly to Designs Department and Research Department.

Also introduced into service in 1967 was a colour capable Vertical Aperture Corrector.

In 1968 Dr R D A Maurice succeeded S N Watson as Head of Designs Department on the latter taking up the appoint of Chief Engineer, Television.

During the year stereophonic broadcasting on Radio 3 began as a regular service from Wrotham, Sutton Coldfield and Holme Moss. Designs Department constructed and supplied eleven receivers for these transmissions, as well as specially modified receivers for installation at Whipsnade to receive the Wrotham transmissions and route them via a SHF link to Sutton Coldfield.

Also during 1968, a new outside broadcast facility was introduced; this was a stabilised aerial platform for use on board ship to maintain the correct orientation of the highly directional SHF aerials. It was designed to be connected to the ship's gyro compass for azimuthal sensing, and contained its own gyroscope for elevational sensing.

A major event of the year was the reception via a transatlantic satellite circuit, ATS 3, of colour television pictures of the Mexico Olympic Games for transmission in this country and Europe. The manning of the satellite terminal apparatus was shared between Designs and Communications Departments, and some 170 hours of programme were transmitted during the course of the games. The processing of the received signal included standards conversion by means of the Field-Store Standards Converter and, in addition to this, a comprehensive array of equipment was provided for the correction or amelioration of distorted signals.

In 1969 it was decided that the Goldring 800 gramophone pickup cartridge was the one best suited to the Corporation's needs for the reproduction of both monophonic and stereophonic fine groove records. Older reproducing desks were modified to give monophonic reproduction using the new cartridge, and a new desk, coded RPS/6, was designed for monophonic or stereophonic reproduction. This has all the facilities of the older desks in improved form and in addition frequency response selection and variable speed operation in the range 10 to 80 r.p.m. as well as the normal fixed speeds of 33 ⅓ r.p.m. and 45 r.p.m.

1969 - 1972 Economy, Efficiency, External Relations and Continued Development

In 1969 P Rainger succeeded Dr Maurice as Head of Designs Department on the latter taking up the appointment of HRD; also during this year the Department was analysed by the McKinsey Organisation and investigated by Management Services Group.

Prompted by these events, a number of changes were made to the organisation of the Department. These included the expansion of General Services Section, to include a General Office to deal with a more comprehensive recording of management information on the work of the Department and a Liaison Unit to handle work resulting from an Agreement between the BBC and the ITA, now the IBA, for the exchange of information. Another and, in the event, more long lasting activity undertaken by Liaison Unit was the production of a series of Engineering Design Information Sheets to make known current developments in the design work of the Department. In 1969 and since, these information sheets achieved a wide distribution throughout the BBC and industry.

Because the Post Office is introducing carrier programme circuits, the use of phantom circuits for signalling is less frequently possible than hitherto. To overcome this problem a new switching system was developed. Known as the Universal Switching system, it uses a very robust pulse code signal and is exceedingly flexible in its adaptability to signalling speeds and pulse clock frequencies. The system can be used on speech or music circuits without interfering with the normal traffic. The first application in 1969 was between London and Wrotham to enable various transmitter functions to be controlled from Broadcasting House.

In the same year, Designs Department undertook the engineering of Research Department's system for the insertion of a pulse code modulated sound signal into the synchronising periods of a video signal "Sound in syncs". Prototype equipment was produced and a demonstration of the system given to members of the EBU. To facilitate the processing of video signals, a high performance semi-conductor switching matrix was developed, together with the means of paralleling three such matrices while maintaining performance and timing. The range of Colour Natlock equipment was completed, and the first large-scale use was made of this equipment at the investiture of the Prince of Wales at Caernarvon in July 1959.

In March the IBA transmitter mast at Emley Moor collapsed during heavy icing conditions and it was necessary to provide a replacement feed of BBC 2 input signal to Belmont, which is normally fed by radio broadcast reception from Emley Moor. Designs Department co-operated with Transmitter Department and TPID to solve the problem by providing mobile equipment close to Belmont to receive the signal from Waltham Cross and re-transmit it at the Emley Moor frequency - Channel 51.

In 1970 the design was completed of a continuity system and equipment, using Type D modules, for use in the Broadcasting House sound continuity suites in London. The equipment comprises control desks for the continuity announcer or programme presenter and for the technical operations and programme staff and an apparatus bay; the facilities provided include the selection, combination and control of four monophonic or stereophonic remote sources and locally originated announcements, disks and tapes.

A new UHF link equipment was designed and produced in the Department in time for the television coverage of the University Boat Race in March 1970. This was the first occasion on which the event was broadcast in colour. The new equipment, as well as being colour capable, replaced earlier apparatus which was bulky and inconvenient. Four of the new transmitters and eight receivers were constructed in Designs Department for use by Television Outside Broadcasts Department.

The first production model of a new type of UHF rebroadcast receiver, designed in the Department, was put into service at Heathfield. This receiver utilises synchronous demodulation, which greatly reduces the degradation of the signal compared with that imposed by older receivers, and it is possible to use two links containing new type receivers in tandem. The use of this type of receiver necessitates the provision of specialised test equipment which was also designed and constructed in the Department.

Among the more interesting achievements of 1970 was the completion of the development of the Electronic Character generator equipment, popularly known as "ANCHOR", by means of which captions consisting of upper case letters, figures and a useful range of punctuation marks etc can be super-imposed on a television picture. The captions can be composed at a keyboard or reproduced from punched tape or the store of a computer. The special feature of the equipment is that the characters produced are of conventional appearance and not of the distorted shape commonly

associated with electronic devices. Later, 1972, the capability of the equipment was extended to the production of lower case letters.

Efforts to foster communication between the Department and the Corporation generally continued, and the practice began of welcoming groups of staff from Television Centre on two-monthly visits to Designs Department in Western House. These seminars proved to be valuable occasions for contact between the Department's engineers and the operational staff, both technical and non-technical. 1970 saw also the beginning of an attempt to up-date the training of already qualified engineers, a number of whom attended specialised courses of instruction within the BBC.

In 1971 E R Rout succeeded P Rainger as Head of Designs Department on the latter's taking up the appointment of HRD in succession to Dr Maurice who had become Chief Assistant to DE.

During the year, solid state VHF FM transmitters designed and built in the Department were installed in the local radio stations at Brighton, Leicester and Nottingham. These are from a range of such transmitters, which are low in cost and highly reliable as a result of the use of two or more similar circuits in parallel. They deliver output powers in the range of 5 to 400 watts, the lower powered equipment being intended as drivers for high power valve amplifiers.

To improve the reliability of radio broadcast reception feeds, a two channel diversity receiver was produced; the first example of this was installed at Rowridge in 1971 to provide the Radio 3 stereophonic feed to that station. A similar facility for the television service was provided by a double diversity switch, designed for use with two rebroadcast or microwave link receivers to select the better output signal automatically.

Also in 1971, the development was completed of a transparency scanner designed in the Department, and the prototype was installed in Studio E at Lime Grove. The scanner was intended to be a low cost device for use in small regional installations, but it is highly reliable and incorporates a number of novel features. There is random access to any of twenty slides, the maximum change time being one second. The mechanism can be controlled remotely, and the whole equipment is contained within a standard sized bay.

The following year a second slide scanner was installed in Studio E, together with a control panel for the operation of the two equipments. The panel carries two banks of 20 slide selection switches, an ADVANCE button and fader control for each machine and a CUT button. Cross fades are possible by the simultaneous operation of the fader controls, and when either of these controls is moved to its "fully out" setting the slide carrier of the corresponding scanner is advanced one slide position. Hence, repeated cross fades can cause the entire sequence of forty slides in the two scanners to be shown in turn, the scanners contributing slides to the sequence alternately. Repeated cuts cause a similar pattern of presentation.

The performance of 16 mm telecine machines was improved by the provision of vertical aperture correction units, production models of which became available in 1971. The use of this equipment made the quality of pictures reproduced from 16 mm film acceptable for purposes which had formerly required 35 mm film, so that considerable savings on film stock and new equipment became possible.

To provide an easily portable colour picture monitor for use, for example, by outside broadcast commentators, a type of small commercial colour receiver was modified to accept input signals from line alternatively to the normal RF input.

New television test equipment produced by the Department during 1971 included a field interval noise measuring set and a gated noise measuring set. Both of these measure the signal-to-noise ratio in the presence of a signal; the gated noise measuring set is more suitable for making measurements on cameras, etc.

During the year the Department arranged a number of demonstrations, two of which are worthy of mention as major occasions. The first was a visit of Heads of Research and Development from

member organisations of the European Broadcasting Union who were shown automatic monitoring, the television carrier system, new measuring apparatus and parts of the thirteen channel pulse code modulation system which was then under development (see below). The second notable demonstration was to some thirty visiting engineers from the French organisation ORTF, who were shown automatic monitoring and control and automatic fault reporting equipment.

In 1972 development was completed of a 13 channel, high quality system for the distribution of sound signals, using the principles of pulse code multiplexing of the "sound in syncs" system (see page xx). The system was intended primarily to facilitate the distribution of stereophonic pairs of signals, since the stereo image can be seriously damaged by otherwise insignificant differences of propagation time when the two signals are transmitted by line.

The introduction of OB programmes such as Radio One Club necessitated the development of a transportable presenter's desk to be used normally with a pair of disk reproducers. The desk incorporates three stereophonic tape cartridge machines and has three monophonic and six stereophonic channels. It is designed to feed a remote OB engineer's desk via cables up to 100 metres in length. The reproducing desks contain Gates turntables and 12 inch Gray pick up arms with Goldring 800 cartridges. Speeds of 33 ⅓ r.p.m., 45 r.p.m. and 78 r.p.m. are available, but the pickup stylus must be changed if 78 r.p.m. coarse grooved records re to be played.

A very compact transmitter, tuneable over the range 45 MHz - 65 MHz, was developed for radio microphone use in outside broadcasts. It is constructed in a moulded plastic case, which contains also a mercury cell battery capable of powering the circuit for six hours, and which is small enough to be carried easily in the user's pocket.

The use of satellites for the transatlantic relaying of television signals created a need for an audio delay device to bring the accompanying sound, received via transatlantic cable, into synchronism with the video signal which was delayed approximately half a second by its longer transmission path via the satellite. To meet this need equipment was developed in which the audio signal is recorded as a circular track on a sheet of magnetic-coated material, resembling that of recording tape, which covers a commercial gramophone turntable. The signal is reproduced by a head which can be positioned around the recorded track so that the transit time between the recording and reproducing heads of a point on the track gives the required delay.

For general testing of AF equipment an instrument has been designed which combines an AC test meter and a variable frequency tone source in a single case, together with high pass filters for the measurement of harmonic contact. The device is battery powered and is therefore entirely self contained and suitable for portable use or for bay mounting.

A new item of television transmission equipment, known as an Active Deflector, was introduced to provide a service of a UHF transmission in localities within the service areas of transmitters where, usually for topographical reasons, the field strength of the main transmission is inadequate. The active deflector receives, amplifies the signal, and re-transmits it on the same frequency; instability is avoided by the use of a different polarisation for the re-transmitted signal, so that isolation between the receiving and transmitting aerials is typically 95 dB at the working frequency.

In the interests of compactness and accurate reproducibility of matched value components, increasing use is being made of thin film circuit "packages". During the year, resistor matrices have been developed, in collaboration with a commercial manufacturer, which can be used with integrated circuit operational amplifiers to form the coder and decoder circuits of a colour television system.

Improvements in thick film techniques made possible the development of a thick film video amplifier with a performance adequate to replace an earlier and more expensive thin film amplifier in many applications of a general nature in the television signal chain. Here, again, a compact device became available to replace more bulky, less reliable equivalent discrete circuitry.

The growing use of digital techniques at this time led to the development, by Dr C Dalton, of a new standards converter which operated on signals in digital form. Such signals, being considerably more robust than analogue signals, could be handled by electronic equipment of conventional layout and construction (as opposed to the special arrangements necessary in earlier standards converters) and processed with increased reliability and greater consistency of performance. The method lends itself well to the generation of additional lines in the video signal by the combination in varying proportions of information from the existing lines between which the interpolation is made; this process is an inherent feature of standards conversion.

An important measurement in the course of the operation of the television service is that of the durations of the various component pulses of the synchronising wave forms; a pulse duration meter has been produced in the Department to enable this to be done conveniently and with a high degree of accuracy, the measurement being indicated by a digital display.

Designs Department shares with Research Department a position in the forefront of technological advance in the field of electronic communication. Over the years of its existence, members of the department have made frequent contributions to the relevant literature and have also delivered numerous lectures on notable developments in their work to meetings of professional bodies such as the Institution of Electrical Engineers. A notable feature of such lectures has always been the lavish and ably-staged demonstrations which have attracted large attendances and aroused considerable interest.

At the end of its first quarter century, Designs Department can look back with some satisfaction on a record of having contributed to an expanding broadcasting service a considerable part of the engineering means for achieving increasingly flexible and polished presentation, a high degree of reliability, prompt exploitation of new technology, and maximum economy in both operation and capital outlay. There is every hope that this history of success will be extended throughout the foreseeable future.

DEH/TMB

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