No. 6 – Autumn 1981

ENG INF

The Quarterly For BBC Engineering Staff

The Royal Wedding

Cameraman Chris Wickham covers the procession from St. Clement Danes Church

The Royal Wedding on July 29th was the largest single outside broadcast ever mounted by OB's. Production facilities involved some seventeen Colour Mobile Control Rooms (CMCR's) and over sixty cameras, providing cover of all the wedding celebrations nationwide. 109 broadcasting organisations from 74 countries took the pictures to an estimated worldwide audience of 750 million viewers. In this special feature we take a look behind the scenes at some of the facilities and people that made the broadcast possible.

The engineer behind the broadcast was Frank Hughes, Head of Engineering Planning at Kendal Avenue "It was just like any other outside broadcast really", said Frank, "except on a larger scale." Technical planning for the broadcast had been going on ever since the engagement announcement in March. Some of the early plans had to be changed when clearance for camera positions was refused by the Police; other details, such as the honeymoon departure point, were only known a few days in advance.

Focal point for the outside broadcast was the Colour Mobile Central Control Room (CMCCR) which was located at St. Paul's Cathedral and had only entered service in April for the Boat Race (Eng Inf No. 4). It was designed by Bill Rhodes of SCPD and his team with broadcasts such as Royal Ceremonials, Open Golf Championships and Wimbledon Tennis in mind.

In productions involving many cameras or other sources, it is not possible to display all of the inputs on monitors because of the limited number available in a conventional CMCR. Even adding additional monitors creates a problem because of the limited space available. Vehicles of conventional roadwidth are just too small for the job, so the CMCCR uses an unusual design to overcome the problem. The sides of the production area in the middle of the vehcile are expanded by 1 metre on each side, increasing the width from 2.4 metres to 4.4 metres. This allows a bank of thirty-four monochrome and four colour monitors to be seen by all of the production staff at the control desk, and all of the picture sources can normally be displayed. For the Royal

'continued on page 3'

In this edition of ENG INF:

Wrotham - mixed polarisation

At the end of this year the vhf/fm transmissions from Wrotham for London and the south-east of England will change to mixed polarisation. It will be the first high power station in the country (and probably in Europe) to use this form of transmission. In effect, the power of the transmission is being doubled by the addition of an equal vertically-polarized component to the existing horizontally-polarized one. The change is being made to give better reception to listeners with portable radios and those in cars, all of whom tend to use simple vertical aerials. Research Department investigations over the past few years indicate that these listeners should get a benefit equivalent to increasing power on the present polarization between four and eight times. Listeners who use fixed roof-top or loft aerials are asked to make no change to their installations and should not notice any significant difference in reception on them. (There may be small differences owing to the inability to match the radiation patterns of the new aerial precisely to those of the existing one).

Some local radio stations, and those relay stations recently built in the national regions, already radiate mixed polarisation although it may have been given a different name. Slant polarization implies that the vertical and horizontal components are in phase, whereas circular polarization implies that they are in phase quadrature. On small, simple aerials it is possible to achieve either of these conditions, but on large and complicated aerials like Wrotham the phase difference between the components varies with azimuth so that in most directions the polarization is neither slant nor circular but elliptical. Accordingly the more general term mixed polarization has been adopted to cover all these conditions.

The work at Wrotham started with the installation by Transmitter Capital Projects Department (T.C.P.D.) of four new Pye 10 kW transmitters to carry the Radio 2 and 3 transmissions temporarily while the Architects and Civil Engineers Department (A.C.E.D.) modified the building ready for all the new equipment. Since then a new mast has been built and the outside work on aerials and feeders completed. Inside the building the installation of six new 20 kW Marconi transmitters is well advanced and the transmitter combining units are now in the preliminary stages of installation. The project also involves new monitoring and control gear, drives and auto-phasing equipment. Commissioning tests are due to start in November for service by the end of the year.

This is the first station in a massive programme of re-engineering being carried out by T.C.P.D. and A.C.E.D. covering all ninety-one large and small vhf stations in the UK. The next major stations to be re-engineered are Sutton Coldfield and Holme Moss (by 1983) and the whole programme is scheduled for completion by 1989.

* * *

Transmitters Opened

The following uhf tv relay stations have opened since June:

June
Kirkoswald, Strathclyde
Broad Haven, Dyfed
Crucorney, Gwent
Delph, Greater Manchester
Union Mills, Isle of Man
Backwell, Avon

July
Lauder, Borders
Stow, Borders
Monmouth, Gwent
Dolwyddelan, Gwynedd
Llanarmon-yn-Ial, Clwyd
Cerrigydrudion, Clwyd
Sunderland, Tyne & Wear
Cartmel, Cumbria
Urswick, Cumbria
Staveley-in-Cartmel, Cumbria
Hawkshead, Cumbria
Kettlewell, N. Yorks

August
Collafirth Hill, Shetland Isles
Beer, Devon
Belper, Derbyshire

September
Kirkfieldbank, Strathclyde
Methven, Tayside
Strathallan, Tayside
Fintry, Central Scotland
Fishguard, Dyfed
Gilfrew, West Glamorgan
Gulval, Cornwall
Millbrook, Hants
Penny Bridge, Cumbria
Backbarrow, Cumbria

Transmitter Changes

Vhf - August
Mynydd Pencarreg, Dyfed - new vhf 3 service station

Local Radio
June - Radio Leicester goes stereo
August - Radio Medway: Extension of service to Tunbridge and Royal Tunbridge Wells.

Editorial

October has been designated "National Teletext Month", by the Department of Industry and the public are being bombarded with information about the new facilities available. To coincide with the promotion, the BBC will increase the number of lines carrying data information from two to four, halving the page access time, and removing one of the major criticisms of the system. It is encouraging to see that development of the system continues at Research Department, with work on improved graphics, rounded character sets, and photographic quality pictures which will enhance the basic system in years to come.

The viewer should not fear these changes, however, as all of the developments and enhancements will retain the overall compatibility with existing decoders.

BBC engineers can be proud that they have introduced a revolutionary service, and that broadcaster, manufacturer and public will all benefit.

ROYAL WEDDING

This letter is one of many received from grateful viewers. Well done all concerned.

Dolwyddelan,
Gwynedd,
Wales.

Dear Sirs,

Would you kindly convey to all those responsible and all those who helped them, our most grateful thanks for the new transmitter to serve this village: more especially for getting it functioning in time for the Royal Wedding.

Many of us have written grumbling letters in the past, so my husband and I wanted to say "Thank you" for the superbly improved t.v. picture we now receive - very much appreciated.

Yours gratefully,
(Mrs.) Dorothy Valentine

'continued from page 1'

The Royal Wedding

BBC cameras were in position long before the procession passed

Wedding an extra eight monochrome monitors were mounted on racking; the additional space created by the expanding sides allowing plenty of room to accommodate them. The extra space also allows greater freedom of movement for staff around the control desk. At the rear of the vehicle is a sound area with a 44 channel Neve stereo sound mixer and a central communications system, the heart of which is a 50 x 100 pin-board matrix which enables the system to be tailored to suit each broadcast. The front of the vehicle contains engineering and vision control, where all of the vision signals from the smaller CMCR's were fed to the CMCCR allowing Michael Lumley the Producer, to have complete production control.

Near Buckingham Palace a technical area was established behind the wrought iron work of Canada Gate, in the corner of Green Park. Thames Television, CBC and ABC shared the site, which soon became festooned with cables and cameras.

The BBC had two type 5 CMCR's in the Park. These vehicles carry a normal complement of four cameras, although they can accommodate up to eight with the associated control equipment. Vision mixing is effected on an ABCD mixer, and a Neve 24 channel sound desk handles the sound mixing. One of the CMCR's, LO2, carried a full complement of eight Philips LDK5 cameras, which were mounted in and around the Buckingham Palace area. The second CMCR was detached from the BBC Cardiff OB base for the wedding and carried three Link 110 and one Link 120 camera. Special ducts were constructed under Constitution Hill to carry the triaxial camera control and other cables from Buckingham Palace camera positions to the CMCR's. Sound and vision signals from these cameras were mixed locally, and passed to the CMCCR at St. Paul's Cathedral via an shf radio link. Commentary boxes were established on Queen Victoria's memorial in the middle of The Mall, and emergency commentary facilities were provided in the Welsh scanner just in case the crowds proved to be too dense for the commentator, Tom Fleming, to reach the commentary box; fortunately this facility was not required.

Further along The Mall another CMCR, LO3, had been sited by engineering manager John Livingstone close to Admiralty Arch. Six Philips LDK5 cameras were connected to this vehicle, one of which was mounted on top of the Arch itself, providing the high level shots of the processions in The Mall. Local sound and vision mixing were available to the director, Peter Cleaver, on this, the latest of the type 5 scanners. The output of this vehicle was, like the vehicles at Green Park, connected to the CMCCR at St. Paul's Cathedral via an shf radio link.

The London skyline is not helpful to the communications engineers who require a clear line-of-site path for the shf radio link equipment. An intermediate relay point was therefore established, on top of New Zealand House in Pall Mall. Several shf links were established, four relaying signals to St. Paul's and one to Television Centre. A single LDK5 camera was also mounted on New Zealand House, providing the spectacular aerial shots across the roofs of central London.

In The Strand, Don Craske had brought a three camera CMCR from the Open University production centre at Milton Keynes. Link 110 cameras had been removed from the studios for the broadcast, and these were mounted on Simon hoists which had been parked in side roads leading from The Strand. A

'continued on page 4'

Radio OB caravans at Canada Gate

'continued from page 3'

The Royal Wedding

Cameraman Ken Moia outside Buckingham Palace

single-camera unit carrying an EMI 2001 camera was located nearby, and its output was fed to the Open University CMCR. Local mixing was provided for the director, Ken Griffin, the output being fed to St. Paul's Cathedral via wide-band underground cables provided by British Telecom.

Three Philips LDK5 cameras were connected to another CMCR near Temple Bar, where Peter Greenyer had obtained permission for the vehicle to park in the yard of the Royal Courts of Justice. One camera was located in the middle of the road, on the island by St. Clement Danes Church, and another was located on a Simon hoist in Bell Yard. The third was located on scaffolding protruding from a solicitor's office in Fleet Street, where the platform had to be counter-balanced to prevent the camera, and Jerry Ellis the cameraman, toppling into the crowds on the narrow streets below. The platform was cleverly concealed behind red, white and blue bunting specially bought for the occasion by Peter Greenyer. "Concealing the platform was no problem" says Peter, "it was the 4km cable run around the back streets to the CMCR that caused the biggest headache!" British Telecom, once again, provided wideband underground cables from the CMCR to St. Paul's Cathedral.

At St. Paul's Cathedral a special fence was erected around the complex of outside broadcast vehicles. The shf radio links were sited high up on the Cathedral roof by Roy Carpenter who was responsible for co-ordinating the communications for the broadcast.

The communication facilities for the broadcast were complex, with each of the local cameras requiring talk-back facilities, as well to the CMCR's located along the route. The Mobile Communications Area vehicle (MCA) housed all of the radio equipment used for the broadcast, as well as six independent vhf radio telephone systems used for talk-back. The vehicle has facilities for monitoring and quality checking both the shf radio links, and the lines provided by British Telecom; after any necessary correction the signals were passed to the CMCCR nearby.

As well as the CMCCR and MCA, under the watchful eye of John Kemp the engineering manager, two type 5 CMCR's and a two-camera CMCR were co-located in this area. These provided the base-stations for the eighteen cameras in and around St. Paul's Cathedral. A Philips LDK5 camera was mounted on the roof of the Abbey Life building overlooking the west door of the Cathedral, where the difficulty of laying cables was overcome by using radio-data control equipment to connect the camera to its base station. Another camera was mounted on Queen Anne's statue, where special screens were painted to match the surrounding stonework, and afforded a degree of camouflage. Inside the Cathedral the cameras were also mounted and decorated so that they blended with the natural surroundings.

From St. Paul's Cathedral two separate outputs from the CMCCR were fed via two individual shf radio links and wideband cables to studio 6 in Television Centre, where Angela Rippon and Michael Woods provided linking material and interviews. Next door, in studio 7, forty commentary positions were rigged for use by foreign broadcasting organisations commentating "off-tube".

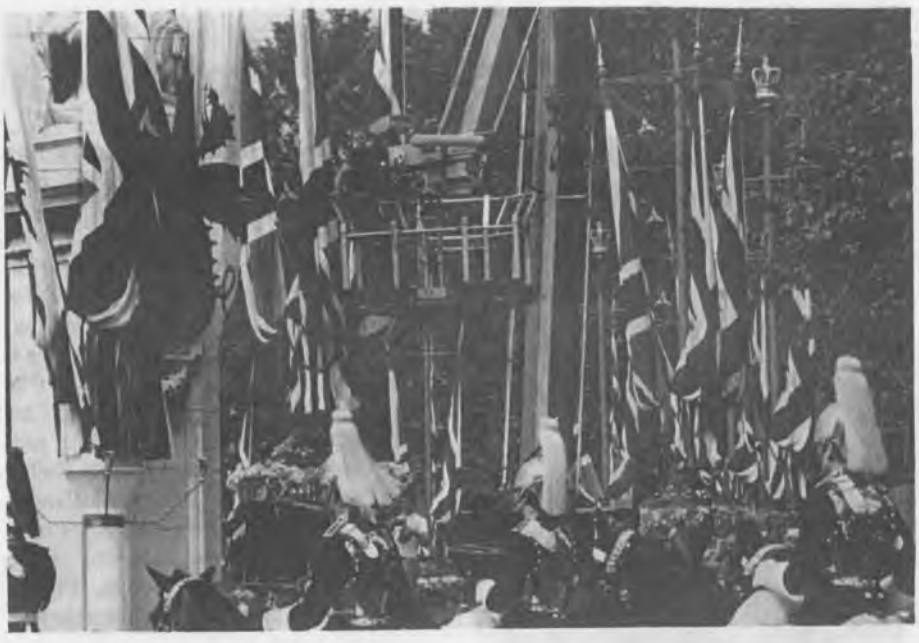
Programme feeds were made available to the EBU headquarters in Brussels for distribution around Europe, and to three Intelsat satellites, one over the Indian Ocean for reception and distribution to Asia, and two over the Atlantic for North and South America. Over fifty countries took the broadcast live: a two camera CMCR was made available to foreign broadcast

Cameraman Jack Hayward mounts his LDK 514 in the Golden Gallery

organisations for in-vision shots of national commentators; it was located outside Buckingham Palace.

The honeymoon departure from Buckingham Palace to Waterloo Station was covered by the same cameras in The Mall that had covered the earlier wedding procession. A Scottish type 5 CMCR and the lightweight production unit (LPU) were at Waterloo Station. Other units were hired from TV International and Trillion to cover the route from Horse Guards Parade into Whitehall, in Parliament Square, and at County Hall.

After the honeymoon departure the OB crews worked quickly to de-rig the vehicles and cameras so that they could be re-deployed onto other locations. Two days later the same units were covering athletics from Crystal Palace, showjumping from Hickstead and the "Much Loved Music Show".



One of the camera positions in The Mall

LIGHTING A ROYAL WEDDING

by Bryan Wilkes, Head of Lighting, Television Outside Broadcasts

For some in BBC Television the Royal Wedding was, in many ways, just another multi-camera Outside Broadcast, following the pattern set by previous Royal events. However, this one proved to be different - the sense of occasion did 'get to' some of the steeliest professionals, when it was realised this would be 'The Wedding of the Century' with probably the biggest 'live' audience of all time - around 600 million or even more - like a country's GNP, figures of this magnitude are different to comprehend.

What distinguished the event for broadcasters was not only its scale and its setting but its significance in the life of the nation - the wedding of our future King and Queen - which meant that it would be the most important OB for some time, demanding meticulous planning and execution and the best resources available. Lighting alone accounted for nearly £100,000 of combined BBC and ITV cash, an expenditure in modern lighting technology unparalleled in the history of Outside Broadcasts.

Because the venue for the Wedding was not immediately known, I assumed, like many others that it would be Westminster Abbey, but quickly learned that it was to be St. Paul's Cathedral, giving me a bigger and loftier building to light. Just as impressive, but in a different way. Of course, previous broadcasts from St. Paul's had paved the way; we had last lit the Cathedral for the Queen Mother's 80th birthday, and before that there had been Queen Elizabeth's Jubilee Service and Sir Winston Churchill's Funeral Service. But, with the developments which had taken place in lighting technology and the improved standards, we could now achieve a higher incident level for a lower Kilowattage.

After several sessions at the Cathedral with producer Michael Lumley and ITV's Jim Pople, I prepared an outline lighting plot relating lights to camera positions, and then discussed the arrangements with Lee Electric (Lighting) Ltd., Wembley. Lee hold the BBC contract for all OB lighting in the UK and EEC countries. In this case ITV had already agreed that we should design and organise the lighting, with ITV sharing the costs. Three Movietone film cameramen and over 50 stills photographers selected to cover the Wedding would automatically benefit too.

Lee management indicated that they could meet our needs from their extensive stock of equipment, relying on the high-technology Thorn CSI (compact source iodide) and CID (compact iodide, daylight) lamps for most of the lighting because of their superior efficacy and colour stability.

I wanted to light the Cathedral to a level of at least 1700 lux, so that cameras could use aperture settings of around f4 - 5.6 achieving good depth of field and the best optical performance from their lenses. In previous broadcasts we had barely bettered 1000 lux, leaving cameras operating at maximum lens aperture with the difficulties of short depth of field when zoomed into narrow angle of view.

When I had completed my lighting plot, a number of visits were necessary

'continued on page 6'

Lighting the Wedding required some 270 or more luminaires

'continued from page 5'

The Royal Wedding

Bryan Wilkes checks the lighting levels inside the Cathedral

to the Cathedral, with my Electrical Supervisor, to detail our layout and plan the installation. This involved liaising with a number of different authorities including the Receiver of St. Paul's and his Clerk of Works, London Electricity Board who would provide the power, and with the police over security.

Camera dispositions

Eventually it was decided by the producer that twelve camera positions were required to enable us to cover the ceremony adequately, and ITV used nine. Several of these were joint positions at which our own Philips camera was located next to ITV's Marconi or Philips equipment. Fortunately the movements of the main participants in the ceremony were to be fairly straightforward. Our chosen camera positions would be able to cover the full ceremony and congregation quite easily.

A camera high above the West Portico would provide a wide angle shot of the Cathedral, with the ability to zoom into closer shots in the Nave and Chancel. Another camera on the North side of the aisle just inside the West Portico with a lens height of about 8 feet provided pictures of arrivals. The lighting in this area was provided by eight of Thorn's 2.5kW CID and fourteen 1kW CID. I found the colour temperature of 5,500K an admirable match with the daylight pouring through the West Door. ITV had a similar camera position on the South side of the aisle. The respective vision engineers had been briefed beforehand that as the cameras panned away from the CID lit area there would be a gradual transition of colour temperature from 5500 to 4300K, the Nave and the remainder of the Cathedral being lit by Thorns 1kW CSI lamps in the Lee Electric designed housings, known as - 1K single and Twin CSI. This change of colour temperature extended over an area of some 30 feet by mixing CSI and CID light, until the CSI colour took over completely. This worked well in practice - camera colour balancing controls only needing slight adjustment in vision - as we now know the change was not obvious on the screen. Further eastwards along the Nave, cameras were positioned on both sides of the main aisle and in the North and South Transepts. One camera was positioned in the North Transept by the Font - providing a side-on shot of the Bach Choir and the Symphony Orchestra. Two large windows in this area each twenty-two foot by ten foot had to be colour corrected by using a combined filter of .3 neutral density/orange which prevented a blue cast from falling across the Choir. Three other large windows on the South side of the Cathedral had filter frames fixed to the exterior of the windows, each with .6 N.D./orange correction filter which reduced and corrected the incoming sunlight by 2 stops.

Other cameras were positioned behind the Royal Family and Earl Spencer's family in the N.E. and S.E. Transept aisles. They were able to provide frontal shots of the respective families as well as side shots of Prince Charles and Lady Diana, also shots of guests sitting under the Dome area - mainly close friends of the Bride and Groom and the Crowned Heads of countries around the world. A camera placed just above the North Choir stalls gave an 'over the shoulder' (the Archbishop's) shot of the couple. Two more cameras placed at East and West sides of the Whispering Gallery were able to zoom the length of the Nave and to the Altar. One final camera - giving the now well known shot looking vertically down from the centre of the Dome completed the disposition of cameras within the Cathedral.

The orange plastic filter stretched over one of the Cathedral windows

Lighting equipment in the triforium is adjusted

The Bach Choir of some 200 members - complete with opera singer, Kiri Te Kanawa, and a symphony orchestra all under the direction of Sir David Wilcocks were to add so much to this Royal occasion by the majesty of their music. Lighting this large number of people squeezed into the North Transept for close-up shots proved to be difficult: the angle from the Triforium above them was very steep, too steep for a pleasant keylight effect. I had no alternative but to use a number of Twin CSI lampheads from the South side of the Dome - an area known locally as the South West Quarter Dome - lamp to subject distance of some 200 feet! Diffused spot spreader lenses did the trick and allowed me to skate the light past an immense chandelier, without creating a shadow problem. Other lighting of the Choir and Orchestra was done from a lower level - 29 feet high each side of the rostra - CSI with medium angle spreader lenses and 2kW I.Q. lamps provided the necessary incident level, the latter being colour corrected to match the CSI.

The Dome

At floor level, under the Dome there is a seating area of some 150 feet in diameter. The nearest position for lampheads is in three of the four quarter domes, the fourth being forbidden territory - it's full of organ equipment! The quarter domes are above the level of the Triforium and even further away from the subject. For such a large area and a tremendous throw for the lamps, I used three Dino-lights on molevator stands each with 24 x 1kW PAR 64 Thorn lamps, colour corrected to match CSI: they provided an incident level of 1,400 lux. To this I added 12 x Twin CSI bringing the level up to 1,700 lux - the CSI's providing that extra punch and sparkle. The interior of the Dome has eight frescoes painted by Sir James Thornhill, illustrating the life of St. Paul. Six twin CSIs on the Whispering Gallery lit these to a level that allowed the cameras to zoom into extreme narrow angle and gave many people - viewers, and those present - their first clear glimpse of his work. The ceiling mosaics above the Choir and Altar - gold and delicate shades of blues, greens and reds, needed a different lighting technique to enhance the colours and to make the gold sparkle even more than it normally does. This was achieved by using uncorrected PAR 36 lamps in Lee's eight-light fittings positioned in the Triforium. By using the cameras colour balanced for the ceremony to CSI lamps and without rebalancing them for the lower blue gain setting on the camera control unit, it enhanced the mosaics by giving them a warm cast - adding richness.

Michael Lumley checks out the mixing desk in the CMCCR2

Altogether 273 Thorn 1kW CSI lamps in Lee fittings were installed. Most of these were in fixed positions, but seven CSI twin fittings in the Whispering Gallery were on moveable stands. The fixed lampheads were clamped to scaffold tubing installed on the narrow Triforium by St. Paul's scaffolders and at the lower level by Lee Scaffolding Ltd.

In my view, CSI was the only practical choice for this event. In the old days, we would have had to rely on 10kW tungsten lamps, with their attendant problems of bulk, weight and heat. I have calculated that our total electrical load for lighting would then have been 1.6MW rather than the 690kW we actually used. CSI has proved to be a valuable lamp for OB's; the BBC was the first to recognise its potential in our specialised field and worked closely with Thorn as they developed it as a source able to meet the stringent requirements of TV lighting directors and film cameramen. We have now used it successfully for a decade. The lamp has revolutionised location lighting of some events, and without it we would have needed two or three times the 17 tons of lighting equipment that was eventually moved into St. Paul's. The only other possible alternative, CID lamps throughout the Cathedral, would have resulted in even better colour rendering for the cameras, but would have meant a 15% power penalty. In any case, the CID lamp - while promising much for the future - is still relatively new and we could take no chances on this occasion.

This camera covers the North Choir during rehearsals

'continued on page 8'

'continued from page 7'

The Royal Wedding

The expanded sides of the CMCCR 2

With CSI there are few problems. The lamp is well tried, reliable and - because it is compact - did not dominate visually or take up too much room in the Cathedral. Heat generated is modest and is readily conducted away by fins on the lamp housing. Musicians, though always concerned about any nearby sources of heat, were far less likely to be put out by CSI than by the sources we might have used a few years ago.

Our mains power supply was drawn from the National Grid through a main sub-station, near the Cathedral. In the event of failure of the main, the power would have been restored immediately by either of two standby supplies routed from different parts of the Grid system. From the sub-station three separate supplies enter the Cathedral precincts. We drew about 400 amps per phase from a 1500 amp per phase capacity supply near the Choir School on the east side. Another similar supply was drawn from the Chaper House area on the north side and a third supply from the south side. A major concern though, was the possiblity that a momentary failure would extinguish the CSI and CID lamps. To cover this situation, a 130 kVA standby generator was separately cabled to 3 Dino-lights and 9 Maxibrutes. Between them these accounted for 126kW of lighting - PAR 64's - which would survive mains failure - just sufficient to allow pictures to be transmitted if the worst happened. The Maxi-Brutes and Dino-lights had colour correction filters fitted together with specially made glare shields - they served four purposes: correction of tungsten to CSI; the filter was held neatly and securely away from contact with the lamps; Side spill light was avoided, and in case of a "bubble burst" they afforded additional security to the normal safety mesh. At all times, electricians had access to generous stocks of chokes and lamps at strategic points within the Cathedral.

Installation

Electricians started work in the Cathedral on 13th July, and had five nights and two days in which to install all the lighting equipment. Lamps started to go in on the 15th. 'Setting' of the lamps took three nights, work of any nature during the day not being possible, as the Cathedral remained open to the public and normal daily Services right up to Sunday evening - with the Wedding on the Wednesday.

All personnel, including the 130 or so BBC staff at the Cathedral on the day, had to be security vetted. Indeed the heavy security surrounding the preparations created additional problems for us; one was that explosive-sniffing dogs and their Police handlers had to check every piece of equipment and scaffolding tubing, including our additional fire extinguishers, plus walking round the narrow Triforium at irregular intervals. They could easily have knocked the lamps off their setting angle, so that their alignment had to be checked after each search. However, with close co-operation all round, we jointly and amicably overcame the problem.

On the day, six electricians stationed in the Triforium were linked by portable 2-way radio to a supervisor who was, in turn, in direct contact with me in the master control vehicle parked with other OB technical vehicles in an area immediately to the north of St. Paul's.

After the Wedding we had to act quickly to move some of our cameras immediately, eight miles of cable and 17 tons of lighting equipment out by 8.30 a.m. on Friday 31st July, to fit in with St. Paul's constant programme of events and services.

Sound Assistant Penny Kirt checks the microphone performance at St. Clement Danes

'continued from page 8'

The Royal Wedding

THE SOUND STORY

Harold Kutscheraurer adjusts a microphone near the High Altar

Engineers from Radio Outside Broadcasts rigged 57 microphones to bring the sound of the wedding service to the worldwide audience estimated at 1,000 million including listeners to BBC and ILR and viewers of BBC and ITV. The sound was fed to a sound control room set up in St. Paul's Crypt where a 64-channel mixer produced a clean-feed of stereo sound and a second mixed-feed mixer added the commentaries to produce the feed for Radio 4. BBC Television carried out their own sound mixing and other broadcasting organisations either took direct microphone feeds or outputs from one of the mixers.

The needs for producing various sound recordings had also to be considered: BBC Enterprises needed a clean-feed of sound for their commercial disc and cassette released soon after the wedding, and two digital recordings were made, one of clean-feed sound and the other including the Radio commentary. And as a completely separate exercise, a surround-sound recording was made.

All in all, the whole operation had the largest number of stereo OB routings for any BBC broadcast, for in addition to the eleven radio commentary positions along the processional route, roving radio links provided interviews with the public and sounds of street celebrations created a wide spectrum of sound for BBC Radio.

Microphone Installation

Detailed engineering planning began as soon as the weddding was announced. Much of the microphone placing in the Cathedral was based on past experience but on this occasion the use of the Bach Choir and the large orchestra positioned in the North Transept was something more ambitious than anything done previously.

Planning the sound in the Cathedral was the responsiblity of Senior Sound Supervisor, Harold Kutscherauer. He arranged coverage around twenty stereo capacitor microphones (mostly coincident pairs), eleven of which were mounted on slings and others suspended on strengthened cables from the 70 ft high Triforium gallery of the Cathedral. The main internal 'sound stages' to be covered were the dais and the altar for the marriage ceremony itself, the Cathedral Choir and Kneller Hall trumpeters in the Chancel, the State Trumpeters in the Whispering Gallery and by the West Door, the Orchestra and Bach Choir in the North Transept, the organ speaking in the North-East Quarter Dome and above the West Door, and the Cathedral Bells. An external stereo pair was suspended from the West Portico to catch the West Door Trumpeters immediately below sounding their fanfare on the arrival of Lady Diana. The remaining complement consisted of spot microphones for soloists and sections of the orchestra and choir, and lectern positions for the ceremonial.

When it comes to siting microphones in St. Paul's the problems are more physical than acoustical. The Cathedral's good-natured acoustics and the use of close mic techniques ensure that sound levels rarely rise high enough to excite any troublesome echoes. The criteria followed in siting for this particular event were:

1. Primarily to provide complete coverage bearing in mind the sound radio presentation. Radio listeners, lacking any visual component, easily become confused when any of the action inadvertently wanders beyond microphone coverage.

2. To make the microphones less obtrusive to a television audience without sacrificing sound quality. An example of this was the siting of the Cathedral Choir microphones on either side of the Chancel instead of choosing the classical midway positions. The black finish of some of the microphones helped make them less conspicuous.

3. To provide tighter control of balance by the use of spot microphones. This gave the television sound mixers the useful option of favouring the sounds of small groups of orchestral performers, for instance, when they were being shown in close-up by the cameras.

Virtually all microphones were capacitor types used in cardioid configuration and most routed signals down to

'continued on page 10'

Peter Hunt at the controls of the mixing desk

'continued from page 9'

The Royal Wedding

Julian Walther sets up the "clean feed" position

the Crypt control room on 20-pair cables. Certain key microphones were individually cabled as an extra precaution against a multipair failure.

Control and Mixing

In the control room each microphone's signal was fed firstly to a splitter, one output of which was taken to the clean feed 64-channel mixer, a second to a 'ceremonial' bay and, in the case of speech microphones, a further feed was taken to the Cathedral's public address system. (A 'Ceremonial' bay is BBC parlance for a type of microphone distribution amplifier used chiefly on ceremonial occasions whence it gets its name. Each bay will handle nine microphone inputs and each input has two buffered outputs.) The outputs of the 'ceremonial' bays provided both direct microphone signals, for example, for BBC Television and Thames Television, or in other cases, a mixed feed, for example to Broadcasting House for the Radio Network.

For large ceremonies it is normal practice in BBC Radio for two mixers to be installed where possible. The mixers are used in adjacent but acoustically isolated rooms as they were on this occasion in the Crypt. This isolation enabled the mixer at the 'clean feed' desk to concentrate more fully on balancing the ceremonial. The 'clean feed' desk output was then fed to the 'mixed feed' position where the operator mixed the commentators' microphones using cues from talkback.

Recording the Wedding

An occasion as sonically grand as this one also gave the impetus to make two extra forms of sound recording over and above the standard analogue ones.

In the first instance two digital recordings were made, one of clean feed sound carried out in the digital recording van parked in the Cathedral Churchyard, the other of mixed feed sound, undertaken at BH.

The digital van was equipped with twin video recorders with a 16-bit pulse-code-modulation unit plus the normal sound monitoring and mixing facilities. Previous problems with tape drop-outs, more noticeable in digital recording, are now largely overcome by ensuring a dust-free recording area and using only highest quality pen-tested recording tape.

Finally the surround sound recording project was undertaken by OB Engineers as a technical experiment to aid British industry. Four sound-field microphones of an improved design were specially loaned for the event, three being used internally in the Cathedral to cover the Chancel, North Transept and the Nave towards the West Door. The fourth was mounted near the Cathedral steps in the N.W. Lantern. The four component outputs from each microphone were separately assigned to individual tracks of a 24-track recorder without any form of surround-sound coding. The use of special noise reduction devices was planned, but interference from nearby thyristor lighting dimmers ruled out their use and, instead, a higher tape speed of 30 i.p.s. was used to improve signal/noise ratio. A problem then arose with sound linking on tape changeovers since at this high speed each reel of tape ran for only 30 minutes. This was overcome by arranging changovers to occur during pauses in the wedding service or, at least, on non-musical items, and further arranging for a standby two-channel recorder to make a linking recording in stereo. These stereo recordings would then suffice in any subsequent System HJ matrixing to bridge the gaps in the multichannel surround-sound recording.

Setting the sound-field microphones was relatively simple: each unit's four encapsulated microphones combined with a matrix processor gave the system a unique versatility enabling an extremely wide range of operating modes to be electronically selected. In the Cathedral each sound-field microphone's physical height was set

'continued on page 12'

Dennis Yee in the digital sound recording vehicle

Satellite Terminal made by RD

The vehicle and trailer ready for the road

The mobile satellite link terminal commissioned for Television Outside Broadcasts has just been completed by Research Department, and is undergoing pre-operational trials prior to programme commitments starting next month.

Use of a satellite to get television signals back to Television Centre will enable the tv service to mount OBs which cannot easily be covered by conventional means. The principle was successful demonstrated on 7 June 1980 on a live tv OB from Glencoe when the BBC hired a satellite terminal as an experiment. The main terrestrial route required seven radio link hops to be set up.

However, a more stream-lined and versatile satellite terminal was desirable to fit in with the future OB operational arrangements. A team was set up at Research Department under the leadership of Malcolm Harman to design and construct suitable equipment using the latest technology. Much expertise had already been gained from the design and construction of a small experimental satellite receiving station at Kingswood Warren for experiments with OTS.

A particular feature of the new terminal is its compact size, such that the complete transmitter is housed on a relatively light-weight trailer which may be couple to any standard radio-links van. This has been achieved by using the latest transmitter technology and

'Project manager Malcolm Harman (right) checks for radiation hazards around the periphery of the transmitting dish during acceptance tests at Kingwood Warren, with (from left to right) Trevor Denham (TVOBs), Derek Hodge and Chris Gandy (satellite team, RD)'.

represents a significant advance over previous mobile satellite terminals. The trailer houses the 3m dish aerial, 600W 14 GHz transmitters, check receivers, f.m. modem and other associated equipment special to the satellite link. The trailer may be remoted up to 400 ft away from the link van to ensure that a clear line-of-sight path to the satellite can be achieved, and it can also be kept clear of the OB control area.

Baseband video and audio interfaces and all the transmitter remote control and monitoring equipment are housed in 3 equipment boxes which fit into the multiplex shelving bays in the link van. Thus, once the transmitter has been set up and the satellite initially accessed, the operation is completely controlled from the link van.

The transmitter is very flexible and may operate on any of the available channels through the OTS or future ECS satellites. It uses a new Thompson CSF 600W TWT (travelling wave tube) in the output amplifier, which has been the key in achieving flexibility, compact size and conservative single-phase power requirements. In practice there are two such amplifiers arranged in dual-redundant mode so that negligible break in transmission will occur should one amplifier fail in service. The amplifiers were specially made for this project by EMI Varian and Malcolm Harman recently spent an anxious period at their factory in Santa Clara, USA to see that the units were completed in time.

Work on the project began about 18 months ago and completion has been specially brought forward to meet programme requirements of the Television Service. It is thanks to the determination and enthusiasm of the team and the support they received from Technical Services that the terminal has been completed on time despite delays experienced in the supply of major components from manufacturers.

* * *

'continued from page 10'

The Royal Wedding

by listening to the output of a unit in omnidirectional mode, and fixing the height when the most satisfactory balance was heard. A height in the range 30-50 ft proved about right.

Royal Success

And so, for such a complex exercise as the Royal Wedding and one requiring high reliability with 1,000 million pairs of ears listening for the marriage vows, how did the whole system perform?

Well, very successfully - it could hardly have been otherwise, but bearing in mind that much of the ceremony could not be properly rehearsed, the quiet sighs of relief from the engineers at the successful conclusion could be well understood.

The introduction of television and its accompanying lighting into a large, completely 'wired-for-sound' cathedral certainly presented numerous hum problems, for instance. But after the below-par cable screening was tracked down and some cable re-routing undertaken, the 7 miles of microphone cable and the 10-mile long lighting network co-existed successfully, each in its own way making a vital contribution to Britain's and the World's biggest O.B.

IN-VISION SUBTITLES

No fewer than four caption generators were used to provide the in-vision subtitles for the Royal Wedding on BBC 2. Two were associated with the material prepared before the broadcast, and two others were connected to main and reserve Palantype transcription computers to give a verbatim transcription of Tom Fleming's commentary. Because this was a rather special event, the subtitles were available for all to see rather than being transmitted through the CEEFAX magazine computer as would normally be the case.

The experimental Palantype transcription system is the result of a collaboration between Designs Department and Leicester Polytechnic where Lyndon Thomas, a computer scientist, has been writing the various computer programs.

Last year whilst on attachment to Designs Department he made the transcription program run on a sophisticated micro-computer for the first time; and since then the equipment has been made suitable for the CEEFAX broadcasting chain.

On the Royal Wedding day the system worked as follows: the Palantypist keyed the speech phonetically into a special keyboard, syllable by syllable; the keyboard output was fed to the transcription computer which matched the syllables to the contents of a dictionary held in store on a Winchester hard disk memory. As each complete word was found, it was passed to a small outputformatting micro-computer which assembled the words into lines of text and passed them to a character generator.

Up to the last moment, Ron Spencer of Designs Department, and Lyndon Thomas of Leicester Polytechnic were in close contact over the major up-date of the dictionary held in the Palantype transcription computer. For such was the scale of this up-date that a completely new dictionary had to be prepared using the large campus computer at Leicester Polytechnic; this meant that rehearsal for the programme could only begin on the Monday two days before the event.

The three Palantypists chosen for this work had spent some time rehearsing on their mechanical keyboards, with audio tapes of Tom Fleming's previous commentaries but now they could try out their key strokes using the computer in its final form and rehearse changeovers every ten minutes or so, to cover the events for an hour before and after the Wedding Service in St. Paul's. In the event, the rate of speech was much faster than the audio tapes had suggested and this, coupled with the atmosphere of a very special occasion, caused the error rate to be fairly high. In their normal work the Palantypists can easily correct these errors, and so provide accurate transcription from their subsequent typing of their shorthand records. Real-time verbatim transcription offers no such second chance; the subtitles have to go out as they are. Nevertheless the response from many deaf people was one of gratitude, encouraging, and at times moving.

Mike Cathawood, the producer of the subtitled programme, handled the mixture of old and new techniques in a truly imaginative fashion, and the Palantype team were grateful for the way he researched the subject, giving the information that was required to make the most of the subtitles offered. Moreover there was excellent support from the Network Engineers on duty in Sub-Control Room in Television Centre.

The other people worked very hard to make the operation a success. Pearl Martelly typed in the twenty thousand or so entries for the new computer dictionary. Peter Sommerfield, another member of the Designs Department team, supervised the two word-processing micro-computers that Pearl used, as well as ensuring that all the hardware was manufactured in time.

There are many aspects of the verbatim transcription of speech by Palantype which will have to be understood before it becomes clear to what extent the techniques can be used in broadcasting. For the moment, probably the two most important problems to be solved are the training and acclimatisation of Palantypists to broadcasting. It is hoped to give the Palantypists more practice by using a special commentator for the deaf, so that a reduced rate of speaking can be used. Moreover it will give the audience a better chance to read the subtitles and research may show this to be a very important consideration.

It is possible that a somewhat larger, more versatile and error-correcting transcription computer will have to be provided, but the resources required for this development can only be justified by the results obtained from existing equipment. Meanwhile much remains to be done if one day we are to provide the kind of service for the deaf that hearing viewers already enjoy.

Certainly the results from the verbatim system were not as good as those suggested by the tests that had previously been carried out, and at first there was an air of disappointment that the programme did not demonstrate the breakthrough that everyone had worked for. But to reassure both the engineers and palantype team, what was needed was not the opinion of those who enjoy the output of three television networks day by day, but the opinion of those who cannot hear. As far as we can judge their verdict comes to the BBC as an overwhelming "Thank You".

 Published by BBC Engineering Information Department, and printed by Print Unit, ETD, Wood Norton