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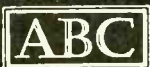
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# studio sound

AND BROADCAST ENGINEERING

At first sight it may seem rather single minded to devote the greater part of an issue to one recording studio, even if it is equipped and staffed to the best international standards. If the complex is called 'EMI Studios, Abbey Road' a few thousand people will understand rather better. Contract the name to a simple 'Abbey Road' and the thousand will become a million.

But Abbey Road Studios represent more than an Ip by the same name. They symbolise the explosive rise and expansion of the recording industry in the sixties, as well as the ultimate in lift-offs for the young hopefuls who queued to work there. Doubtless, even without that Ip, the studios would have been just as successful because in terms of economic viability it is primarily down to the efficiency of the people who work there.

Contrast suggests the possible speculation of the Beatles recording at a less successful establishment—Command Studios, perhaps.

Without raising too many skeletons from the dead, that complex probably started out with as much if not more going for it, in terms of money and personnel, than any other studio. And then there was the human element which ultimately spelt disaster for everyone concerned. Individual reputations and studio potential were no match for the internal friction and strife generated by the incompatible attitudes of the bankers who supplied the money and the chiefs who specified the facilities with little regard for those who had to try and make them work. Command failed through lack of consideration which resulted in summary dismissal of the engineer's intuitive feeling and point of view.

With this background, the Beatles' patronage would have probably resulted in rather less than fame for the recording studio; George Martin would certainly not have tolerated the kind of session hassles that occurred at Command. It's mid-take and looks promising. The control room door opens and in walks a gentleman who, *in front of the client*, proceeds to deliver an instant lecture to the engineer on the compound effects of clock watching. No amount of superstars could have helped a situation like this.

Abbey Road, and many other studios are an unqualified success. They are because of what they are, rather than the stature of the names that attend them.

To lend the name to an Ip implies the existence of success rather than an attempt at its instigation.

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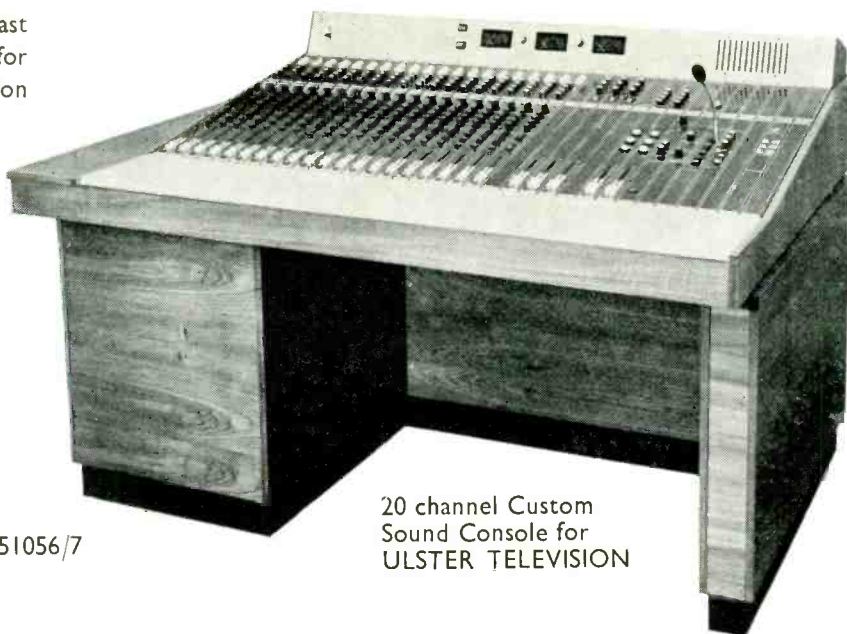
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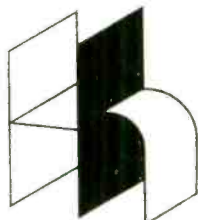
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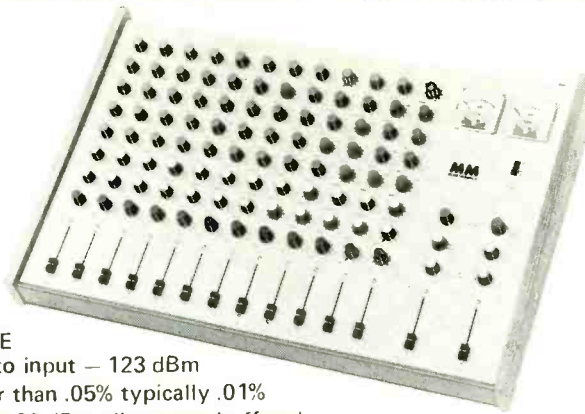
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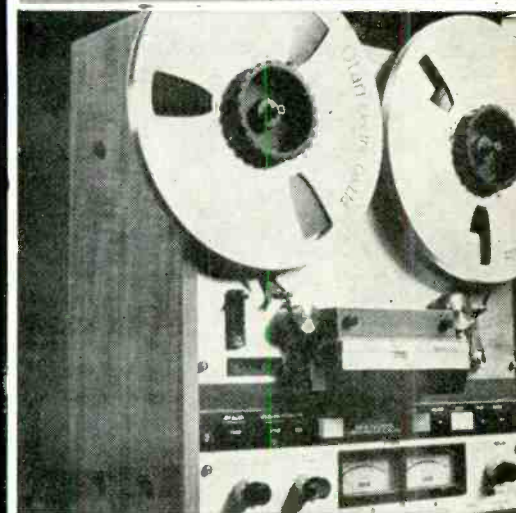
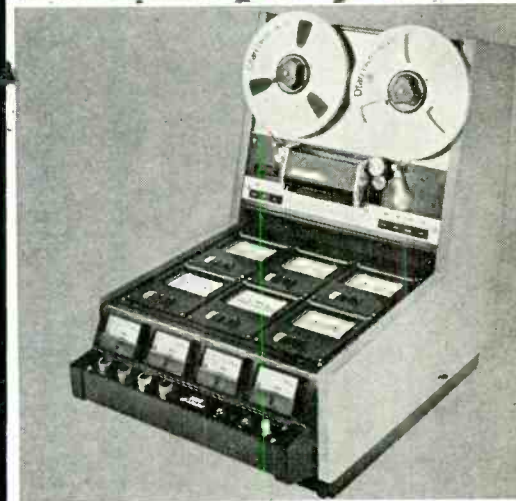
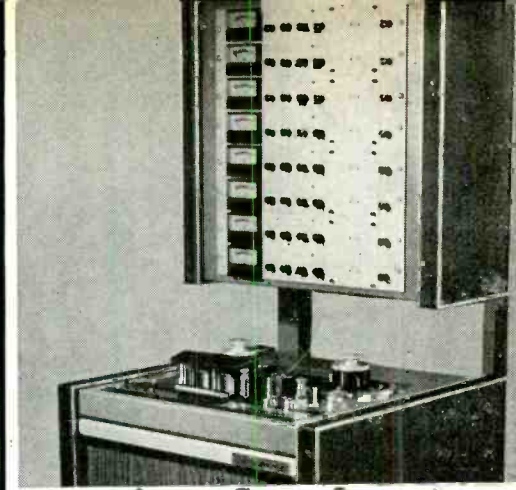
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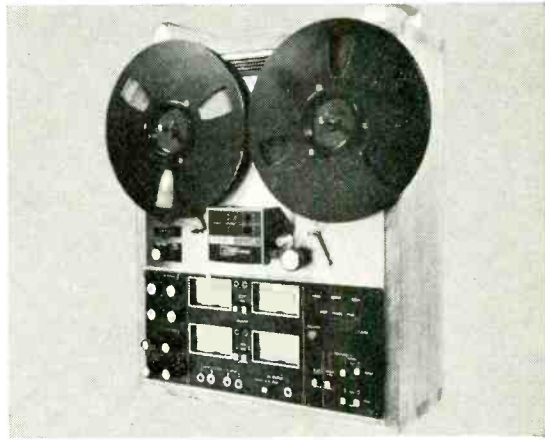


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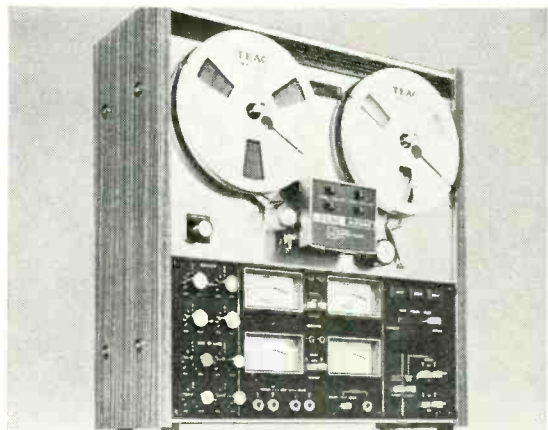
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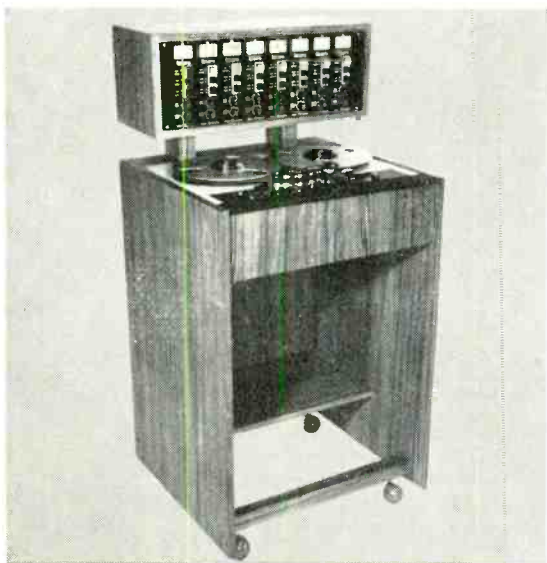
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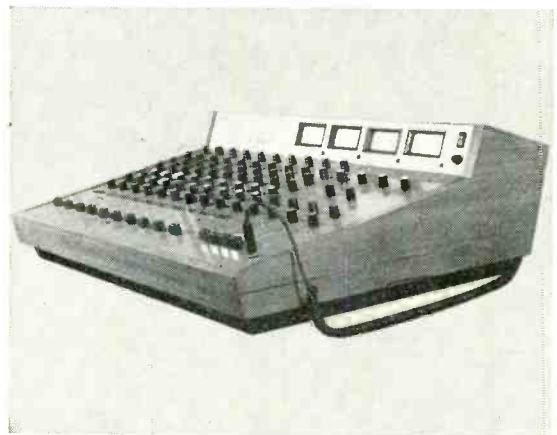


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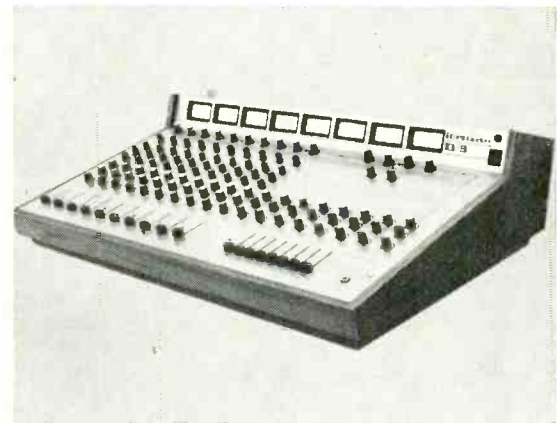
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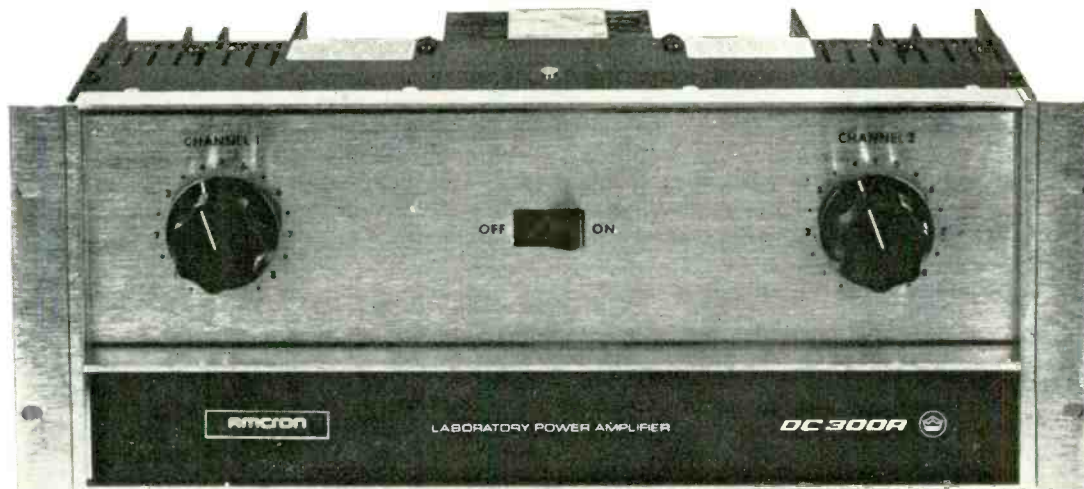
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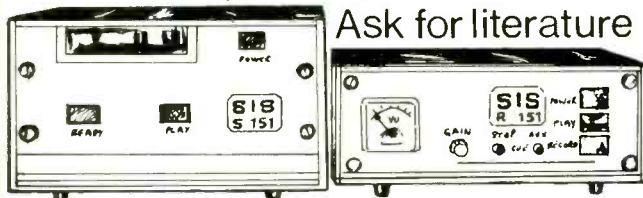
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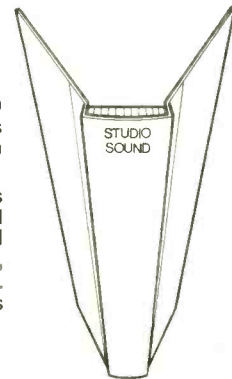
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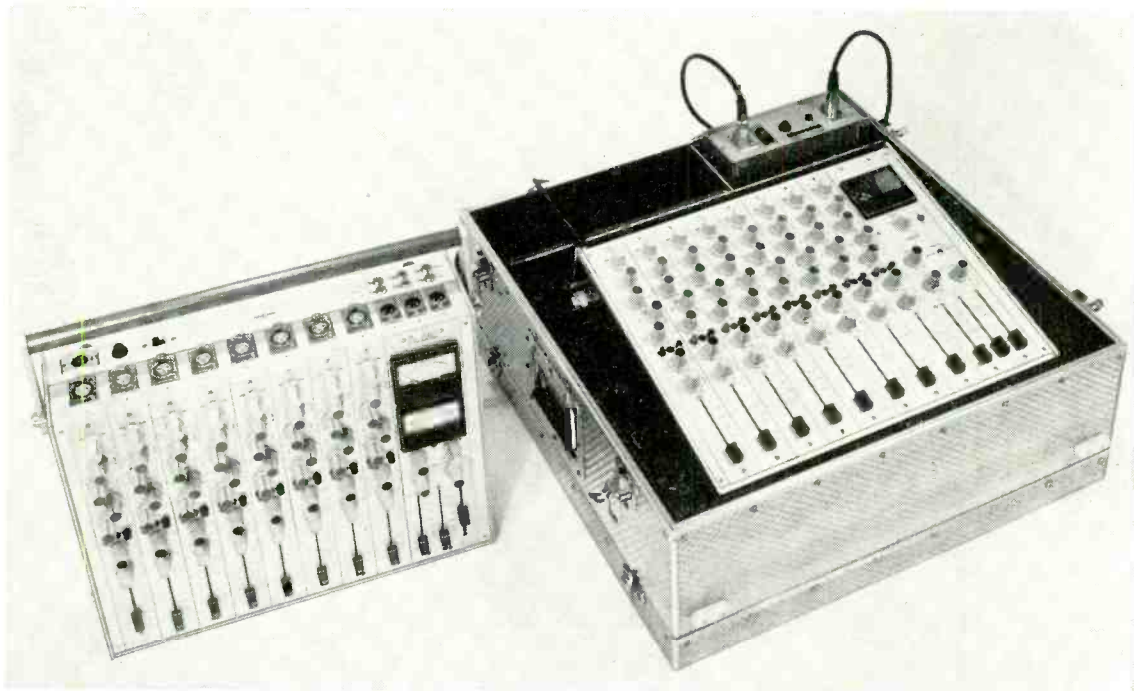
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## Japanese cassette system

Sony, Matsushita and Teac recently announced agreement on a new audio tape system, christened the *Elcaset*. Looking like a cross between a video and a compact audio cassette, the *Elcaset* contains 6.3 mm wide tape, with a standardised running speed of 9.5 cm/second. The track pattern resembles that of a Philips audio 3.8 mm compact tape cassette, thus providing compatibility between mono and stereo recordings. But in addition a narrow cue track is provided alongside each audio track, to provide for automatic stop, play, rewind and fast forward searching. The cue track can also be used to carry film or slide sync pulses. Unlike the Philips compact cassette, but like a videocassette, the *Elcaset* has no transport mechanism other than a take-up and take-off spool. A pair of flaps on the cassette front face hinge back, video-style, to release sufficient tape to wrap round the heads of the player machine. So far, an LC-60 with a total length of 60 minutes playing (30 minutes each side) and an LC-90 (total playing time 90 minutes) have been proposed, and both Aiwa and Victor of Japan, have agreed on the standard with the three companies behind the development.

prototype unveiled prematurely, audio quality was poor. Clearly, however, it is only a question of time and development before broadcast quality can be extracted from the system and success or failure of the system will depend far more on how hard it is sold. Machines are promised for later this year, but it is unlikely that the domestic public will voluntarily welcome the *Elcaset* as an alternative to their existing Philips compact cassette or open reel tape systems. Moreover the BASF *Uniset* 6.3 mm tape cassette, with which the *Elcaset* has much in common, is well known to Western professionals, and EMT and Studer machines capable of handling the *Uniset* are known to be nearing the production stage. The *Elcaset* may be a good idea launched too late, and this thought is reinforced by an impression that some of those in the East behind the launch were unaware of the *Uniset* and its capabilities.

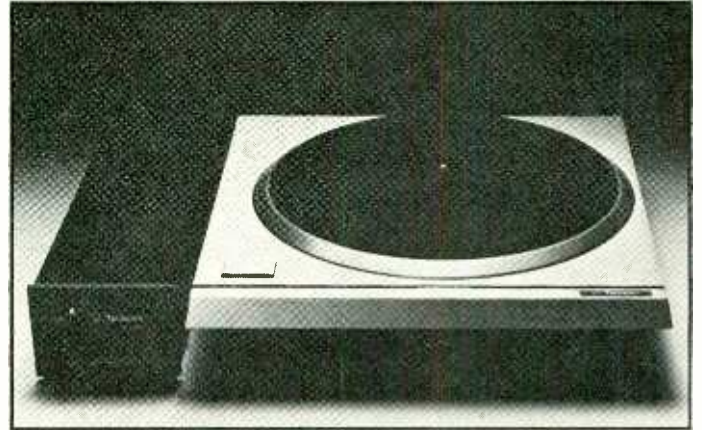
More likely to be of immediate interest to professionals is the Technics *SP-10 MkII* direct-drive turntable, with 'instant' start and stop. The turntable, which uses a quartz-controlled phase-locked servo circuit to hold its running speed constant to within  $\pm 0.002$  per cent, is remarkable for its extraordinary starting torque of

A similar duration applied to in-use switched speed change between  $33\frac{1}{3}$ , 45 and 78 rpm. A combination of electrical and magnetic braking stops the platter dead within 0.3s or  $30^\circ$  of rotation at  $33\frac{1}{3}$  rpm. A remote control on/off switch is provided, which can be ganged to the zero position of a console fader, thereby automatically muting the brief run-up time as the fader is raised to full gain. Another alternative is to back-cue into silence by just  $25^\circ$  and start at full gain. In the latter case, however, the power supply to the turntable must be switched off, to release the braking system.

when accidentally touched while running. A record can also be quite brutally cleaned during reproduction. In down-to-earth language, the tea lady can brush up against the turntable and the dj can clean jam off the record, without a listener being any the wiser.

Technics see it as a cheap alternative to the widely used Gates and EMT turntables, and already some have been bought by Swedish Radio. Incidentally, Technics claim they could easily have produced a turntable with even greater torque, but refrained quite simply because it could have constituted a real risk

Technics *SP-10 MkII* ▼



Most impressive of all is the way in which the *SP-10* platter keeps running at constant speed even

to engineers' fingers. 'We hope', they said, 'that we haven't started a torque race'. **Adrian Hope**

## New EMI tape

A very amiable booze up at the EMI Studios, Abbey Road, marked the launch of the latest generation of mastering tapes from that company. Naturally, the new *830* series is described as high output, low noise, high headroom, low print-through, etc, etc, with these statements borne out by some relatively watertight published specifications for 38 cm/s tape speed:

**High output:** 8.5 dB above 320 nWb/m reference level generating 3% thd at 1 kHz. A similar figure of 10 kHz is +7 dB.

**Low noise:** noise 73 dB below signal using stereo track format, A-weighting into a quasi-peak measuring system at 1 kHz.

**High headroom:** see high output.

**Low print-through:** 56.5 dB measured at +8.5 dB above 320 nWb/m with 1 kHz tone after 72 hrs storage at 20°C.

The *830* series is available in the usual widths in smooth back (*831*), matt back (*832*) and smooth back long play (*833*).

sizes of delay cartridge for use with machines incorporating delay heads. Available in 8s and 10s lengths, they differ from normal construction in the pressure pad arrangement and reel lubrication. Fidelipac, 109 Gaither Drive, Mount Laurel, New Jersey 08057, USA. Phone: (609) 235 3511.

## Analogue delay line

This unit, from Multi-Track of Hollywood, looks like being the first production unit to be offered using bucket brigade style charge coupled device technology. This system samples the audio input signal as an absolute quantity for a time increment proportional to the shifting rate. It does not quantify into a digital word thus producing no least significant bit uncertainty noise. To date, the analogue shift register mostly found use in self scanning imaging units and anti-clutter circuits for radar work.

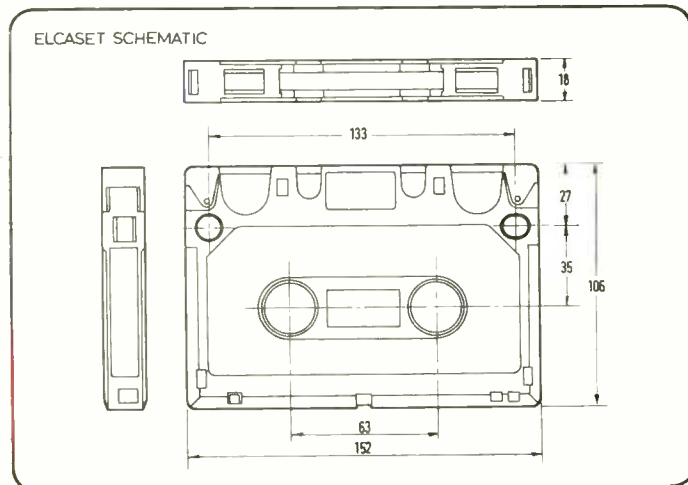
Manufacturer's quoted spec:

**Max delay:** 98 ms max in two channels of 49 ms in 1 ms steps.

**Frequency response:** 10 to 20k Hz  $\pm 1$  dB. **16** ▶

## Delay cart

For use in prevention of abuse/boredom from phone-in freaks, Fidelipac now manufacture two



All dimensions in millimetres

The first demonstrations, given in Japan, showed that the auto-search facility can work as claimed. But, probably due to a faulty

6 kg/cm. This enables the platter to attain full speed from zero within 0.25s, or a platter rotation angle of only  $25^\circ$  for  $33\frac{1}{3}$  rpm use.





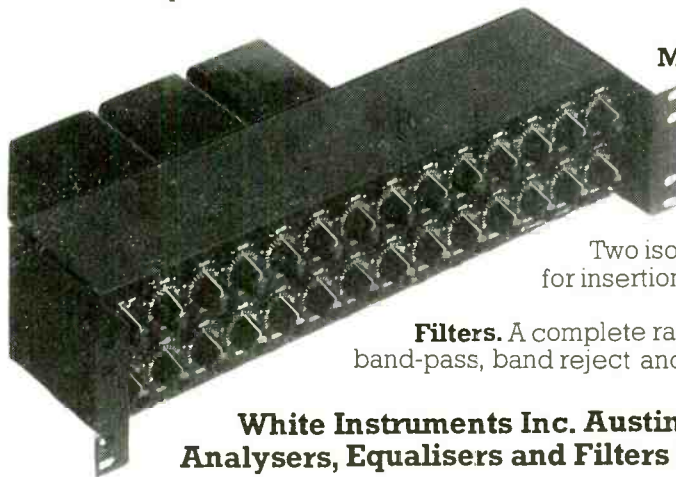
**Model 140 Acoustical Analyser.**

27  $\frac{1}{3}$  Octave double-tuned filters on ISO centres from 40Hz to 16kHz and broadband indication of db SPL reading out on a matrix of 319 LED's. Built in pink noise generator for system excitation.

**Model 141 Micplexer** (shown in lid of 140). Multiplexes three microphones and presents single output signal to a Model 140 for analysis of sound field.

**Model 142 Sound Analyser.**

Peak-reading instrument for  $\frac{1}{3}$  octave analysis of programme material. 27 Single tuned filters 40Hz to 16kHz. Built in pink noise generator and two CMOS memories for instant programme energy distribution comparisons.



**Model 4001 Active Equaliser.**

Intended for monitor system equalisation. This unit has 27 ISO centred controls from 40Hz to 16kHz and provides  $\pm 10$  db range on each control plus low end roll-off.

Two isolated output stages with provision for insertion of an octal-based crossover network.

**Filters.** A complete range of high-pass, low-pass, band-pass, band reject and low-level loudspeaker crossover

**White Instruments Inc. Austin, Texas.  
Analysers, Equalisers and Filters for Audio Applications.**

For complete information or a demonstration of any White Instruments Products contact the sole UK Agent:

# Scenic Sounds Equipment

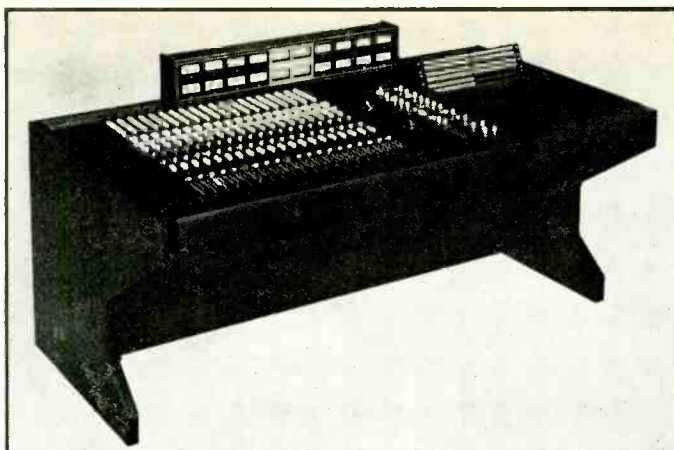
27-31 Bryanston Street, London W1H 7AB Tel: 01 935 0141  
In France: **3M France S.A. Mincom Div.** 135 Blvd. Serurier 75019 Paris  
Tel: 1 202 8080

## NEWS

**Sampling frequency:** 102.4 kHz (externally modulated for phasing etc).  
**Signal-to-noise ratio:** better than 85 dB at 49 ms delay (20 to 20k Hz).  
**Distortion:** typically less than 0.2% at 49 ms.  
**Interface:** line level.  
**Delay control:** by thumbwheel switch.  
**Power requirements:**  $\pm 15V$  dc.  
**Environmental:** 10-50° C.

It is hoped that production units will be available shortly.

Multi-Track, PO Box 3187, Hollywood, Ca 90028, USA. Phone: (213) 462 1351. UK: Mellotronics Ltd, 35 Portland Place, London WIN 3AG. Phone: 01-637 0692.



Above: QA 3000 Quantum Audio Labs

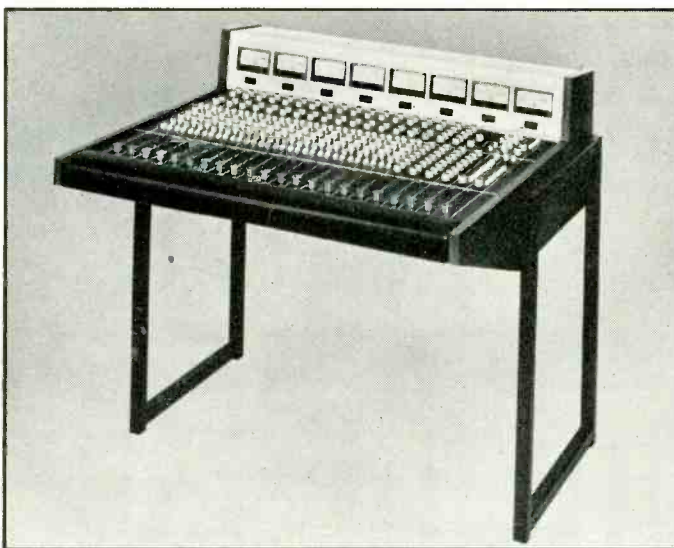
Below: Grandson III from Auditronics Inc

### New console

Quantum Audio Labs' QA-3000 uses modular construction to give the flexibility of specification associated with that method of construction. The system can be supplied with as few as eight inputs eight outputs or as many as 40 in by 16 out. All variations are kitted out with quad mixdown facilities.

Standard equipment includes four echo busses, quad panning, full monitor mix, four knob eight frequency eq, cue solo and talk back, hi and lo pass filters, front end pads, vu meters, conductive plastic faders and phantom powering. The usual jackfield facilities are present.

Quantum Audio Labs Inc, 1905 Riverside Drive, Glendale, Ca 91201, USA. Phone: (213) 841 0970.



### Great grandson

Actually, Auditronics, the manufacturers, call it *Grandson III* but it looks as though it might be very useful for applications in what the manufacturers describe as 'the live performing arts'. That means sound re-inforcement, public address or whatever.

This new mixing console is oriented very much towards theatre situations. For instance, in addition to and separate from the 16 inputs and eight outputs, there are two talkback/paging circuits as well as the normal talkback arrangements to either the monitor or output circuits. Four subgroups on the output side allow sectional fades with single fader operation.

Measuring 97 x 82 cm, the desk uses modular construction to allow for system expansion at a later date. Individual mic channels feature phantom powering on the inputs and an input giving sensitivities between -70 to +20 dB at the input relative to 0 dB on line

out. Other channel facilities include three knob six centre eq plus the usual hi and lo pass networks. There are three sends per channel officially designated as two effects and one foldback circuit. Eight way routing is standard. Auditronics states an output drive capability of +24 dBm.

Auditronics Inc, 207 Summit Street, Memphis, Tenn 38104, USA. Phone: (901) 276 6338.

### Distortion meter

The VP7701A distortion meter manufactured by National of Japan features an automatic level control for use over the input range 100 mV to 100V without manual adjustment, an autoranging capability giving measurements down to 0.03% total harmonic distortion and a frequency range from 10 to 200k Hz. The unit can also be used as a millivoltmeter with manual or autoranging. There is an external

socket for distortion signal output. The unit is distributed in the UK by Telonic Altair, 2 Castle Hill Terrace, Maidenhead, Berks SL6 4JR. Phone: 0628-28057.

### Musexpo 76

This year's show, the direct American equivalent to the Cannes MIDEM, will be held at the Fairmont Hotel, New Orleans from September 8 to 11. Organised by the International Record & Music Industry Market, exhibitors will include a strong British contingent following the intervention of the British Overseas Trade Board with hard cash aid for UK participants.

In addition to the usual gathering of the clans, two talent showcases will operate under the same roof as the main exhibition. Special attention will be paid to the organisation of this year's event following the various complaints about noise, communications, showcase locations and exhibitor squabbles that

marred last year's exhibition. 1350 Avenue of the Americas, New York, NY 10019, USA. Phone: (212) 489 9245. UK contact: Jimmy Parsons, 6 Boreham Holt, Allum Lane, Elstree, Herts WD6 3QF. Phone: 01-953 7260/836 8211.

### New amplifier

Naim Audio are to produce a smaller version of the established 160 and 250. Rated at 40W/channel into 8 ohms (60W/channel into 4 ohms) the company says that the new model will drive 'any loudspeaker with a music signal without loss of information'. Extract from manufacturer's spec:

**Transient power:** more than 150W.

**Total harmonic distortion:** less than 0.04% at any audio frequency up to 30W.

**Signal-to-noise:** -85 dB ref 18V output.

**Sensitivity:** 700 mV for 18V.

**Stability:** unconditional.

Naim Audio Ltd, 11 Salt Lane, Salisbury, Wiltshire SP1 1DT. Phone: 0722-3746.

### Agencies for MicMix

The company has appointed the following agencies for its range of *Master Room* reverberation chambers: Chicago area, Irving Rose Associates; East Central States, Sphere Associates of Washington DC. Sphere has installed a New York City telephone line (212/246 0176) for direct contact with the Washington office. Internationally, Eltron Ltd, of Johannesburg, was recently appointed as the distributor for South Africa.

MicMix Audio Products Inc, 9990 Monroe Drive, Suite 222, Dallas, Texas 75220, USA. Phone: (214) 352 3811.

### 2 mil low print tape

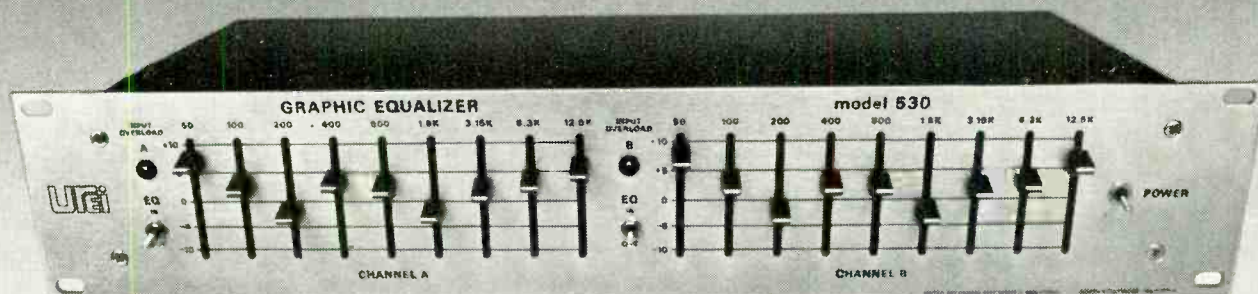
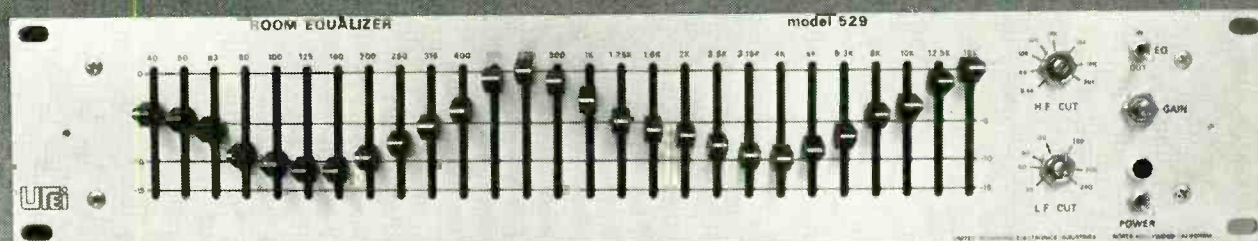
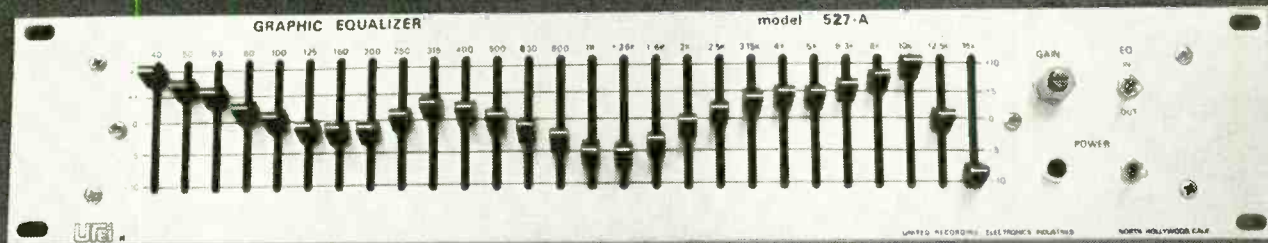
One of the characteristics claimed for the new Q15 tape from Capitol Magnetics is that of low print through—the new product has been designed specifically for applications in broadcast and recording studios. Although the two mil base thickness is standard, the product, marketed under the Audiotape brand name, will also be available in 1 and 1.5 mil bases in the usual widths from 6.25 to 50 mm. When supplied on a 26.5 cm NAB spool, tape length is 710m. Capitol Magnetic Products, 1750 North Vine, Los Angeles, Ca 90028, USA. Phone: (213) 462 6252.

Capitol Magnetics, EMI, Elstree Studios, Borehamwood, Herts. Phone: 01-953 1600.



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The most comprehensive range of graphic equalisers for recording and sound reinforcement applications. Moderately priced, with UREI quality, of course.

Model 527 features 10dB boost and attenuation from 40Hz to 16kHz in  $27 \times \frac{1}{3}$ rd octave steps.

Model 529 offers from 40Hz to 16kHz in 27 steps with up to 15dB of attenuation; with additional high-pass and low-pass filters.

Model 530 a two-channel octave equaliser allowing independent selection in 9 steps from 50Hz to 12.5kHz for stereo application, 10dB boost and attenuation.

Model 532 - the mono version of the 530.

## F.W.O. Bauch Limited

49 Theobald Street, Boreham Wood,  
Hertfordshire, WD6 4RZ  
Tel: 01 953 0091 Telex: 27502



# In the beginning...

## GUS COOK\*

*Abbey Road recording studios officially opened for business on November 12, 1931*

\*General Manager (1969-74)  
EMI Studios, Abbey Road

RECORDING for the gramophone was first started in the UK by the Gramophone Company (His Masters Voice) in 1898. The rather primitive method used consisted of collecting the sound by means of a large horn, the performers being suitably grouped around its flare, and the generated waves made to vibrate a glass diaphragm connected to a floating arm at the narrow end. A sapphire cutting stylus was attached to the diaphragm and the resulting mechanical vibrations were recorded or inscribed on the surface of a soft wax blank which was then processed to produce the record. To accommodate the limited ensembles used for this acoustic system of recording a small studio was built in the office block at Blyth Road, Hayes.

In 1925 the Western Electric Company of America introduced the first electrical system of recording using microphones to pick up the sound. The resultant increase in flexibility made it possible to

employ much larger groups of artists and musicians, and this necessitated the use of bigger studios and halls such as Queens and Kingsway. Even at this early date, due to the increasing numbers of concerts taking place, difficulties were being encountered in using the halls for recording sessions. The renewed interest in concert performances was due to the stimulus of broadcasting on the new state networks and to the increasing availability of gramophone records. It therefore became necessary to consider the building of a permanent recording complex in the centre of London (the Hayes site being some 12 miles away in Middlesex) in which all the activities of the company could be co-ordinated.

A parallel development was taking place at the Columbia Graphophone Company under its founder Louis Sterling later to become the first managing director of EMI. This organisation was by now well established with a record factory at Earlsfield and a complex in Westminster consisting of two studios, a research laboratory and equipment workshops in Petty France on the site now occupied by the Passport Office. For the recording of large scale works the Columbia Company also had the use of the Central Hall, Westminster and the Portman Rooms at Baker Street.

Due to the foresight of Osmund Williams, who was head of the international artists department at that time, a site was chosen for the Gramophone Company's new studios to the north west of Piccadilly at St John's Wood.

The Abbey Road location proved to be ideal for the purpose, St John's Wood being considered, even today, one of the best areas of London with its tree lined streets of spacious houses and flats surrounded by gardens. The house at No 3 Abbey Road, close to Lords cricket ground, was purchased in 1930 and converted into offices. The facade was repaired but otherwise unchanged, remaining so to this day in order to maintain the residential character of the neighbourhood. A connecting block was built in the large garden of the house consisting of three studios, transfer or mastering rooms, workshops, listening rooms etc, and a garage for what was to be the first mobile gramophone recording unit. No 2 Studio was placed at right angles to the main construction and utilised part of the gardens purchased from No 5 Abbey Road and adjacent houses in Hill Road. It is interesting

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Map & Plan. 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.





to note that when in 1960 the basement portion of the old house was undergoing alteration to provide an additional echo chamber, it still contained an enormous kitchen range with several ovens, and harness hooks for the coach horse accoutrements were still in site around the kitchen walls. The floors of the rooms above were found to be made of long planks of solid elm more than an inch thick and secured by nails which were undoubtedly hand forged. It was the first time that a complex of such dimensions was purpose built for gramophone recording and its No 1 Studio, recently internally rebuilt and modernised, is considered to be the best in Europe, perhaps the world, used solely for this type of work.

The opening ceremony was on November 12, 1931 with a recording by the LSO directed by Sir Edward Elgar of his symphonic poem *Falstaff*. Among the many notables attending the inaugural session were George Bernard Shaw and Sir Landon Ronald, two old friends of the maestro. Earlier in that year a merger had taken place between the Gramophone Company and the Columbia Graphophone Company forming Electric and Musical Industries, now the EMI Group of Companies. The Petty France studios were closed down in 1932.

The studios at Abbey Road were initially equipped with the WE system of recording which was protected by numerous patents both in America and the UK covering the condenser microphone and also the moving iron cutter head (BP 262389). The cutter had a linear response from 200 to 4500 Hz falling away at its lower end to 50 Hz at a rate of 6 dB/octave. The cutter resonances were damped out by the ingenious use of a rubber transmission line. This equipment could not be purchased outright but was hired to licensees under a rental system which included the payment of a royalty on each record sold.

The head of r & d at the Columbia studios at that time was a shrewd radio engineer Isaac Shoenberg (originally from the Marconi Company) who was later to become responsible for the development of the EMI broadcast system adopted by British Television. It was requested by Louis Sterling that research should develop a new electrical recording system avoiding the use of the WE patents and thus the large royalties being paid to America. This resulted in Isaac Shoenberg engaging a young scientist, Alan Dower Blumlein, to work on the project.

ADB already had a number of interesting patents to his credit and by 1929 with two able assistants, R E Holman and H A M Clark, was busy working out the details of the moving coil system, the first of its kind, which was to be used by the EMI Group of Companies for the next two decades. The microphone used was of an entirely new design having a stretched metal diaphragm attached to a moving coil wound on a balsa wood former.

The resonance of this arrangement occurred at 500 Hz and was removed by the use of an equaliser, situated in the microphone amplifier. As well as being used by EMI for many years this type of microphone was also used by the BBC at Alexandra Palace in the television broadcasts from that station.

The moving coil recorder or cutterhead was also of a unique design (BP 350954 and 350998). It was driven by a quarter kilowatt Marconi transmitting triode, *DEM 3*, but arranged for this purpose as a low frequency amplifier using 1000 volts on its anode. This was followed by a flexible wide range equaliser which enabled considerable adjustment to be made to cutter head response. The equipment was constructed and calibrated in the labs and workshops at the Petty France Studios.

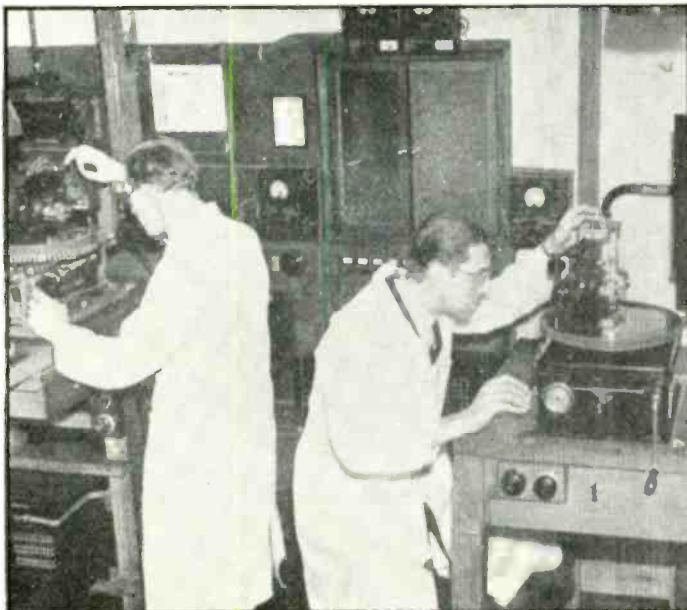
After the merger forming EMI the new recording system was installed at Abbey Road and the WE apparatus returned to the States. The Blumlein system remained in full use throughout World War II and was not replaced until about 1948.

During 1932 Alan Blumlein produced a portable version of the MC System for use on remote or location recording sessions and also to equip some of the smaller companies abroad, the main European centres such as Berlin, Paris and Milan having already been equipped with the standard studio MC System. For this lightweight equipment he utilised a MC microphone with a permanent magnetic field, together with a modified cutter with synthetic rubber pivots for the coil. The rubber for this was specially developed by the Dunlop Company and became known as Neoprene. Due to this development the new recorder required much less power to drive it and this was provided by two small power valves in push-pull. The circuitry was also arranged to extend the upper frequency limit to 10 kHz if required. This equipment was manufactured and calibrated at the EMI workshops, located at Hayes, Middlesex.

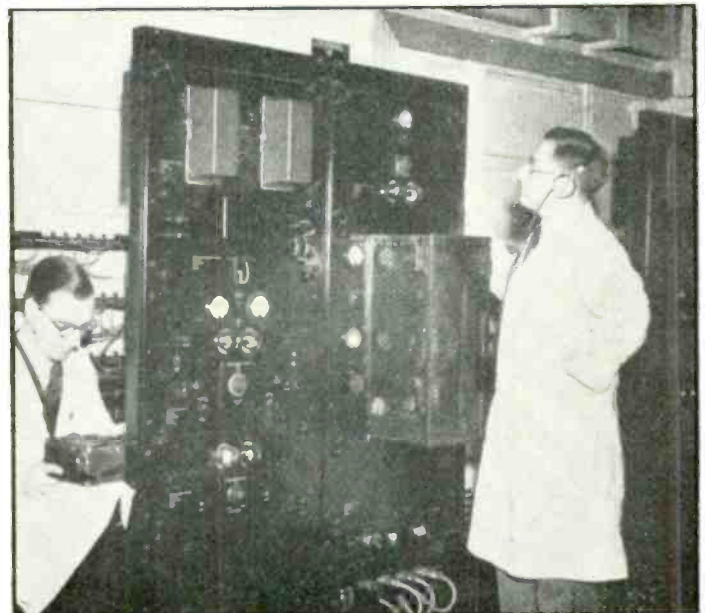
Complementing the studios was the mobile recording unit which, being built in the late twenties, was undoubtedly the first of its kind. It consisted of a purpose built body on a Lancia two-ton chassis and was equipped with a complete recording system including two weight driven lathes. A jacking system was arranged to support each corner of the van during recording to level the machines with their 55lb lead weights for the gravity motors. The power for the amplifiers, suction and heating of waxes was derived from batteries which were recharged in situ during rest periods. This enabled the unit to work in town or country and many hours were spent, for example, by Albert Deering and Leonard Page working with Ludwig Koch on his well-known series on *British Birds*.

Another event recorded annually was the Aldershot Military Tattoo. The waxes, which were cut during rehearsal and the first performance, were rushed to the factory for processing, and 20 ▶

No 3 control room—1932



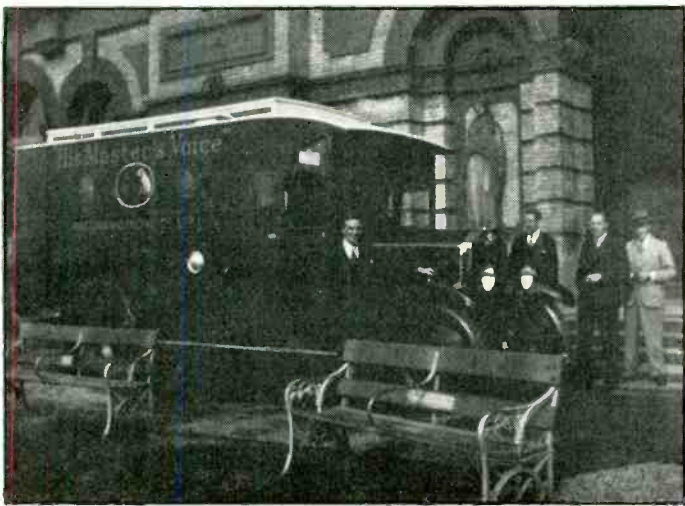
The DEM 3 amp system with Gus Cook and George Deakin





## IN THE BEGINNING . . .

selected items were then lifted by pickup from the resulting records in the transfer room at Abbey Road by a team of specialists. The pair of composite records made by this operation were able to be put on sale at Aldershot before the final stages of the Tattoo. This was a highly technical operation for those days since unlike the use of tape, the minutest error would necessitate the re-transfer of a complete side.



*The Lancia mobile at Alexandra Palace for an organ recording of Reginald Goss-Custard in 1930. L to R: Jim Mays, Edward Bulkley, Arthur Clark and George Dillnutt. Photo by Harry Hands.*

Due to enemy action at Manchester during the latter part of the last war the Lancia Van, as it was called, was destroyed by fire. A replacement was built and travelled many thousands of miles all over the British Isles recording organs and dance bands of the period together with classical sessions of every kind. Tribute must be paid at this point to Harry Hands the driver of these vehicles who for more than 30 years ensured that they arrived on site at the right time, and for the cheerful assistance he gave to many a young recording engineer of the period including myself.

Mention must also be made of the Compton organ which for many years was a feature of No 1 Studio. This organ had a four manual movable console connected by cable to the main structure which was located in the centre of a side wall and projected into the studio supported on two wooden pillars. It was equipped with an electronic section with a drum driven system of oscillators for the use of special effects.

Its prime purpose was to cater for records by prominent organists when it was not possible to record them at the cinema or theatre where they normally played. I recall passing through London during the early days of the last war: at the time I was a very green corporal or sergeant in the RAF and when possible I would call at the studios to see old colleagues. I was told I should see another RAF type who was recording in No 1 Studio. This turned out to be a very smart corporal rejoicing in the name of Reginald Dixon with whom I had been working for some years at the Blackpool Tower. I recall that we used to work from midnight to 4 am fortified with numerous bottles of Bass, which was Reggie's favourite beverage. The supervisor of the programmes which were recorded for Radio Luxembourg was Howard Thomas, now a famous name in the television world.

To return to the Compton, in 1938 Fats Waller made some piano and organ records at Abbey Road in No 1 Studio. The organ tracks were made on a Möller, which at that time was the property of Reginald Föort, and brought to the studio for the session—the new lp *Fats Waller in London* has just been issued. As Fats was always fascinated with pipe organs he insisted on having a go on the Compton after hours when the normal work was done. I was abroad at this time but I was told by those fortunate enough to be present that with the aid of a bottle of whisky as lubrication he extracted sounds from the rather staid Compton never heard

before or indeed since, and that this little interlude was an experience never to be forgotten.

Unfortunately with the coming of stereo and the necessity for greater floor space the organ and console had to be dismantled. It had been little used except as a fill-in device for some years due to the decline of interest in cinema organs. However, I am happy to report that it is still in existence and now resides in a Cornish tithe barn somewhere in the Liskeard area.

The period 1939-1945 saw about one-third of the Abbey Road



*Glenn Miller with the AEF Band recording in No 1 Studio. September 16, 1944*

technical staff either on radio work in the armed forces or on government work at Hayes. The studios were manned by a skeleton staff which was engaged principally on ENSA work for the forces entertainment, the programmes for which were either recorded in the studios or by land line from the BBC networks via the Broadcasting House Control Room at Portland Place. The Glenn Miller Orchestra was actually recording at Abbey Road shortly before the ill-fated plane trip from which its leader did not return.

During 1945-46 recording companies both in this country and in America began experiments to extend the recording range in the upper frequencies and much was made of this in their advertising. The range of the moving coil system was extended (as had been envisaged by the canny Blumlein) by Barry Waite and Harold Davidson two senior engineers at Abbey Road, but the changes were not published by EMI it being considered by the company to be a normal development in recording techniques. In the same year (1946) a team of audio engineers from England and America, including Berth Jones from Abbey Road, went to Germany to study the developments in magnetic recording. Military equipment captured towards the end of the war indicated that a system of monitoring was being used by the German command in which Allied high speed signals were being recorded on a system using magnetic tape. The signals were then played back at a reduced speed in an attempt to break the codes in use. As a result of the data gained from this system EMI were able to embark on the manufacture of tape and tape recorders which resulted in the production of the well-known *BTR* series. Various forms of this type of recorder, from the original *BTR 1* to the *BTR 3*, were installed at Abbey Road from 1947 onwards, and remained in use for the next 25 years.

The introduction of magnetic tape now provided a medium whereby high quality programmes could be recorded, edited and replayed without any processing and it was these facilities which allowed the exploitation of the newly developed long playing microgroove record introduced by Professor Goldmark of CBS. A considerable amount of experiment was necessary before a library of tapes was available and this work was undertaken by Bill Livy and Albert Deering. The programme material was obtained by laboriously lifting suitable tracks from existing records (using a





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**FOURTH.** A truly vast range of sounds! The V.S. Musician can be set to sound like a 5 watt practice amp, a 100 watt valve amp on full steam, a clean and tingly transistor amp or any other amp you may favour.

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Milton, Cambs. Tel. Cambridge 65945.  
Please send me details of the V-S range and  
other new products.  
Name.....  
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## IN THE BEGINNING . . .

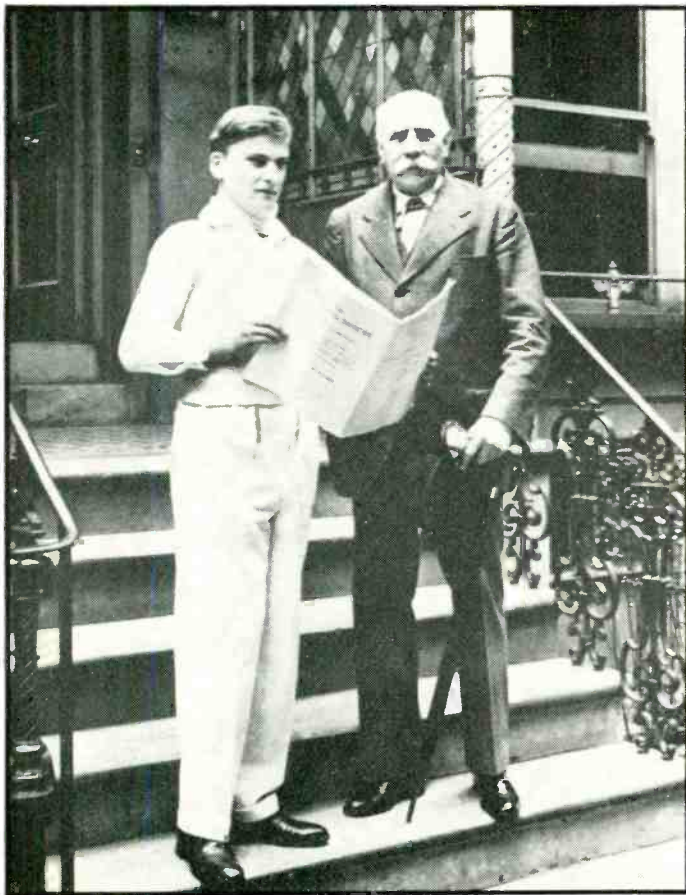
special GEC pickup) and re-recording on to tape. These programmes were edited and then re-transferred to microgroove lacquer masters for processing.

Until 1948 masters were cut either on a thick wax blank which could be re-surfaced (or shaved) a number of times after the galvanic process or on a wax coated, optically-flat glass plate known in the industry as a 'flow coat'. Due to the technical difficulties of processing a wax for microgroove records it became necessary to change to a lacquer disc for mastering. This type of disc was under intensive development, the difficulty being, as it still is, to obtain a really flat aluminium core. Thus the old type of wax and flow coats which had served the industry for so long were finally phased out.

This change, as is so often the case, brought certain advantages. The lacquer could be played back with minimal degradation, allowing an accurate judgement to be made of quality and performance. The wax was rendered unusable after one playing with the primitive lightweight pickups of the period, whereas the lacquer assisted the calibration of the transfer channel since it was now possible to measure signal-to-noise and quality on test cuts. Due to the increase in load on the cutter head for lacquer as opposed to soft wax it now became necessary to dispense with the old gravity weight driven lathes and these were replaced with electric drive. This development now made it possible to consider a form of automatic groove spacing.

About this time the Blumlein cutter heads were replaced by the EMI *RS 1* series in order to further extend the frequency range; and continuing the process these were again superseded by the Westrex

Yehudi Menuhin and  
Sir Edward Elgar at  
Abbey Road in 1931 for the recording  
of Elgar's Violin Concerto.



mono cutters at Abbey Road in 1954. To digress into the past a little, 1931 saw Blumlein already working on a stereo system of recording using a wax master running at 78 rpm. The system was covered by a number of patents which included BP 394325 of world fame. The channel separation even at that time was of the order of 20 dB and the upper frequency range began to fall off at about 4000 Hz. The new development was originated with the film industry in mind but proved to be in advance of its time as the principle was not exploited until the mid fifties.

In 1955 EMI introduced the first commercial pre-recorded tapes using the *Stereosonic* trademark and these were produced on open reels at 7½ ips, most of the programme originating from Abbey Road recordings.

New moving coil cutters were introduced in 1956 and by 1958 the Westrex *3A* type was in use at Abbey Road for stereo mastering. A steady stream of high grade condenser microphones was now also available. These were mainly of German origin and (due to component miniaturisation) becoming progressively smaller, thus having the advantage of offering less opposition to the sound field. Credit must be given here to the Neumann Company of Berlin for the vast amount of development work undertaken by them in this area of the audio field. The first postwar microphones of this type were the *M49*, two of which were acquired by Abbey Road from FWO Bauch early in 1952. The switchable polar characteristics were found to be of great use in the miking of the groups beginning to appear on the pop scene at that time.

Also about that time studios in the US and some in the UK began using a three track half-inch system of multitrack recording with the object of filling the so-called 'hole in the middle' of the stereo spread. The method did not find acceptance at Abbey Road since EMI consoles of the period had adequate control facilities (panning) not usually encountered on other mixers. The r & d section produced a four track experimental *BTR* machine which gave good results but due to the necessity of a rack of separate amplifiers it proved a little cumbersome to move around the studios. There was also available a special four track one inch recorder which had been supplied to EMI r & d to use as a programme source for the development of a stereo broadcast system. This machine was a modified version of the Siemens Telefunken *T9U*. Monitoring sync circuits were added by the Abbey Road engineers and the system was found to have considerable advantages over the three track arrangement since there was no degradation in signal-to-noise using the one inch format.

Thus four track recording was brought into use at Abbey Road at a very early stage, first for pop working and then for certain classical work since it was possible to make two stereo pictures simultaneously, the levels of which could be varied with respect to each other during the remixing stage. This increase in flexibility whereby orchestral and vocal levels could be varied was a very useful balance facility and the first operatic recording employing the new technique was the *Don Giovanni* sessions in Abbey Road's No 1 Studio in 1959. March 1960 saw the introduction of the new Neumann *ZS 90/45* cutter head which replaced the rather cumbersome Westrex version. The use of this cutter together with a small degree of automation in groove spacing freed the transfer engineer from the concentration required by hand control, allowing more attention to be paid to the other aspects of mastering.

Over the next fifteen years the use of multitrack techniques brought a period of great activity and change to Abbey Road. The shift from four to eight, eight to 16 and finally in 1975 to 24 track brought with it additional complications. It now became necessary to employ a system of noise reduction to keep tape background to an acceptable figure. Each new tape configuration implied modification to or a change of the mixer console and these measures involved the studios in a large capital expenditure each year. A vast quantity of electronic aids were devised to assist the balance engineer with his ever more complicated equipment. Organs, pianos, harpsichords, synthesisers and electric instruments of all kinds were increasingly used in the pop field, while limiters, compressors, reverberation units and sound re-inforcement systems also became available.

It also became necessary to reconsider the working conditions of both artists and engineers. Extensive alterations were made to the studio and control room decor providing comfortable and relaxed conditions—the quasi factory or clinical atmosphere was eliminated. To illustrate the point, until 1949 all studio staff



were required to wear white coats which in the words of the manager at that time 'were to distinguish between artists and engineers'. On the occasion of a visit by Sir Winston Churchill just prior to the last war I was awaiting his arrival near the talks studio. As he reached the top of the stairs and paused for breath, he took one look and said: 'My God, I thought I'd come to the wrong place it looks like a hospital.' And so it did.

The changes included lighting systems with dimmer control so that the atmosphere could be varied to suit the music being recorded. Carpeting and comfortable furnishings were introduced, not only in the studio and control room areas but also in the transfer suites and listening rooms where engineers and artists apply the finishing touches to the technical and artistic performance which emerges as a gramophone record.

It would be impossible to list here all the artists who have recorded at Abbey Road so I have picked a few at random without any classification, and I think you will agree that it reads like a page from Debretts: Bert Ambrose, Jack Hylton, Gracie Fields, Tommy Handley, George Formby, Jessie Matthews, Sir Lawrence Olivier, David Oistrakh, Sir Thomas Beecham, Elisabeth Schwarzkopf, Maria Callas, Igor Stravinsky, Aaron Copland, Ray Noble, Bill

Cotton, Lew Stone, Sid Phillips, the list is endless.

But before I close, special mention must also be made of two of these celebrities who have remained loyal to EMI over the last 45 years. I refer firstly to Yehudi Menuhin who recorded the Elgar Violin Concerto with the composer in Abbey Road's No 1 Studio in 1931 and who is still making magnificent music in the same place. The other musician is of course Joe Loss who was recording in No 2 Studio about the same time and who happily is still doing just this today.

One aspect of Abbey Road which has not yet been touched upon is its role as a training ground for engineers and technicians for the industry. The high engineering standards which have always been maintained over the years have made it a much sought after centre of employment, and applications are received daily from engineers worldwide wishing to undertake a period of training, often asking to work without pay.

Thus Abbey Road has become almost a recording Mecca since it is impossible to work in this industry without encountering in either film making, television, radio broadcasting or gramophone recording an engineer who at some point in his career has been associated with what is probably the best known studio in the world. ■

## agony

The producer, one of the new intuitive breed, wandered into the recently re-equipped control room to find the engineer lining up for the session. Pleasantries were exchanged in the course of which the new monitors were pointed out to the client. 'Hey, I don't like those,' said the man in a transatlantic accent deemed by his buddies to be as phony as the hairpiece. 'I used them at the Plant and I couldn't get on.'

Perhaps not the best way to start a session but everyone needed

the money, for the monitors weren't cheap. In the event, things just about got underway again with the producer demanding an attentive audience for his 9.5 cm/s demo to give everyone an idea of 'what I want you guys to do'.

'Oh no,' cried the man scratching his head with caution. 'That sound won't do. Gimme another four dB at 40k.'

The engineer simply gave the man a look of unbridled astonishment.

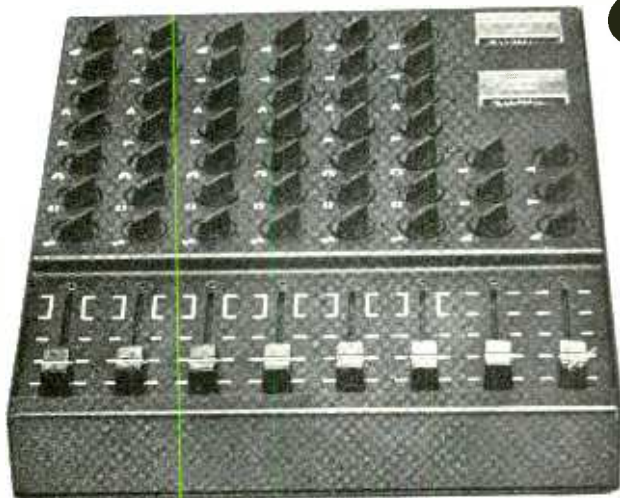
'I said gimme another four dB at 40 kilohertz.'

Not even good pr could save the session now.

'Cor blimey, mate, you'd better do it, 'cause I can't bleeding well hear that.'

From then on, things went down hill.

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# From mono to multitrack

**KEN TOWNSEND\***

*Abbey Road has pioneered many recording techniques—this article discusses the period from mono BTR to 24 track A80.*

\*General Manager (since 1974)  
EMI Studios, Abbey Road

**A**BBEY ROAD today forms an intrinsic part of the production unit of EMI Records, and Roy Matthews as Director of Production is responsible for the record factory at Uxbridge Road and the studios. Its prime function is to act as a service area for the group and as such is a self-contained unit capable of any operation in the complex chain from the initial recording, through the remix and editing stages to the subsequent master tape; thence the cutting of the master lacquer and the supply of copy master tapes not only for the cassette duplication plant but also to the many EMI overseas factories. Contrary to popular misconception Abbey Road has to be financially viable, and the valuable custom work enables the utilisation to be kept constantly high, thereby holding charges down to a level compatible with the independent competition.

One fundamental difference between Abbey Road and the majority of its rivals is that it forms the centre of a worldwide recording organisation. Wally Rand, based at Duke Street, in his capacity as Director of Overseas Technical Liaison co-ordinates the technical activities of studios and factories worldwide (Australia, New Zealand, United States, India, Pakistan, Hong Kong, Singapore, Nigeria, Argentine, Brazil, Mexico, West Germany, Sweden, South Africa, Japan, Spain, Italy, France, Holland and Greece).

In the past these areas tended to follow their own technical policies and in many instances were years behind the major centres in both equipment and techniques, with the nett result that discarded Abbey Road equipment could normally find a resting place overseas. Those days are now over as standards throughout the world have improved, and only a few outposts remain where the old equipment is acceptable, and this is invariably caused by crippling importation duty.

Anyone visiting Abbey Road will inevitably find at least one engineer at the studio from overseas, either on a training course or for technical discussions. The EmiNeve console is a direct result of very close liaison between Abbey Road, some of the major overseas studios and Rupert Neve & Co. Consoles of the same basic design but of sizes tailored for the location, are now installed in many areas of the world.

Provided one has a recording studio of suitable physical dimensions there are in my opinion three main ingredients essential in running a successful operation. First and foremost one must have the right equipment, secondly the right staff to operate that

equipment, and thirdly the right environmental atmosphere in which artists, engineers and producers can work harmoniously. Having the right equipment necessitates in the first instance the technical knowledge to either design or else select wisely from the various manufacturers, secondly the requisite skill to install not only ergonomically but also to very high technical standards; and thirdly and very important the technical back up staff to ensure that the equipment is constantly maintained and aligned correctly. One major difference between Abbey Road and the majority of other studios is the fact that a very wide range of recordings are undertaken from operatic to solo piano in the classical field and from shows, sing-a-longs, big bands to pop groups on the other side. Throw in a wide range of mobile recordings both at home and abroad and it will be instantly appreciated that the balance staff need to be highly specialised, and the engineer who can successfully cover the entire range is very rare. It has taken many years to build up the operational team as now exists.

The third point, that of atmosphere, can only be achieved with good staff relations and the realisation that everyone in the building plays an important role in the overall production. Every person must adopt a positive approach towards the ultimate aim, the production of a successful gramophone record. It is the combination of the first two ingredients, the equipment and the engineers, in association with producers and artists that has been responsible for the rapidly changing recording techniques, which



*The EmiNeve console, Olivia Newton-John and John Farrar in Control Room Three.*



in turn have resulted in the constant upgrading of equipment.

I joined EMI on a five year apprenticeship in 1950 direct from school, culminating in Abbey Road taking me on to their permanent staff. The days of wax were already over, and the *BTR* tape machine, a superb piece of engineering skill for its era, reigned supreme. My longest memory of Abbey Road is the question I was asked by George Corran, then chief engineer, at my interview: 'Now tell me, if you were being paid ten pounds a week, and you were offered an increase, which would be the greater, two pounds or 2 dB.' The first session I can recall was Peter Dawson's last session before moving to Australia, the recording of *On the Road to Mandalay* in Studio One.

In the early fifties the transfer of two major American labels to rival British Companies caused EMI immediate problems. The loss of artists, such as Guy Mitchell and Johnny Ray, meant that British talent had to be found to compete with their American counterparts, and also of great importance to Abbey Road, an attempt had to be made to match the definitely superior sound of the American records.

The equipment available at Abbey Road was very primitive compared with present standards and consisted basically of a four input mixing console known as the *RS 39*, normally fed by four EMI moving coil microphones, type *HBIC*, with an external field supply. These microphones were considered to be omni-directional apart from an internal rise of about 4 dB at 6 kHz in the forward direction of the diaphragm. I vividly recall one such set of equipment installed on the van, driven and cared for by the meticulous Harry Hands, being used at the SSAFA tattoo at the White City, where we used four ball and biscuit microphones, and also the annual expedition to Blackpool Tower to record Reginald Dixon at the Wurlitzer Organ. Harry would take two complete days to drive to Blackpool with an overnight stay at Lichfield. Although ribbon microphones were available at the studios, in particular the *RCA 44BX* (which incidentally later proved to be the best vocal microphone for Adam Faith), and also the EMI types *RM1B* and *RM1C*, they were used almost exclusively by the classical engineers. The pop boys found

them difficult to use in close proximity to dance bands, and their extremely low sensitivity also caused problems.

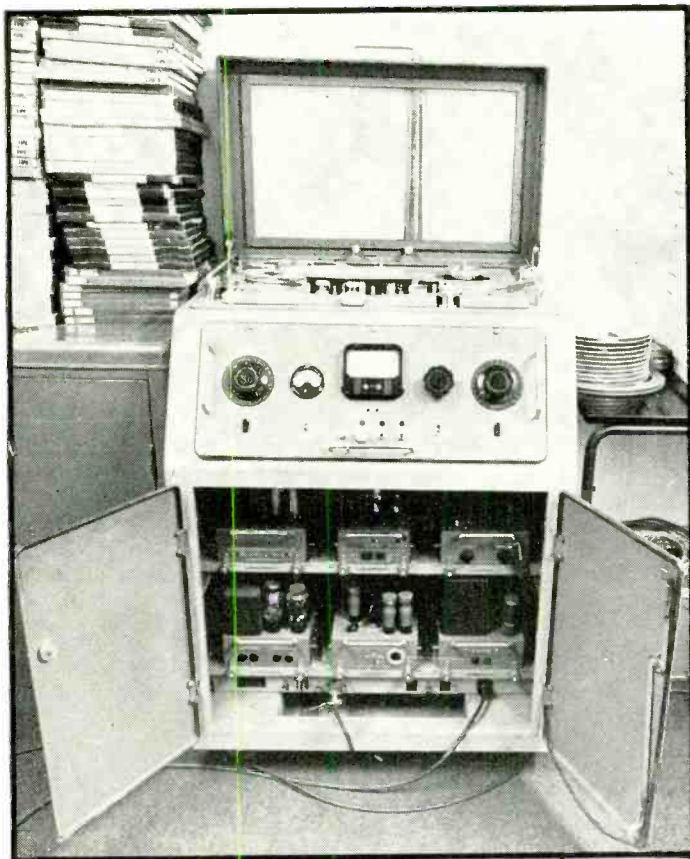
Significant changes took place in this era. Previously the balance engineers of the day, although possessing musical knowledge, had been trained primarily as toolmakers due to the skills required to maintain the 78 rpm wax cutting machines. The majority of these engineers were approaching retirement age, and with the rapidly changing technology from wax to tape, many were unable to adjust their techniques to the new medium. As a result two young engineers were promoted to pop balance, namely Stuart Eltham and Peter Bown. The injection of new blood had an almost immediate effect. They realised the necessity of new techniques and requested the manufacture of an eight input mono mixer, with echo sends from each channel, plus two echo returns, eq on each microphone channel, and plug in points for a limiter or compressor.

The studio in those days had its own manufacturing department on the top floor and this area was later to be extended and further cutting rooms built. Berth Jones designed the new equipment and it was to be built in 19 inch racks with each individual unit being given an RS number standing for Recording Studio. Thus the microphone amplifier became the *RS 61* known as X amp, the power amplifier for the loudspeaker the *RS 63* called the Z amp, the PLI unit the *RS 68* and so on. This equipment was built to exceptionally high standards, and the X amp had a gain of 40 dB  $\pm$  0.1 dB from 30 to 15k Hz, and a remarkably good stability due to very heavy negative feedback. The console type *RS 70* was the first equipment to be fitted with slider faders, all previously having had the rotary type. This console was unique at the time, and was truly the forerunner of the present day models.

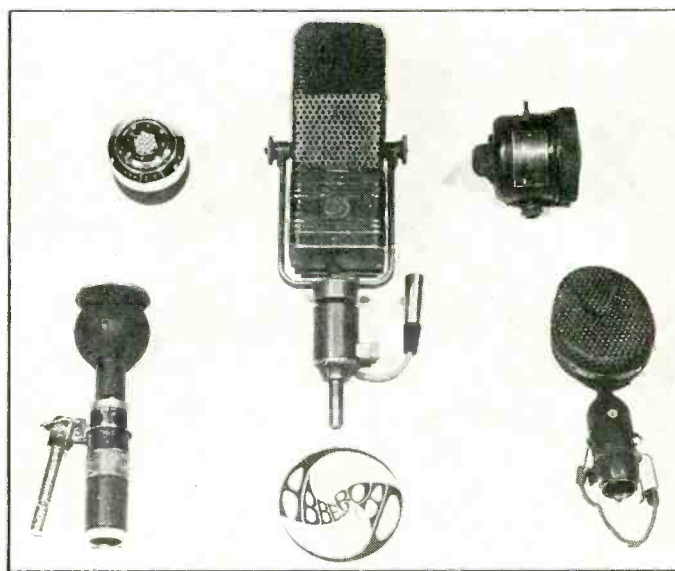
Jack points were provided by Ericsson plugs and sockets, not only for the insertion of ancillary apparatus but also for regular calibration. The pressure on studio time was far less than now, and so one period was booked in each studio and cutting room each week when regular gain runs were taken on every integral piece of equipment. Meanwhile Mike Batchelor, now the Chief Engineer at Abbey Road, was designing a limiter to be called the *RS 114*.

The vast majority of the recording undertaken at that time however was classical, due to the fact that not only was Studio Three used almost entirely for solo piano with many world-famous pianists, but Kingsway Hall was virtually in constant use, with EMI having a larger share than Decca; and also regular trips were made with mobile equipment to venues such as 'La Scala' Milan, Paris, Vienna, Holland and Spain. It would be foolish to attempt to list the world-famous classical artists who performed in Studios One and Three during this period but easier to list those who didn't.

As a result Abbey Road had a predominance of classical engineers. 'Chick' Fowler was about to become Studio Manager upon the retirement of W S Barrell; Bob Beckett was nearing the end of a distinguished career, and was soon to take over supervisory duties 26▶



The sole remaining BTR at Abbey Road, now relegated to banding in the tape library.



Some Abbey Road oldies.



## FROM MONO TO MULTITRACK

from Teddy Holmes, who well past retirement age would spend most of his time reminiscing about the Grand Old Days, when he had taken recording equipment to Russian Palaces. Duggie Larter was turning out exceptionally fine products every time he sat at the desk, particularly at Kingsway, and Harold Davidson was to do a few more years of recording before going on to transfer work. Thus the way had been made clear for Chris Parker, Bob Gooch and then Neville Boyling to join Francis Dillnutt and spearhead new ideas and techniques in the classical field also. Strange how in those days the classical musicians were referred to as the 'long haired brigade'.

Walter Legge, who needs no introduction, had his office at Abbey Road where Playback Room 41 stands now, while the pop a & r with Leonard Smith, Norman Newell and Wally Ridley had recently moved from the studios to Great Castle Street. Three more names were soon to be added, when Norrie Paramor and Ray Martin were taken on initially as conductor/arrangers and then George Martin recruited as assistant to Oscar Preuss. It seems ridiculous looking back to visualise George Martin turning up for sessions on a three-wheeler motor cycle and side car complete with all the gear. All three were soon to be Artist Managers, referred to now as producers, Norrie and Ray with Columbia and George with Parlophone, Wally Ridley of course being with HMV.

The jigsaw was slowly piecing together, and with Gus Cook having purchased in 1952 from FWO Bauch the very first Neumann condenser microphones to enter the country a new era of recording was just round the corner. The classical staff were the first to acknowledge the infinitely superior characteristics of these new microphones. The unbelievable cardioid polar diaphragms of the *M49* and *U47* enabled for the first time real separation to be obtained between different sections of the orchestra, with immediate benefits on sessions such as Cortot and Gieseking. The all round *M50* too was to be used by Laurie Bamber on the Sid Phillips band, but with the musicians providing their own internal balance clustered round one microphone; a method soon to vanish.

The trend of the 78 days on pop, had tended to favour the voice balanced well forward with the backing taking second place. Norrie Paramor had discovered a sweet young Irish singer called Ruby Murray, whose mother perhaps not trusting the engineers always came along with her; and Ray Martin had unearthed a fantastic

trumpet player called Eddie Calvert. The new *RS 114* limiter was used on Ruby's voice and Eddie's trumpet with remarkable effect, as neither the voice nor the trumpet were restricted by dynamic peaks. The result was an apparently louder record, permitting the backing to be brought further forward. These new mixing consoles were installed in all three studios at Abbey Road and in Kingsway Hall thus permitting multi-microphone techniques to become a reality.

A steady stream of No 1 hits came from Studio Two during this period and these were the days of well planned sessions, with frequently four titles being completed in the allocated three hour session—and no mixing necessary afterwards. Peter and Stuart also endeavoured to reduce the bathroom effect of Echo Chamber Two by placing a conglomeration of drain pipes and concrete slabs inside with such startling effect that the echo chamber became one of the studio's prize possessions.

Meanwhile in the 'Amp Room' Gwyn Stock, a young West Country engineer, was to start the 'gimmick box' craze with two delayed echo systems, using *BTR 2* tape machines, called *STEED* (Single Tape Echo and Echo Delay) and *FITE* (Fader Isolated Tape Echo). Years after they had been in almost constant use, Bill Livy, then Chief Engineer, discovered that they introduced impedance mis-matches in the echo send racks, but it was too late to change as they had become an established part of the system.

Overdubbing was achieved in the mid fifties by using two mono tape machines. People also enjoyed a good practical joke. One evening Ray Martin had recorded a number with his orchestra and asked to add the sound of water lapping against the seashore. The obvious method was to send the output from one machine through the mixer, add the sound effects and record the combined signal on the other, but without the use of headphones. Ray was to paddle around in a big metal bath himself and since he insisted on warm water we decided to get our own back. After the track had finished we removed the tape, switched off the gear, and left him paddling for what seemed hours. Eventually he appeared cursing and swearing from the studio to find the place deserted. He was last seen towing a metal bucket tied to the rear bumper of his brand new Jag.

The first experimental stereo sessions began in 1954 with Chris Parker, and Philip Vanderlyn from Research using two crossed ribbons (at £12 each) and then two *M49* matched pairs built into a special case with an insulating piece to prevent hum loops. Using simple equipment the Glyndebourne *Marriage of Figaro* was recorded using an *M49* crossed pair. By 1955 the first stereo sessions took place in Berlin with Stokowski, and by 1956 two sets of *REDD 1* stereo equipment became available, one for Abbey Road and one for Kingsway Hall, each having six inputs, for two crossed pairs and two mono injections. At Kingsway, Karajan recorded *Falstaff* and *Rosenkavalier*, recordings which have recently been re-issued.

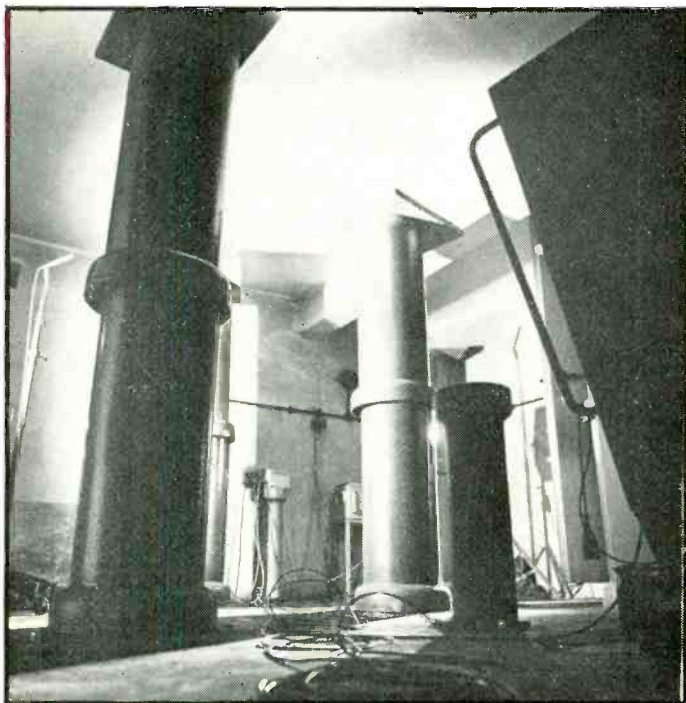
In 1958 a new mixing console arrived, the *REDD 17*, the combined efforts of Len Page and Peter Burkowitz in Cologne. This consisted basically of 10 inputs, two pairs of inputs being available for stereo microphones complete with sum and difference, spreaders and shufflers. This gear was flown to Paris to record the famous version of *Carmen* with Sir Thomas Beecham and then to Vienna for the Vienna Philharmonic Orchestra conducted by Sir Malcolm Sargent.

The pattern of techniques for classical recording had already been established, and only slight variations have been made up to the present time. When Alan Stagg became manager in 1967 for two years he also continued to balance some classical sessions. His method was simpler but nevertheless very effective using fewer microphones, although he was not in favour of the use of stereo pairs. The main objective is to reproduce as accurately as possible the sound in the concert hall or studio, whereas pop in many cases is a very contrived sound; therefore the two require entirely different acoustics—classical needs a fairly long reverberation time, and pop very short.

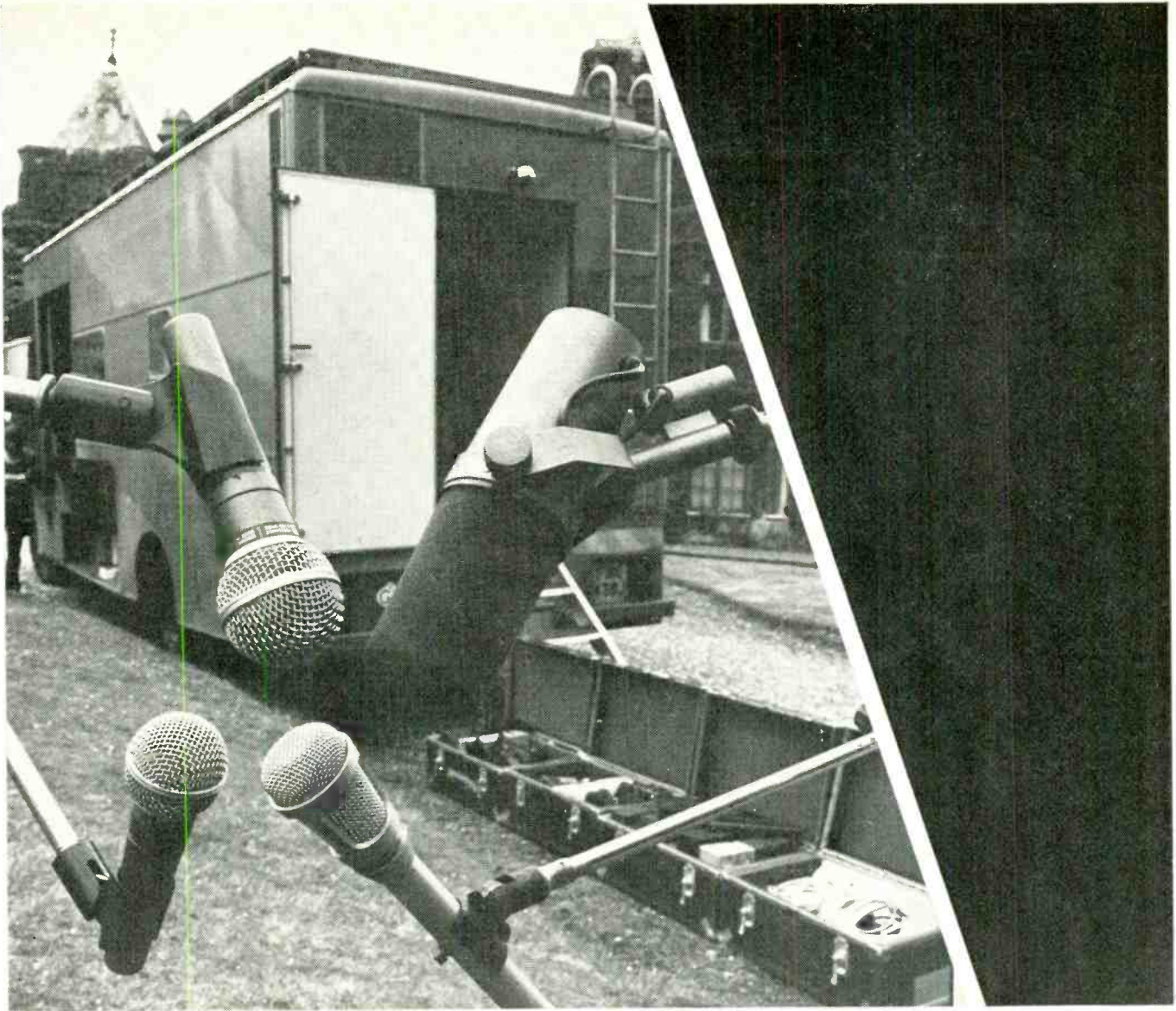
Over the years Studio One has seen a great deal of adjustment to the acoustic treatment. The maximum reverberation time is dependent on the volume, but the problem has always been to offset the effect of having large numbers of human beings in the studio, such as an orchestra of 100 and choir of 150, when the absorption dries up the reverb time at the mid and top end, leaving a 'knee' in the lower frequencies.

Dr Dutton of Research suggested a scheme of ambiophony in 1958, Dave Browning designed a series of magnetic delay drums, and

Echo Chamber Two.







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## FROM MONO TO MULTITRACK

Peter Dix, now the acoustic and loudspeaker authority at CRL, fitted a total of 100 loudspeakers symmetrically to the four walls. The idea was that the acoustics could be artificially tailored to any individual situation, by feeding different banks of speakers with signals delayed at differing intervals.

The system had only limited success, although one recording where it was used to good advantage was *Hansel and Gretel* with the Sadlers Wells Company. A notable feature of this recording was that it used the first noise reduction system, developed by Ted Trendell at Research, and known as Compansion. Unfortunately the system was premature, since the 'golden ears' detected on occasions slight degradation of the programme quality, due almost entirely to an over complicated alignment procedure. Also with a four track 25 mm tape format, tape noise was insignificant; this not being the case later on when Dolby's simpler system became virtually essential for multitrack. Various combinations of stereo microphones, all with very accurately matched elements, were, and still are, used on classical work. However it proved almost impossible to use stereo microphones and achieve an acceptable balance without the addition of spaced and spot microphones.

Although each classical engineer has developed his own technique, they differ only slightly from each other by virtue of preference of particular microphone types, by variation of microphone placing and their proximity to the orchestra, and by the use of ambience microphones. This latter point has become more essential as EMI now issue the majority of new classical records in stereo/quadrasonic format. This has meant that we have now standardised on eight track for classical recording, although 16 track and 24 track are available, with two tracks normally allocated to ambience and placed on the rear channels of the SQ product. This is not always the case, as occasionally on recordings such as the Berlioz *Requiem* by Louis Fremaux with the CBSO, the trumpets can be heard from the rear right loudspeaker. Abbey Road was the first studio to employ tape editors solely for that function. David Bell now edits the eight track to produce the master tape prior to remixing. The four editing rooms and the listening rooms are thus equipped with eight track Studer A80 replay machines together with quadrasonic monitoring facilities.

In order not to affect the 'bread and butter' mono product the early days of experimental pop stereo had complete duplication of microphones and were balanced in a remote stereo control room. Valuable experience was thus gained, although session changeover

periods were extremely hectic. Victor Sylvester's Ballroom Dance Orchestra was one of the first to get the double treatment. One crossed 49 pair was used on the two pianos with centre injection for bass, drums and accordion, and a second stereo pair in cross figure-of-eight on front melody line with sax and clarinet at rear of microphone, and solo muted violin on the front. Due to the low volume of the violin it was necessary for Oscar Grasso to play within 15 cm of the stereo microphone and as he always swayed slightly when concentrating on playing, the results in the control room were quite startling with rapid movements of the violin in the stereo picture.

The next sessions were with the Joe Loss Band. One stereo pair on brass with another on saxophones, and centre injection on piano, bass, drums and guitar gave immediate problems with the violent level differences of open and muted brass, and the one microphone used for the rhythm section proving inadequate. It became immediately obvious that stereo pairs for pop work were impracticable, although for classical they were a very useful tool. The next stage was to provide additional four way pre-mix boxes on each of left, right and centre injections, with very satisfactory results.

The volume of pop work continued to increase, eventually ousting classical from Studio Three. With only two pop engineers the burden was eased with the acquisition of Malcolm Addey, in 1958, who introduced new techniques, most notably the close mixing of individual drums, including a #38 ribbon only 15 cm from the snare. Malcolm was the originator of the expression—'if you can't make it good—make it loud'. His technique was very professional, and by careful planning, accurate placing of microphones, and setting of the attenuators and tone controls to pre-determined positions he achieved an excellent balance on the very first take.

On an audience live session in Studio Two, Norrie Paramor was to introduce a new artist, and his words still echo in my memory, 'and now I would like to introduce a young man whom I feel sure you will hear a lot of in the future—Cliff Richard'. Two of his original group called the Drifters, are still part of the Shadows as they were renamed, Hank B. Marvin and Bruce Welch. Cliff and the Shadows were to make many great hits, always at Abbey Road, and Bruce recently produced Cliff's latest album *I'm Nearly Famous*.

This article would be incomplete without reference to Norman Newell. The list of artists with whom he has been associated at Abbey Road, nearly always using the very experienced Peter Bown as engineer, makes incredible reading. To name just a few, consider: Paul Anka, Moira Anderson, Julie Andrews, Dirk Bogarde, Shirley Bassey, Beverley Sisters, Sean Connery, Russ Conway, Billy Cotton, Noel Coward, Marlene Dietrich, Ken Dodd, Gerry Dorsey (later known as Englebert Humperdinck), Bette Davis, Yvonne de Carlo, Gracie Fields, Bruce Forsyth, Bud Flanagan, Dolores Gray, Frankie Howerd, Laurence Harvey, Stanley Holloway, Sid James, Van Johnson, Howard Keel, Eartha Kitt, Vanessa Lee, Vera Lynn, Geoff Love, Cleo Laine, Danny la Rue, Bob Monkhouse, Johnny Mathis, Mrs Mills, Nina and Frederick, Des O'Connor, Donald Peers, Beryl Reid, Paul Robeson, Dorothy Squires, Tommy Steele, Mel Tormé, Barbara Windsor, Danny Williams, Norman Wisdom and Jimmy Young.

Wally Ridley also has been responsible over the years for producing a great number of very commercial recordings at Abbey Road in his own inimitable way. For example: The Black and White Minstrels, Joe Loss, George Melachrino, Alma Cogan, Ronnie Hilton, Morecambe and Wise and Andy Stewart. In recent years Wally has worked almost exclusively with that very fine engineer Peter Vince and together they regularly confound the critics by getting something very different to the No 1 spot in the charts—remember Benny Hill with *Ernie* and more recently Don Estelle and Windsor Davies with *Whispering Grass*.

Despite the thousands of recordings that have been made at Abbey Road during the past 45 years it has been made famous by the activities of one particular group, and they in turn made producer George Martin a household name all over the world. George, prior to the Beatles had not really indulged in the world of pop groups, specialising in a very wide variety of recordings. Apart from the fine orchestra of Ron Goodwin, the jazz of Johnny Dankworth and Humphrey Lyttelton, and the voice of Matt Munro, George was very keen on unusual recordings. A big hit, with Peter Sellers and Sophia Loren, was *Goodness Gracious Me*

A view of Studio One that indicates the size, layout and ambiphony speaker arrangement. The session is 'Don Giovanni' with Otto Klemperer.







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## FROM MONO TO MULTITRACK

and recordings with Spike Milligan, Bernard Cribbins and location recordings of *At the Drop of a Hat* and *At the Drop of Another Hat* with that wonderful duo of Michael Flanders and Donald Swann were more in his style.

Stuart Eltham and myself were working with George in Cambridge, recording Alan Bennett, Peter Cook, Dudley Moore and Jonathan Miller in *Beyond the Fringe* when news reached George of his very first number one hit—The Temperance Seven with *You're Driving Me Crazy*. EMI already had one pop group on their label, Cliff Richard and the Shadows, and the general consensus of opinion was that one pop group was enough, but nevertheless scores of hopefuls turned up at Abbey Road each week for artists' tests. The standard was abysmal, and the quality of their equipment even worse.

Nobody, therefore, was very keen to work on a commercial test for George Martin from seven to nine pm on a nice summer's evening on June 6, 1962. Norman Smith had agreed to balance the test, and the team was made up of 'button pusher' Chris Neal and myself. Although we always used a two man team on mobiles, back at base there was rather more rigid demarcation, with the tape operator doing nothing else but press the buttons and write down details on the tape box; a system that we have now abolished.

There was something obviously very different about the four young lads from Liverpool who turned up for the test that night. But there was the usual problem with lousy equipment,

*The Beatles with tape-op, Richard Langham on the 'Please Please Me' album.*



*The Beatles in Studio Two with George Martin and the unfortunate Mal Evans.*



and the young bass guitar player in particular produced a sound not very congenial to good recording. George asked if I could do something to improve the bass otherwise he would have to call the session off. Fortunately that night, there was no demand for Echo Chamber One, right down in the basement of the old house. Norman and myself carried the very large Tannoy from the chamber through to Studio Two, and then I soldered a jack socket on to the input stage of a Leak *TL12* amplifier. Paul tried it and we were back in business. Two numbers were recorded for the test that night—*Love Me Do* and *Ask Me Why* and at the end of the session, which incidentally finished early, George explained over the talkback the differences between performing live and recording in a studio. Back in the 'box' George pointed out the advantage of singing on the front and back of the *U48* microphone, with the polar set to figure-of-eight, and asked if anyone had any questions. 'Yes,' replied Paul McCartney, 'where did you get that tie?' The Beatles had arrived!

It was nearly three months later, September 4, 1962, to be precise, that they returned to make their first actual recordings of *How Do You Do* and *Love Me Do*. Incidentally drummer Ringo Starr had not featured on the test recording, Pete Best being their original drummer.

The Beatles more than anyone were to change the art of pop recording. Although their initial recordings were very simple, using two track techniques with voices on one track and backing on the other, they soon got into the four track scene and with their fantastic success already assured, they began to revolutionise recording by arriving at the studios relatively unrehearsed, and using the studio as a workshop, with an open-ended time scale. With time being of no object this enabled every conceivable type of technical innovation to be dreamt up, as they continually strove for something different. They started, too, a new technique—double tracking vocals. Driving home down the Western Avenue, at five thirty one morning, I felt that double tracking had been quite time consuming that night. The idea came to me of using the sync head of the four track machine, with a suitable time delay, to add to the replay head signal on remix; after all the signal coming from the replay head had already traversed the sync head about 100 ms earlier in the case of a *J37*, and 200 ms in the case of an *M10*. We had already wired out the synchronous motor of some BTR tape machines for variable speed operation, and had built a rather cumbersome trolley with power amplifiers to drive it for previous Beatles' 'effects'.

I was back at the studio by lunchtime, and experimented on a 'Cilla Black' tape. The effect was startling and by use of a crystal oscillator on the *BTR 2* tape machine, the second voice could be spaced at any required time interval either side of the original. Every gimmick at Abbey Road had to be given a name so I called this one ADT, standing for Artificial Double Tracking and not Automatic Double Tracking as it is now frequently called. The Beatles were immediately impressed with this new toy, and for ages it was used on all sorts of instruments, as well as voice, John Lennon always referring to it as Ken's Flanger.

Norman Smith moved on to Manchester Square as a producer, and later as the renowned Hurricane Smith, so the young Geoff Emerick took his place as Beatles balance man. Geoff had amazing hearing and could pick out minor blemishes even when the monitoring was approaching the threshold of pain, and he was soon to engineer what I consider to be one the greatest pop recordings of all time, *Sergeant Pepper*.

This recording was achieved by using only four track machines and remixing from four to two, not by bump tracking, but by using two *J37s*. Although strictly speaking this was still four track, it was not really, and for the very last track on the album, *A day in the life*, George Martin asked me if I could link two four track machines together in sync. This I did by recording a 50 Hz tone on one track of the first machine and, using this suitably amplified, to drive the second machine.

Although the method worked, one problem was to get the second machine to start at the right time at the remix stage. Thus it offered a minimum of seven tracks, and the need for more was already obvious; so eight, then 16 and then 24 track followed in quick succession.

Geoff Emerick moved on to 'Apple', and so Ken Scott was engineer on the latter Beatles' sessions before they unfortunately





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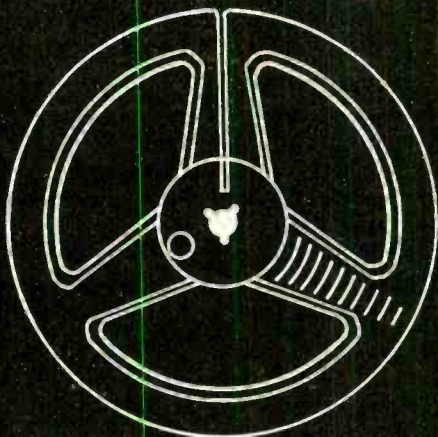
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## FROM MONO TO MULTITRACK

split up. Although eight track was the maximum ever used on a Beatles' session, each Beatle used 16 track at Abbey Road subsequently. For example, George Harrison used 16 track in Studio Three for that great classic *My Sweet Lord* with Phillip McDonald as engineer.

The eight Studer J37 machines proved to be exceptionally reliable, but when in 1967 an eight track machine was required the A80 was not as yet available. Frances Thompson, a leading authority on tape machines, put various makes through his analysis in the workshop next to the tape library. Eventually the 3M was chosen but various modifications were necessary before it was put into operational use to enable the existing facilities to be maintained. The output from the sync head combined with the output from the replay head had long been used for ADT and later on for 'phasing', but the 3M only had an alternative output position. There was also no sync mixing on the machine, no facility for running the capstan motor from frequency control, and no timing clock.

The modifications were completed and it was installed together with the first EMI 24 input eight track console type TG12345 in May 1968. Many hours of good service were given by three such tape machines before they were eventually superseded by the Studer A80s which then became the backbone at Abbey Road for 16 track, and now 24 track.

The success of the Beatles really opened the floodgates for others to follow and ride the bandwagon. As a result the demand for studio time exceeded that available so new independent studios began to mushroom in London, and in order to attract custom began offering facilities in excess of the 'majors' who had been slow to reinvest their profits back at source, namely the studio.

The days of the 'house producer' also became numbered, as producers sought fame and fortune independently. This in turn led to another breed, the engineer/producer, who has the advantage of fully understanding the engineering complexities of multitrack.

Alan Parsons, an Abbey Road thoroughbred is a prime example. Having engineered *Dark Side of the Moon* with Pink Floyd, and been nominated for a Grammy award, he turned his undoubted talents to production, gaining immediate success with two consecutive No 1 records last year: *January* with Pilot and *Make Me Smile* with Steve Harley and Cockney Rebel. Recently he engineered and produced the successful recording *Music* by John Miles. This highlights the present state of the studio world when one considers that not only was it recorded and remixed in Studio Three on 24 track, but was also cut by Chris Blair in Room 24, and yet appears on the 'Decca' label. The opposite, of course, also applies with EMI artists recording at other studios

besides Abbey Road. The Hollies too, once on EMI with producer Ron Richards but now with 'Polydor', have remained loyal to Abbey Road; while recently John Kurlander apart from engineering for several well known EMI artists such as the Kings Singers and Ken Dodd has also recorded both Renaissance and Henry Mancini for RCA in Studio One.

Tony Clark, who balances all Cliff Richard's and the Shadows' records, works a lot with producer John Farrar, with in particular Olivia Newton-John, whose recordings made at Abbey Road met with amazing success in the States. Peter Vince, too, fills the dual role of engineer/producer with the Spinners, and John Leckie with Bebop De Luxe.

Bob Barratt meanwhile has remained together with Wally Ridley, as a house producer and recently gained a No 1 album success with Max Boyce, recorded live with the Abbey Road mobile at Pontardulais and titled *We All Had Doctors Papers*, only a few weeks after Pink Floyd's *Wish You Were Here* recorded on 24 track in Studio Three had reached the same elevated position. Bob's latest No 1 hit, with Tony Clark as engineer, was *I've Got a Brand New Combine Harvester* with the Wurzels. This gave me great personal satisfaction as I shall always remember the day spent touring the pubs of Somerset with Aage Cutler to find a suitable location for the Wurzel's first recording—performed live at the Royal Oak, Nailsea.

The international classical division (ICD) based at Blandford Street also have an excellent production team and under the expert eye of manager Peter Andry, senior producer Christopher Bishop, Suvi Raj Grubb, John Mardler, David Mottley and John Willan the continued involvement of Abbey Road with the world's finest classical artists is assured.

Where do we go from here? Only time will tell. One thing is certain, the days of studios making vast profits are over, and there will almost certainly be a standardisation of 24 track as the 'norm' for pop recording which for modern techniques is essential. Allied to this is the potential of computerised mixdown, and I am pinning great faith on Necam, to be installed in Studio Three later this year.

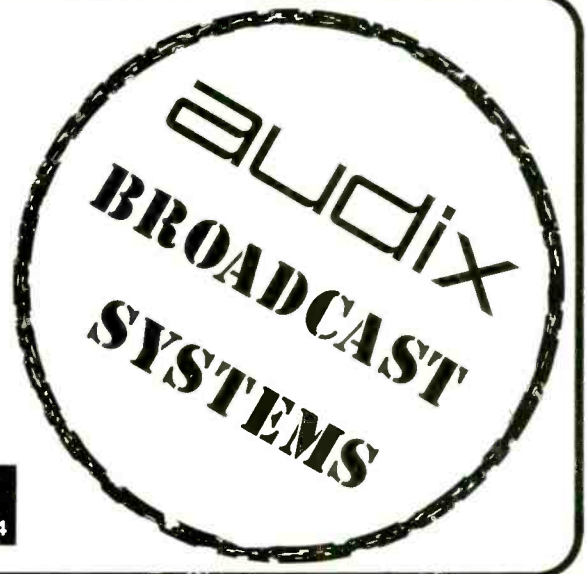
Provided 24 tracks are sensibly used the necessity for 32 is dubious and I hope that the first studio to go 32 track also goes broke. I am all for progress, provided the end product is superior. It must be remembered that the software is issued on two track, and that the intermediate stages purely act as a catalyst. Sometimes it pays to look backwards and learn from the past, so if we listen to some of Duggie Larter's marvellous recordings of the late fifties recorded straight stereo, and also listen to the Beatles' *Sergeant Pepper* recorded four track, one is left with a big question mark.

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# Studio Consultants

**JOHN DWYER**

*Building or altering a studio has become a very expensive business where success can be the responsibility of the client as much as the designer.*

**M**ost of you will at one time or another have been involved in building a studio, and if you haven't there's no doubt one day you will. The problems are endless, because you have to deal most of the time with disciplines and trades you know nothing about. It is clearly one thing to know what speakers you would want in your ideal studio, what desk, amps, tape machines and noise reduction systems and so on; you may even

*Eddie Veale*



know what 'sound' you want in the studio and in the mixing room, but it is equally clearly quite another thing to be able to supply the fabric in and on which these items have to be hung, stood or heard.

This article started as a study of those who were prepared to take on the whole job from start to finish. It has ended rather different from that. The reasons are that so few are prepared to take on the work, and that those who are seemed unwilling to answer our questions. One studio builder thought this was because many of those I had listed were not independent consultants at all, but tied in with hardware manufacturers, something I was particularly interested in. Another reason is that although there are many difficulties that the putative studio occupant has to face, most of them come back to acoustics, and acoustic consultants are plentiful. We compromised by contacting some of the best known consultants in and around the studio design field, and another half dozen of their victims.

I say 'victims' because there are some disillusioned people around the recording world. One old acquaintance said: 'You're on to a winner here; it's about time someone wrote something about this.' Others, however, expressed a different view. John Iles of Chappell Studios said he had no complaints at all about the way Sandy Brown and Associates had done their Studio Two. 'It was done at very short notice . . . and it was finished ahead of schedule. It took about two weeks. They were doing it at night as well. We said they could work from 11 pm onwards but inevitably some sessions in the other studio overran even then. I would certainly recommend Sandy Brown.' He thought consultants were as effective as the amount of money you were willing to pay.

A major complaint when things go less well than they seem to have done at Chappell is the amount of time the work seems to take. One studio told me: 'There's been a lot of messing about, and we've spent two months re-doing the work. That's six months altogether—it seems to be stretching out.'

Even then the result may not be what is wanted: 'I walked into the room and it wasn't right. It wasn't a matter of measuring the room—you can feel when a room isn't right as soon as you walk into it—it's a matter of experience. We took a measurement and the measurements confirmed what I thought . . . We've got a reduction in fees for the fact that it was wrong but that doesn't allow for the time the studio isn't working.'

One studio in London's West End has been building a second studio now for a year, and the work will take another two months at least, according to the studio manager. 'The shell took about three months and we had a lot of trouble with planning permission. Everything since then has been a proving period. There were various tests, then the sound treatment went up and then there were more tests, and then the decorative finishes on top of that. The electronics have to be put in yet . . . It's the planning of the thing that seems to take the time.'

Acoustics is a special subject which I will deal with in a moment, but why is it that building a studio can take as long as a year when Westlake studios, for example, seem to go up in a matter of a couple or so months? One reason must be money. Ken Shearer told me that he thought the average amount of money needed to build the average studio, 'too big for a group, too small for an orchestra', a control room and a small vocal and overdub booth would be about £100 000. That covered lighting and air conditioning but no electronics. Many studios don't have that kind of money and so corners have to be cut, the planning takes that much longer, and getting the final sound right is lengthened too. Equally important is that studio engineers think in terms of acoustic treatment, monitoring and electronics. There are a lot more things to do than that.

Just how many more was explained by Piers Ford Crush of Eden Studios. Eden had been forced to move by a compulsory



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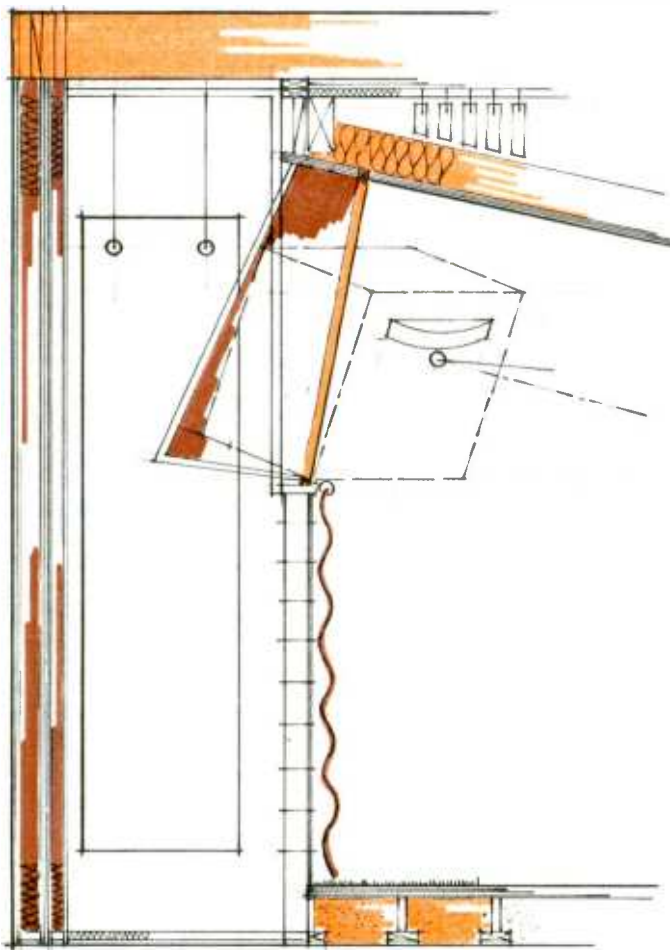
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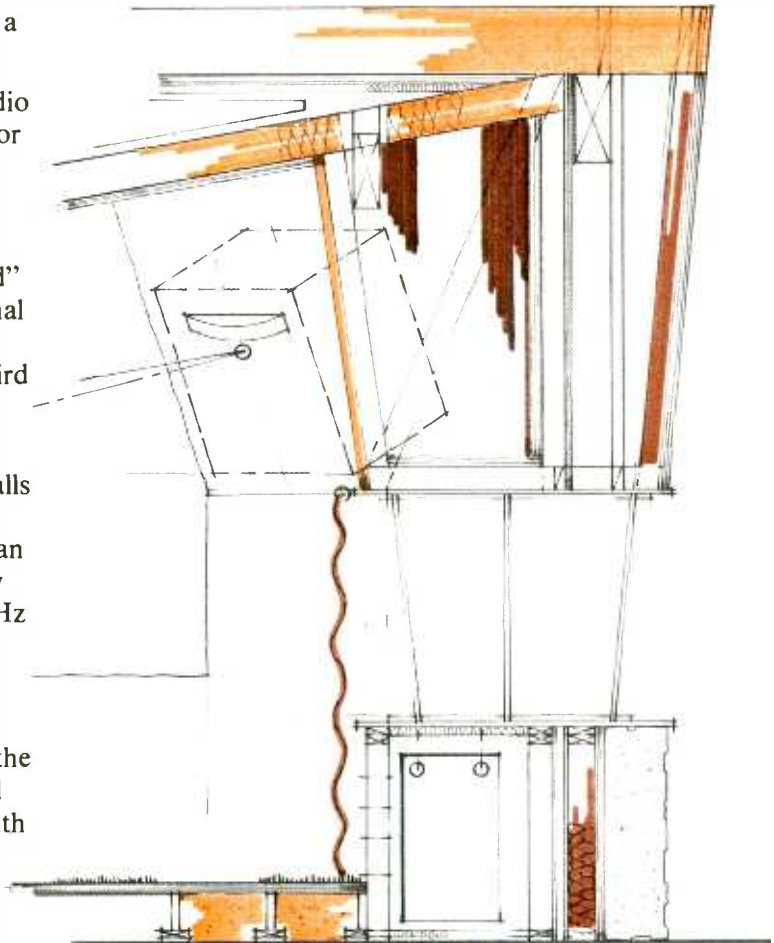
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purchase order and had to find new premises in which they could start again from scratch: 'There were an awful lot of people involved, not just the acoustics. There's the architect, the builder, who also does some of the plumbing and so on, the electrical people, the finishes have to be done and there are electronics and air conditioning that have to be put in.' Ken Shearer, who did the acoustics, recommended an architect to them, as well as a quantity surveyor and air conditioning contractors, 'but it was our decision to appoint them'.

Eden held a site meeting with all those involved: 'We told them how much we could spend, and they all laughed.' Ford Crush says that they saved themselves an awful lot of money by being on site and watching over all the work themselves. 'We were in complete control over all those people; we were responsible if they had been on the fiddle. Any extra expenses would be our problem. It was up to us, and we would carry the can.' He said he had found the prospect rather daunting. 'It's not easy. Anyone who says it is is fooling somebody.' He thought that the idea of putting the whole project into the hands of someone who is used to building studios and tying all the loose ends together was a very good one.

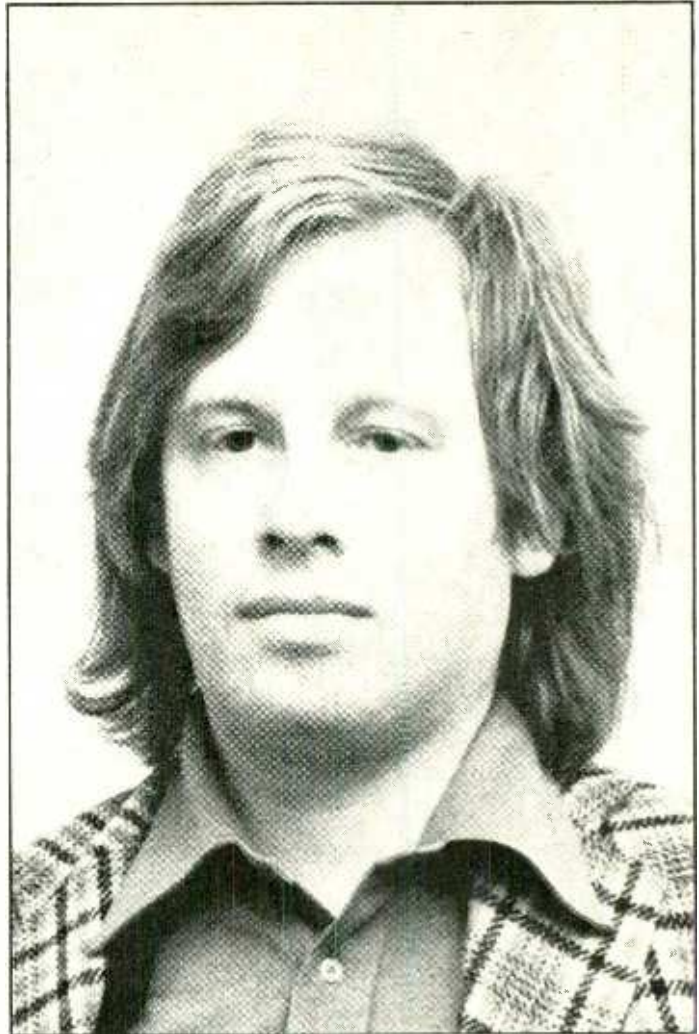
Such a man is likely to be expensive, but various consultants, basically acousticians, will take on the work if asked. 'You mean a project engineer?' said Ken Shearer. 'Preferably you need an air conditioning, mechanical and electrical consultant all in one piece who's done at least two studios before and worked with the architect before at least once. You also need a building contractor who's done a studio before. I have a consortium of such people but I don't think of it as such. I can suggest a nominated contractor and a quantity surveyor who is there to see that the builder does what he's there to do, to see fair play.'

But if Eden can manage without a project engineer surely others can. I asked consultant Eddie Veale why people should go to him rather than do the job themselves: 'Using a consultant will cost them more money at the front end but it relieves them of the responsibilities of problems that may be encountered. The benefits of using somebody such as ourselves or one of our contemporaries is that they trade off the responsibilities and problems in exchange for money. They are employing somebody that should have the expertise in knowing the piece of machinery, console or whatever, know about its peculiarities, know how it behaves when it's connected to other equipment, what sort of noise problems, hum problems and other things can be encountered, and how to cure them.' In addition there were, he said, differences in expertise between designing equipment and using it, just as the man who drove a car wouldn't be expected to know how to build one.

Tom Hidley, now heading the European Eastlake operation, said he thought it was perhaps a high initial outlay to have a studio built throughout by the same people 'but it's cheaper in the end to build it once and finish with it'. Hidley claims his Westlake company was the first to design and build studios from building to electronics. 'Now there are about a dozen of them.' Hidley supplies a construction foreman who engages and supervises local crews of builders. Eastlake even put up curtains and lay carpets, as well as install electrical fittings, lighting, audio wiring and monitoring.

The Westlake monitor was one of the things which Hidley claims was an important part of Westlake's success, but if the client requires he will install some other form of monitoring. Also 'We can supply desks or tape machines if asked to do more than design, construction and monitoring. Some may ask for more than those things and I feel free to suggest what I would do if I were in that position'. He explained that the 100 studios he had built contained desks, tape machines and monitors of all kinds, and he always supplied what the client wanted. 'In Milan we put in a Cadac, in Finland an API, in Montreux a Neve console.' In addition, he said, his agents in the various countries were not hardware dealers in the sense that they handled tape machines or consoles. This wasn't necessarily true of the Westlake operation in the States.

One of the most important things about a consultant is that he should be what he seems. Advice can be obtained free from a lot of sources that is just as good as the paid for kind you get from the consultant, but the reason he's getting his fee is because he is telling you what is best for you and not what is best for



David Binns

himself. He doesn't, or shouldn't, have anything to sell. David Binns of Sandy Brown Associates told me that many of the professional organisations to which the members of his consultancy belonged were forbidden to sell anything to the client: 'He may specify to the client what is needed but the client must get it himself. We are not allowed to make a profit from the sale of goods to a client. We must in all cases act as management consultants and give advice only.'

Sandy Brown operate mostly as an architectural and mechanical engineering facility: 'We have provided equipment but clients usually have a good idea of what they want. We tend to distrust someone who wants a package because the engineer is the key factor in the whole thing and usually a good engineer tends to know already what he wants because he's had experience and he knows what kind of equipment he's used to. Even someone who wants to build a studio without knowing much about it will have enough sense to hire a good engineer first.' Overseas work, he admitted, tended to be more packaged because there was less locally available expertise. In common with Eddie Veale, Pye TVT and others, SBA will recruit and train staff.

Although an independent consultant shouldn't have anything to sell it is sometimes possible to obtain great help from people who do. A firm which supplies custom built equipment, for example, may have a wealth of experience they can share. Pye TVT recently launched a range of packaged radio stations varying from small mobile studios to large network broadcasting headquarters. Although they are selling a range of different packages each one can be varied to suit the needs of each customer, Pye said, and advice can be given on what each customer might need and could afford for given sums.

Pye have chosen the packaged approach because they want to move into the expanding foreign, third world radio and tv

## STUDIO CONSULTANTS

origination market. They feel, in any case, that the UK broadcast market is unlikely to provide much business for them. The equipment Pye use in their studios is that which they make and supply to client's requirements, and no-one could be under any contrary impression when they call Pye in. What they are offering is supply plus advice, and this should be available no matter from whom the equipment is bought.

Richard Swettenham Associates is a consultancy run by the founder of Helios Electronics. Swettenham, one of the most respected figures in professional sound engineering, began his career at EMI studios, then became the chief engineer for Argo Records before going to Olympic. He left in 1969 to found Helios. In his view, it was best for a consultant to be independent: 'When I came out of working in studios consultancy was the thing that I really wanted to do, but unfortunately not having a year's salary in hand I thought we'd better build some hardware to give us our bread and butter at the same time.' Helios took in so much business, he said, that it took up all his time: 'It's only recently that I'm really able to get back to doing what I always wanted to do, which is having a hand in getting studios together for people.'

'Now the ethical side of it as between having a hardware company and being a consultant on the face of it appears to have certain difficulties, but I think if one is absolutely straight with clients from the outset they needn't have any worries in their minds.' He made it clear, he said, that he was also part of Helios and that they needn't buy Helios equipment if they didn't want to. He added, though, that his normal basis of charging when he was asked to advise on equipment was a flat percentage of the value of the equipment bought, but that equipment bought from Helios is omitted in the reckoning up of that fee. Clients could also take advantage of Helios's ability to obtain discounts from some suppliers.

As to the kind of client he preferred, Dick Swettenham made a comment echoed by most of the consultants: 'From the equipment planning point of view what I want him to say is what kind of work he hopes to get into his studio. People who say "We want the best, no short cuts"—this is not a very helpful thing to say because you then write out a budget and they fall flat on their backs. One then has to say "How much have you got?" and start again, with another sheet of paper. It's much better that they set limits, that they declare what they would like to do and they set limits to what money there is and then you know what frame of reference you're in.' Most difficulties arose, he said, when one was dealing with a lay client who hadn't yet hired an engineer. If the work went ahead the new engineer,

*Dick Swettenham*



when he did arrive, might be horrified by what had been specified and a curious and unpleasant triangle develops between client, consultant and engineer.

Another idea sometimes used by companies and organisations much smaller than Pye TVT is that of the consortium. Here a group of manufacturers, suppliers or consultants, or a mixture of all three, co-operate in giving their clients a range of advice and services that they could not provide individually.

Cranbourne Associates (Electronics) Ltd, for example, is less a consultancy service than a consortium of five suppliers of different kinds of skills and equipment.

They emphasise that what the customer eventually gets is the result of long and detailed discussions about the systems design and the money the customer can afford: 'You can say to them "You could cut corners here and here"', Richard Harris told me, 'and you can supply them either with all the facilities at a slightly lower quality or with fewer facilities at slightly better quality.' He also emphasised that Cranbourne would not feel bound to supply equipment made, for example, by Mike Beville of Audio & Design. Beville is one of the five members of Cranbourne Associates. In any case, Beville said, 'We prefer to have a pure consultancy job rather than putting together expensive pieces of equipment'.

Cranbourne has only been running since September last year so it's early to judge how successful the venture is. Their work so far has included the design and building of a training studio for International Computers Ltd, which was a turnkey operation involving construction, acoustics, air conditioning, electrics and furniture. Harris volunteered the information that here they did, in fact, use Audio & Design limiters.

Cranbourne say clients would be told all about the company to start with, about who the members of the company were and what other interests they had, although Cranbourne's brochure mentions nothing about these interests. Other consortia might be less scrupulous and it's important to find out the backgrounds of prospective advisers before you commit them to spending your money. If the company is a limited company you can find out their other directorships from Companies House, but if it's a partnership the information will be more difficult to find. I'll say more about weighing up the reliability of consultants later on.

### 'the learning curve'

But no matter how well-intentioned the consultant may be, however free from the inclination to plug someone's product, sometimes things do go wrong. There are several reasons for this. One of the most important is what the architects, builders and other cognoscenti call 'the learning curve'. Ken Shearer gave it the same name as you and I would: the balls-up. It's unfortunately as true of building a studio as it is of anything else that the less experience a chap has in a particular job the more likely he is to make mistakes. Tom Hidley was refreshingly honest about this: 'At the beginning I had a seat-of-the-pants practical approach', he said. 'I started at a very very low level with low education and what I had to learn has been learnt the hard way, trial and error, and this has been the story of my life, really.'

Hidley is being a little modest. To begin with he was a professional musician at 16 years old: 'Music was all I knew and all I cared about', he said, and added that only poor health made him give it up. Then he spent six years with a firm that made tape machines, three years with JBL, during which time he also did some mobile recording, then he was head of maintenance at MGM's recording studios after which he did remixing for TTG in California. It was after this that he worked for Kellgrun and Stone's Record Plant, building their first studio in LA, the second in New York, and studios for MGM and Warner Brothers before founding Westlake Audio.

Hidley told me that the development of the control rooms, like that of the drum cages, had been a long hard task. 'There've been a lot of mistakes on the way. You can go up for two or three rooms that have been complete successes and then you fall backwards on the next room because you've tried something you shouldn't have. Then it's time to pick up where you left off and try something else and that's the way it has developed. We have had some good rooms and some fair ones, and some people would say we've had some lousy rooms. They have all been measured, they have all been charted. We have seen their



If by some odd thing going wrong you make fools of yourselves, whether in front of the press or in front of your first client, it takes the devil of a time to live that down, whereas if you play it softly-softly and let the *word* get around—especially among the session men—then a good deal of your PR work is already done for you at no cost at all.’

He understood why people got into such a jam. Usually it was because, with the terms on which they had borrowed their money, they had to get the cash coming in by a certain date. ‘The prudent person doesn’t borrow the maximum on terms that he can only just meet if everything goes right. There are some people that I’m dealing with at the moment abroad who say, “Yes, everything is fine but we will not start until we have got underwritten 20 per cent more than the budget figure”, and I think that’s a very wise move.’

Tom Hidley had a comparable view to Swettenham’s about agreeing terms before the work started and offered this advice to someone thinking of taking on a consultant: ‘Have him put what he’s going to do in writing and make it a legally binding document. If he won’t sign it he’s not sure of himself and if he’s not sure of himself he has no right to the client’s money.’

Hidley, of course, shows what in some quarters is regarded as sufficient lack of taste to supply a written guarantee of his work. The terms of the guarantee are familiar to those who have read the colour adverts but other consultants were sceptical about its value. David Binns, for example, thought many of its clauses had no real bearing on the performance of a studio: ‘Some of the parameters in the guarantee are irrelevant; for example, he quotes separation at a particular frequency.’ This told you nothing about what was happening at other frequencies, he said. In addition, he said that Hidley was merely doing a skillful marketing exercise with already established techniques: ‘We can do a drum trap, for instance, that takes up far less space than his. It uses 18 inches of material as opposed to his three feet or so of blankets.’ The approach, he said, was conventional. Shearer agreed that much of Hidley’s approach was conventional. ‘I think the guarantee means something but it’s very difficult to prove or disprove. How do you measure it? Steady tone is very different from a transient of the kind you’re likely to get from a rim shot or a bass drum.’

Swettenham said: ‘This guarantee works within his precisely defined limits. He guarantees certain things, that the sound level and perceived frequency response will not vary over a certain area and things like this, but this isn’t a guarantee that it’s going to sound nice in the view of the studio owner or the producers that get in there.’

#### ‘ . . . approaches to acoustic design . . . ’

There do seem to be certain respects in which Tom Hidley has changed the approach to room design. He does not believe that diaphragmatic absorbers provide adequate acoustic treatment. There can be little doubt that sound levels have increased many times over in the past few years and that the increased use of multitrack in the same period has changed the criteria by which the success of studios must be judged. Better isolation and separation are needed, and engineers are a lot more critical of studio acoustics than they used to be. Hidley was in on the changes at the start: ‘We at TTG had a 16 track two inch machine running a year before they became commercially available’, he said. He and others at the studio had built it themselves. In addition, he says, he learned a lot from working on Frank Zappa’s first album. The levels used were very high. ‘It opened up a lot of thinking. I wondered why I wasn’t hearing it the way it was when I used to sit in the section as a horn player.’

His conclusions were that instead of trying to absorb sounds when they hit the walls of a studio, the sound had to be prevented from going into the studio at all, particularly the bass frequencies: ‘These sources that are noisy have got to be contained before they get into the room. A low frequency sound wave is a long wave. It’s powerful, we know that from loudspeaker development. All right, it’s going down this long wall. What stops it? What hinders it, makes it weaker?’

One method, he concluded, was to use geometric projections in the wall which would smash the wave, but there were other ways. ‘Why, instead of these small little resonators that people have

been putting on walls, why not put in massive motion attenuators to these long powerful wavelengths?’ Hence the ceiling traps. What his philosophy broadened out to was creating so much bass absorption in the roof of the room that effectively the ceiling was removed and so was the troublesome bass spread. ‘Granted the mid range and high end will still bounce and ricochet around that circle, but the mid range and high end can be handled by finished materials that are, let’s say, very absorbent, medium absorbent and lightweight absorbent . . . but the low frequency standing wave curse has gone away because it has the infinite relief of the sky.’ He refers to his own studios as ‘trap-relieved’ rooms, as opposed to ‘compression’ rooms.

Hidley explained his ideas at length in an article in the December 1975 issue. I asked Ken Shearer if removing the ceiling from a room, by whatever means, would produce the result. Hidley said: ‘Yes. By doing that there’s less need for bass absorption on the walls, and there’s a big crosstalk loss, so separation is improved.’ He cautioned, however, that some rooms were too small to allow trap relief. Providing so much bass absorption was a difficult task. For various reasons you would need three or four feet of rockwool of varying thicknesses to achieve it, and one way was to hang up these spaced, sound absorbent blankets.

Bass trapping is only one aspect of the Westlake/Eastlake approach. Other criticism has been levelled at the fact that whatever else may be said of Hidley’s studios they look much the same. Hidley says this criticism is groundless: ‘If you went out to look at the first room, Record Plant in Los Angeles, 1969, you would see similarities, visual similarities, to what we were doing today, and you will also see, if you look two minutes at it, some pretty enormous differences. But you probably would recognise the finger of the same person in it.’

That first room, he said, had been a compression room, but the present rooms were so designed that you could put up a money guarantee on their performance. He admitted however that ‘We do fall heir to some similarity in visual appearances. People come up and say “I want a blue room like so and so’s room” and you say, “wouldn’t you rather have a brown room or an orange room?” and they say “no, it’s got to be so and so”. But it isn’t true that all the rooms look the same. The principles are the same but geometrically there are five different control room configurations to choose from. They vary enormously, that is the thing, but they all meet the performance guarantee.’

Eddie Veale saw two distinct approaches to acoustic design, and Westlake and Sandy Brown represented basically the same approach: ‘Sandy created a design which was fairly repeatable. One could take a space, apply the design and come out 95 per cent of the time with a successful animal. When one achieves that situation it’s very nice to stick with it. It makes life a little bit easy and it also produces quick results. Clients usually want two things: a good job and they want it done yesterday.’ The difficulty was when the client was short of money.

Veale thought Hidley was a latter parallel to Sandy Brown’s early work: ‘Through his employment with Record Plant, Tom created an environment that was an improvement on the stuff that was operating in the States about six years ago. Subsequently . . . he came up with a fairly good solution and there’s been little deviation from that design concept through the remainder of his projects. There again one gets this pattern where the rooms have a particular trade mark associated with them; the sheer shape, the type of treatments, the perspective and the visual effect that’s created. This has significant benefits and advantages for clients because the design is fairly concise, can readily be applied to most because the design is fairly concise and can readily be applied to most rooms. All Tom really needs to apply one of his rooms is a suitable space in which to construct it. It has been proven on several occasions now that given a suitable space, a new control room can be constructed in a very short span of time. This is not difficult to do if one is using a proven design and people one is used to working with.’

Veale added that he, on the other hand, had never repeated a design. ‘We like to, for want of a better word, ‘customise’ each of our projects . . . but if one wants to take it to its ultimate degree, so far as design is concerned, one needs a fairly long time for the design exercise and a healthy fee in order to be able to cover the costs that are involved.’

## STUDIO CONSULTANTS

David Binns presented a different picture of the Sandy Brown operation: 'The requirements of studios vary a great deal. A radio studio is different from a speech studio, a music, drama or orchestral studio.' He didn't adopt a particular set of rules or a single approach for every job: 'We tend to treat each job on its own merits.'

Tom Hidley too maintains that the process is more complicated than it looks: 'You see, all those traps are tunable. They are set up for different frequencies; they have got different Qs; they are all different. They are all doing a different job and unless you know what that formula is and pattern, there is no way that you are going to approximate the performance of that guarantee.'

### 'A trade secret?'

Talk of formulae raises another question: just how scientific is acoustics? When I talked to Piers Ford Crush we had hardly sat down before he said: 'Acoustics is a totally inexact science.'

Shearer seemed to confirm this view: 'It's no more an exact science than bridge building.' He quoted a couple of bridge disasters to prove his point, and added that the designs had probably been sound enough but had not taken account of extraordinary conditions. 'There was probably some young lad in the office who said "What happens if the wind reaches 120 mph?" and they told him "It won't".' It's like a lot of things, some people forget the basic principles that they learned years ago and a young chap just out of college can see things that they can't.

'Acoustics isn't a matter of science exactly. It's being able to see a three dimensional picture of what's going on. I can't put it any clearer than that. I have to explain it to clients by analogy. For example, mathematicians tend to know what's happening in a room but they can't describe it.'

But Hidley said: 'You bet it's a science. It is not a black art, but it's a different science. There's more to it than luck if you can produce a track record like we have.' Veale had a similar view: 'Acoustics is as exact a science as one can afford it to be. One can design and model a room or other area for acoustic qualities and come out 98 per cent correct, the other two per cent being designed tolerances to allow the thing to be trimmed once it's operational. Thus one can come out with 100 per cent success.'

How often did that happen? 'Rarely. It's usually, when one looks back on these things with hindsight, one of two problems. Either lack of time or lack of funds. With computers and current technology it is possible to do virtually anything one wants to do in order to predict an environment situation, but running all the computer time and doing all the research that's necessary absorbs time and funds. It's very difficult to justify, for example, research and design fees of say £5000 on a project when a competitor, for want of a better word, offers a client the same service for £1000.'

Later he enlarged on the way such a success could be achieved. 'There are so many different pieces of equipment that one can select to put into a room that the only way one can achieve anything near to a guaranteed performance is to use a geometry that one has proven, a monitoring system placed within that geometry that is proven and thirdly a particular layout of equipment—you wouldn't place constraints on the type of equipment but its positioning within that room. By that technique one can give satisfaction to about 90 per cent, and at least another eight per cent satisfaction gained by adjustment once the room has been constructed.'

David Binns of Sandy Brown Associates seemed to agree: 'If we do our job right there should be little room for error.' But he added that one of the greatest hazards was that the clients tended to want to cut corners and save money. 'The determining factor is the amount of money the client has to spend.'

The kind of specific difficulties that arise tend to be those involving egress and ingress of noise. As Hidley explained: 'It's not just the room itself, it's the relationship with a neighbour. There are isolation problems, isolation and control between the studio and the outside and between studio and studio. You have to deal with leakage of one kind or another. Many people building studios are concerned with what goes on musically within the environment and not with anything else.'

David Binns' view was that one of the greatest difficulties in studio building was putting the studio in an existing structure sited in a residential area. Apart from the planning difficulties with the local authorities, 'the biggest problem is the isolation from the outside. The insulation between the studio and the control room is somewhat independent; unless you're monitoring off the replay head and there's a delay between what's happening in the studio and what's heard in the control room, the studio to control room isolation is less important'. If the client were short of money this might be an area where you could cut costs. 'The most difficult thing is matching speakers to the room. Designing the speakers is all right, and so is designing the room, but matching the one to the other is very difficult.'

This was the one subject in a very relaxed conversation about which Ken Shearer grew mysterious: 'The monitors are crucial', he said. 'I would tell the client where to put the monitors and how to mount them . . . but that is something I am not going to talk about for publication.' A trade secret? 'Yes, a trade secret if you like. The point is that what I'm selling to people is the result of 25 or 30 years experience.'

He was more expansive about his responsibilities where sound insulation was concerned: 'If you build a studio in Bloggins Street and it's all right, but a year later a printing press works moves in next door and a new underground line arrives underneath them, well it's still your responsibility. It's no good saying, "There's no structure-borne noise at the moment".' It was the same with aircraft flight paths, and even helicopters: 'I usually allow for a chopper at 100 feet.'

Dick Swettenham wasn't sure the consultant need be so assiduous in every case. 'Sound insulation as distinct from the acoustic treatments for a good sound inside the studio is rather more scientific and has rather more precisely defined solutions. It is for the client to say how far he wishes the consultant to go in specifying. I know of a case recently where a consultant gave warnings. He said: "This will be so good but it will not be perfect; it is for you to decide whether you want stronger measures to be taken in order to guarantee certain values of isolation." The use of the adjoining premises at this time was unknown and the client said: "No we don't want to spend more than a certain amount so we will take our chances on that." Then in the adjacent premises something did start to happen, there was general panic and everybody tried to belabour the wretched acoustician for not having provided 100 per cent against this. Fortunately I'd been at a meeting where this was argued out, and I said "I will defend the man on the grounds that he did make the necessary warnings and was told to go ahead, because in the particular case to take absolute precautions would not only have been very expensive but would have reduced the size of the studio below what was effectively a working minimum already".'

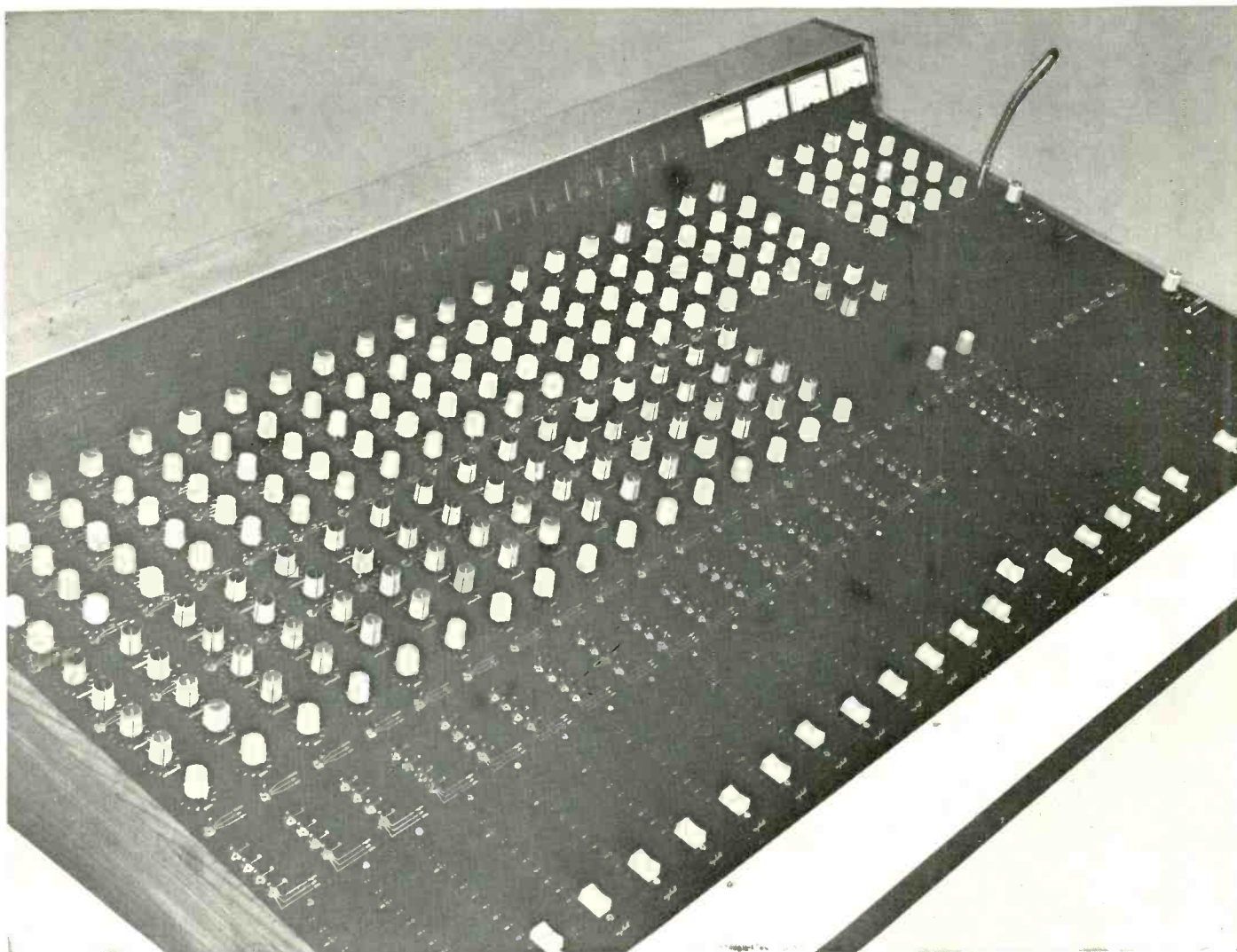
### 'The electronics sometimes caused headaches . . .'

'Another problem is air conditioning', said David Binns. 'We have set up a separate company, Sandy Brown (Mechanical Services Unit), which specialises in low noise systems.' Shearer's view was that 'if you don't keep an eye on them, architects and other people do unfortunate things like placing the air conditioners so that a stream of air is blowing over the microphones.' Swettenham thought the difficulty was that 'Some architects are rather unwilling to admit that a studio is something of a specialised nature, to admit that they don't in fact know all about it. They like giving the crowd the impression that they know everything about everything.' He said the only way to get round it was to be diplomatic.

Eddie Veale noted that in many cases other equipment supplied to the studio had to be repackaged because of spurious resonances or vibrations in the casing. The electronics sometimes caused headaches: 'In this day and age with the various goodies that are available, the way manufacturers hang the bits together can cause all sorts of problems. The most encountered problem is one of hf or rf interference that causes spurious clicks and pops and bangs and other peculiar rasping noises, and they can be right bitches to find and cure. Often it's a case of sitting down and going right through the system and deciding in what areas the system doesn't follow recognised practice. It usually ends up as an earthing problem. An acid test on equipment is to divorce it of earth and see if it still



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# Survey: studio consultants

*Entries to the UK and European survey listings have been presented with business interests (if any) declared as far as possible. Generally, the services on offer are discussed in the accompanying article Studio Consultants. Because of communications and distance, USA listings are not so comprehensive.*

*While attempts have been made to filter out or declare the interests of listed consultants, the magazine accepts no responsibility for the results of any errors contained within the survey—caveat emptor.*

## AIRO

**Acoustical Investigation & Research Organisation Ltd (AIRO), 26/28 Bedford Row, London WC1R 4HS. Phone: 01-242 0391.**

The AIRO Laboratory is at Duxon's Turn, Maylands Avenue, Hemel Hempstead, Herts. Phone: 0442 54884.

**US Office:** PO Box 905, 14428 Big Basin Way, Saratoga, California 95070. Phone: (408) 867 7467

**Directors:** D K Fraser C Eng, M I Mech E, M I Mar E (chmn), G Berry C Eng, M I Mech E, K W Jones FCA. **Staff:** 15, full time.

**Formed:** 1958.

**Fees:** Based on an hourly rate of £10.50.

AIRO Ltd is a wholly owned subsidiary of Hall-Thermotank Ltd.

'In respect of studios, AIRO Ltd is able to offer a consultancy service for the acoustic design of studios covering the achievement of acceptable background noise levels, room acoustics and acoustic separation of adjacent spaces.'

## SANDY BROWN ASSOCIATES

**Sandy Brown Associates, Architects and Acousticians, 12 Conway Street, London W1P 5HP. Phone: 01-388 2571.**

**Partners:** David Binns AA Dipl, RIBA, ARIAS Dick Bowdler BSc, M Inst P, Neil Spring BS, ARCS, M Inst P, C Eng, MIEE, Alex Burd, BSc, F Inst P, C Eng, MIEE, David Lamberty B Arch, RIBA, ARIAS. **Associates:** Frank Ward BSc, F Inst P, C Eng, FIEE, M Cor, Richard Galbraith MSc, BSc (Eng), DIC.

**Links with other bodies:** Sandy Brown Associates are associated with McLaren Ward and Partners, consulting acoustic engineers and two partners of SBA are directors of E I Audio Ltd, a company specialising in sound systems. Neither partnership has any links with suppliers.

**Guarantee:** Both partnerships have unlimited liability and this is the client's protection against any default in service.

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In the UK there are offices in London and South Queensferry outside Edinburgh. In addition to Sandy Brown Associates Architects and Acousticians there is a separate partnership, Sandy Brown Associates Mechanical Services Unit which specialises in mechanical services in buildings and, in particular, low noise air conditioning systems for all studio types. The total strength of the partnership in the UK is 30 people. Offices in Berlin, Berryville, Virginia, USA and Tehran, Iran.

## COLORADO NASHVILLE

**Colorado Nashville Inc, 322 Prairie Road, Colorado Springs, Colorado 80909, USA. Phone: (303) 473 1272.**

**President:** John Indermuehle.

**Vice President:** Carol Martin.

**No of employees:** 6

**Founded:** two years ago.

The company handles all phases of construction, with assistance from outside contractors.

**Guarantee:** two years on all installations.

**Commercial links:** sells some hardware for installation by the company. 'If a client wants a pair of JBL loudspeakers, we try to convince him that the Electro-Voice *Sentry III* is a better speaker. If he buys the *Sentry III*'s he has 60 days to familiarise himself with them and, if for any reason they are not satisfactory, we will take them back and furnish the JBL speakers that he wants. We will not, however, guarantee the JBL speakers.'

**Back up:** yes, but there is little indication as to charges apart from 'shop service in warranty work—no charge'.

**Charges:** installation of audio equipment—\$11 an hour. Location charge—\$150 a day plus expenses. Design work, preliminary drawings—\$7 an hour. Working plans—\$100 flat fee. Construction co-ordination—\$100 a day plus expenses.

## CRANBOURNE ASSOCIATES

**Cranbourne Associates (Electronics) Ltd, Cranbourne House, Shinfield Road, Shinfield Green, Reading, Berkshire. Phone: Reading (0734) 861088.**

**Directors:** Colin Broad, Richard Harris, Michael Beville.

**Associates:** Peter Keeley, Len Lewis.

The company has been operating since September last year, but those involved have been working in the field for much longer than that individually. There are no employees as such but they have recourse to a large number of sub-contractors. They have a laboratory and a small anechoic chamber available.

## EASTLAKE

**Eastlake Audio, 21 Avenue Nestle, 1820 Montreux, Switzerland. Phone: (021) 62 19 44.**

**UK:** Scenic Sounds Equipment, 27-31 Bryanston Street, London W1H 7AB. Phone: 01-935 0141.

**President:** Tom Hidley.

On the first of January, 1976, Hidley resigned from Westlake Audio. He had formed Westlake in 1971 since when he and his team have completed about 100 studios. He is now providing designs for Paul Ford of Westlake and he also has a dealer in Los Angeles, Sierra Audio, which is part of Kendun Recorders.

Eastlake offers a complete service from conceptual planning to completion. Tom Hidley was the first consultant to offer an 'acoustical guarantee'.

## EVERYTHING AUDIO

**Everything Audio, 14045 Sherman Way, Van Nuys, Ca 91405, USA. Phone: (213) 873 4447.**

**President:** Brian Cornfield.

The company provides consultation services that coordinate performance with construction, equipment and installation. The design service claims to offer 'isolation of recording areas and the most accurate monitoring of programme material for recording and mixdown yet offered'. Control room design places the listener in the speaker's direct field and 'dissipates the audio energy once it has passed'. All hard surfaces are arranged to direct reflections away from the listening area.

Everything Audio works in league with Rudolph A Breuer Construction, builder of more than 50 facilities.

## LASALLE AUDIO

**Lasalle Audio, 740 Rush Street, Suite 100, Chicago, Illinois 60611, USA. Phone: (312) 266 7500. Telex: 255268.**

**Owner:** Bill Wilson.

**Sales manager:** John Houman.

This organisation is not strictly a studio consultancy but, by virtue of the large number and variety of product lines marketed, the organisation can offer design and advice concerning most facets of studio and broadcast operation including custom acoustic design and construction.

## PYE TVT

**Pye TVT Ltd, PO Box 41, Coldhams Lane, Cambridge CB1 3JU. Phone: 0223-45115.**

This company is primarily a hardware manufacturing and marketing firm which provides consultancy advice in terms of the goods which it markets. Being a subsidiary of Philips, the resources are great and it would appear that there is little in studio building that they couldn't help with.

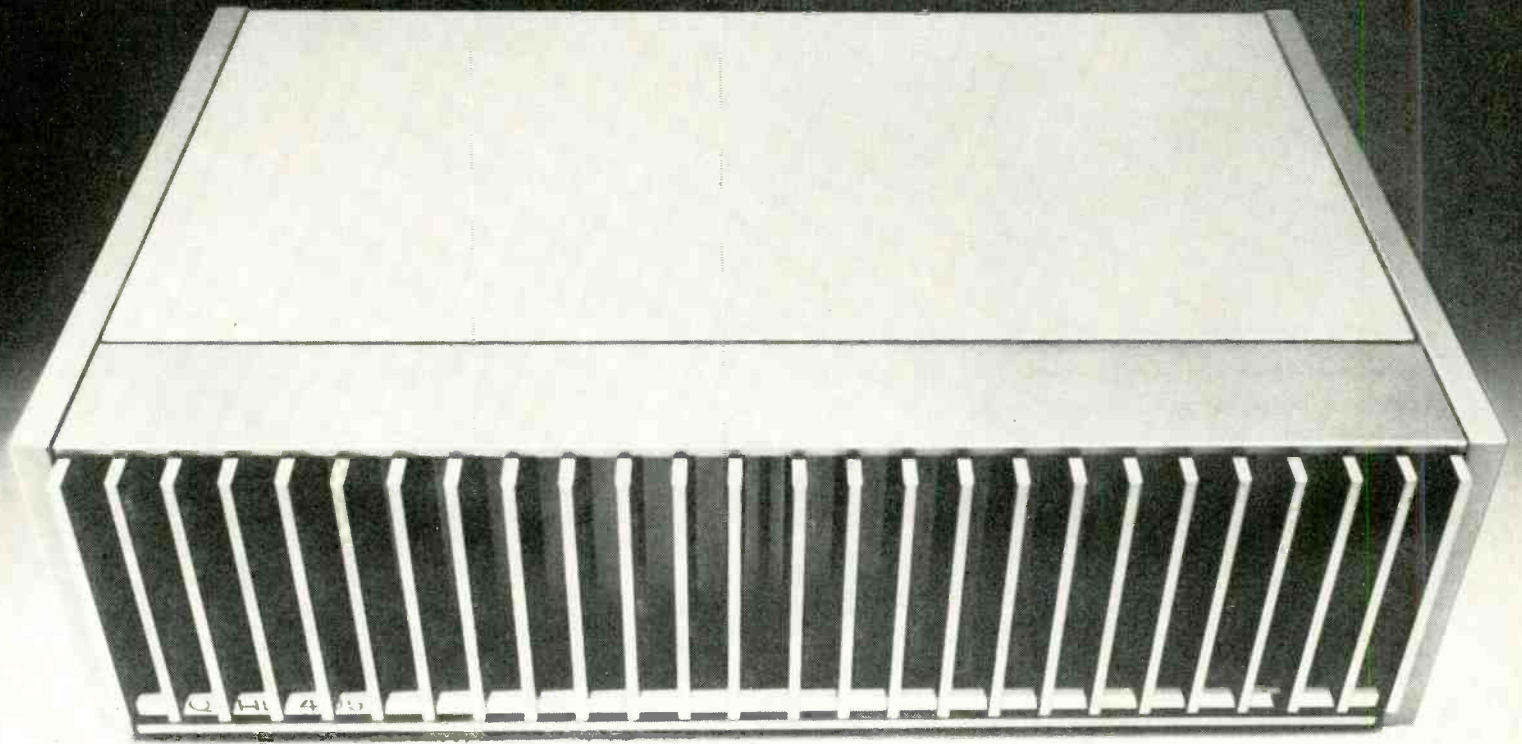
The company provided much help in the preparation of the accompanying consultancy article.

## KENNETH SHEARER

**Kenneth Shearer and Associates, Acorn House, 1 Bartel Close, Leverstock Green, Hemel Hempstead, Herts HP3 8LX. Phone: Hemel Hempstead 54821.**

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### SUGARLOAF VIEW

Sugarloaf View Inc, 75 East 55th Street, New York, NY 10022, USA. Phone: (212) 759 7588.

**President:** John Storyk.

**Founded:** 1974.

Sugarloaf View Inc was formalised in 1974 as a company specialising on architectural and acoustical design and construction. Prior to that, its principals, John Storyk and Robert Walsh, had designed, and been involved with, installations of over a dozen recording studio complexes since 1968.

**Services:** Recording studio and related support facility planning and design—architectural and acoustical design of control rooms, studios, edit rooms, cutting rooms, instrument and vocal isolation booths, multipurpose master studio planning. Electrical and signal layout and design. Interior finishes, furniture and layout.

The company also offers room monitor system analysis and equalisation using  $\frac{1}{3}$  octave frequency plotting with pink noise sources; also specialist design and supply of isolators, door seals, vibration control, speaker mounting, portable screens, and booths.

Regarding equipment recommendation, the company acts as an independent source of information for hardware purchase, installation and interface.

### RICHARD SWETTENHAM

Richard Swettenham Associates, Browells Lane, Feltham, Middlesex TW13 7ER. Phone: 01-890 0087.

The firm is run solely by Richard Swettenham, though he has call on freelancers and those who work for Helios. Usually calls in an acoustics expert unless the client cannot afford to do so. Richard

Swettenham Associates (RSA) is not a limited company.

Swettenham's contribution to the studio equipment scene, especially in mobile recording, is well known. He says he intends to do a great deal more consultancy now that he has built up a team that will take a good deal of the running of Helios off his hands.

### EDWARD VEALE

Edward J. Veale & Associates Limited, Farringdon House, St. Albans Road East, Hatfield, Herts AL10 0ET. Phone: Hatfield 65251, telex 28332.

**Associated companies:** Acoustic Consultants Limited, Audiotek.

**Directors:** E. J. Veale, D. Veale, L. Veale, J. D. Forbes, S. Dahlstedt.

'The company handles acoustic planning, architecture, design, equipment choosing, ordering and installation and sub-contracts construction work to its specifications. Site management and overseeing of sub-contractors is undertaken.'

**Guarantee:** 'The company does not give a written guarantee. Our guarantee is professional responsibility—we value our good name.'

## STUDIO CONSULTANTS

works without any funnies. If it does you've got a very tame system.'

Some studios find that although the studio may be fine when it has just been finished, after a few months the room characteristics seem to change. Tony Clarke, Moody Blues' producer, once jokingly wondered whether the layer of nicotine at Threshold hadn't had some effect. 'The acoustics haven't changed', said Tom Hidley, who designed Threshold, 'but the monitoring characteristics may have. You may get transient surges through the monitor in shutting off the console. That changes the monitor alignment. Or you may get Fahrenheit and humidity changes. Or the sound pressure levels, the average levels, may be so high that this will alter the response curve. Autolifters on the tape machines may not be functioning properly during fast wind.' He said that he had once tested the effect of a power surge by taking measurements of a monitor before and after turning the supply off and back on again. The curve in each case was different.

So even if nothing goes wrong in an obvious way it's important that your studio designer is available some time after the work has been completed. Ken Shearer, for example, makes clear that he is always on call if needed. Hidley says he can arrange that either himself, someone at Eastlake, its representatives or, in the case of a studio with a large maintenance department, the studio themselves can take charge of seeing the studio is looked after.

### 'The most valuable piece of equipment . . .'

I was surprised by how little talk there was of reverberation time. Normally for those who know a little about acoustics this is one quantity you have to know about a room, but it didn't crop up at all in the Hidley conversation and other mentions of it were merely dismissive. David Binns said their aim was to let the acoustic offer 'a clean sheet' to the engineer so that he could then add compression, reverberation and so on. To that end they tried to keep the reverberation time constant with frequency.

Ken Shearer didn't think constant reverberation time was a good idea: 'Reverberation time in itself is only a rather crude measure of the degree of brightness of a room. In a large room I usually aim for 0.5 or 0.6 of a second at the middle and top end and pull it down to about 0.4 at the low end. You need tight bass to avoid the EMT effect back into the microphone on the percussion. You give more kickback at middle and top so that the musicians can hear themselves play. It makes them play better—more in unison and with more correct relative pitch. If they can hear themselves they're more likely to come back next time. Even with session musicians it may make the difference between them saying, when you phone them up, "Oh all right, I suppose I can come", and "Yes, of course I can".' Reverberation

time wasn't important in that: 'The most important criterion is getting it to sound the way you want it to sound . . . The most valuable piece of equipment for tests and acoustic diagnosis is your ears.'

According to Dick Swettenham, 'Uniformity of listening conditions around the room is quite an important and valuable thing and flatness of response as perceived at the monitoring position likewise, but this is not absolutely everything. Of course, there are two things here, that what the old style acoustician measures is reverberation time versus frequency because his feeling is that this is one of the things that you can measure accurately and repeatably. Other people say, "When we sit in this chair we want to hear a flat response from the speaker", but this is not necessarily the same thing because standing waves will build up at certain frequencies on sustained sounds that don't on momentary sounds. So the two things are not really interrelated. I think there's a lot of thinking and talking to be done on exactly what one should measure in relation to the control room and the sound you get in it.'

David Binns said: 'The success of a job is the success of the studio, independent of anything else.' Hidley's view was the same: 'You asked me 20 minutes ago why should Tom Hidley design the room, why can't they do it themselves. There is one cloud-free answer for it no matter what the appearances: the consistent number of hits that have turned out of this studio design philosophy, and that is what it's all about in building a studio today. What is the return going to be?' Shearer made the same point about the Westlake/Eastlake studios even though he admitted he had lost one studio contract to Hidley: 'The basic thing, the most important thing is that he's done all these studios and people are happy with them.'

There are so many variables in studio design; it is such a minefield of controversy, argument and rival claims that snap judgements and conclusions, even for those competent to draw them, are inappropriate. What it comes down to is the consultant's track record and the amount of money available. Perhaps it's consoling to realise that, even though they now think they could have spent more, Eden have built what they and others regard as a satisfactory studio on limited resources. On the other hand, studios have come to grief even though there seemed no shortage of money. Cockatoo is perhaps a good example.

But perhaps the soundest piece of advice any of the consultants could give, and they all mentioned it in various ways, was that those who want to build a studio should give clear instructions. As David Binns put it: 'A good studio needs successful engineers and successful management, but particularly successful engineers. The best kind of client is the one who has a clear understanding of the whole operation and is working with an engineer who knows what he wants.'

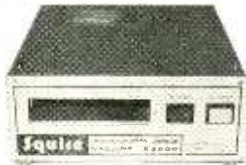


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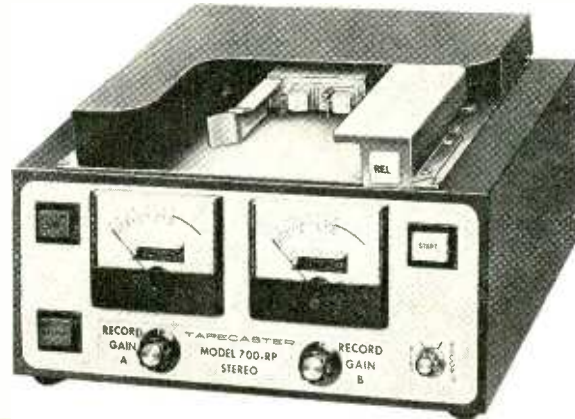


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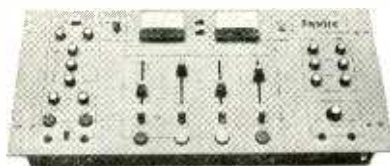
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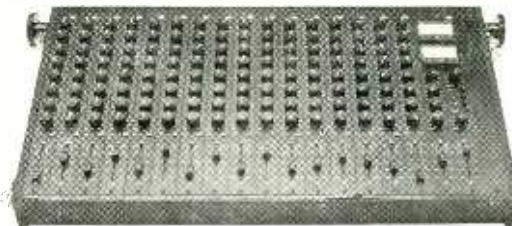
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# A day in the life

ADRIAN HOPE

*There's more to No 3 Abbey Road than meets the eye, but did the Beatles give it too much limelight?*



I WAS LATE for my first appointment at Abbey Road with studio manager Ken Townsend. I'd had this bright idea of photographing the zebra crossing outside the studio, as featured on the cover of the Beatles' album, *Abbey Road*. But I couldn't get a clear run at the shot because a Japanese gentleman with a necklace of cameras was busy trying to persuade four other Japanese gentlemen to stride in step Beatle-fashion across the crossing for his benefit. Finally he turned his attention to photographing the Borough of Westminster sign labelling the road, and I got my chance.

Inside EMI, past the new card-lock security system designed to keep out loonies, I made my excuses about being late.

'Would you believe', I said, 'there was a Japanese chap doing exactly as I wanted to do and photographing the zebra crossing?'

'You were lucky there was only one', I was told, 'most days there is a queue of photographers all taking the same picture to show the folks back home.'

I also learned that the Japanese gentleman was lucky to get a shot of the Abbey Road wall sign. They are prized off and carried back home as souvenirs almost as fast as Westminster Council can erect them. And all this, incidentally, took place just before the massive upsurge of current interest in the Beatles.

Rightly or wrongly, like it or not, Abbey Road and the Beatles are virtually synonymous in the minds of the record-buying public. Even before the lp of the same name, everybody knew that the Beatles and George Martin made their records at Abbey Road. Although Paul McCartney is the only ex-Beatle currently working at Abbey Road, it is now written as history that the making of *Sergeant Pepper* at those studios created a watershed in modern recording. Until then audiences expected their idols to sound on stage as they sounded on record. But no one expected even the Beatles to reproduce *Sergeant Pepper* live on stage, and a new art form was born—the gramophone record as an entertainment medium in its own right.

Although Abbey Road Studios have worked hard and profitably since the Beatles ceased recording and broke up, they have tended to pass from the limelight. This is largely due to EMI's failure to credit the studios on many of its record sleeves and obviously disappoints the staff who believe the studio's claim to fame and success is founded on far more than the successful recordings of one pop group. Even though the current re-emergence of interest

in the Beatles (re-cut and re-issue of all their singles, a film festival in New York and some daft talk about a \$30 million, 15-minute Please Please Me re-union) will also interest the popular media in Abbey Road once again, the studio would doubtless far rather be thought of as a going concern than as an archaeological site. It was with this in mind that I embarked on an overall look at Abbey Road today.

The main problem proved to be where to start. Traditionally in an article on a studio, one mentions past artists who have worked there. But in the little green book that the studio has compiled to list past visitors there are enough names to fill an article on their own. Taking the B-for-Beatles pages, I noticed Dirk Bogarde, The Beverley Sisters, Eve Boswell, The Big Ben Banjo Band, Webster Booth, Jack Buchanan, Owen Brannigan and Max Beerbohm. Because Abbey Road handles not only recording sessions for EMI artists but also independents and sessions controlled by rival companies (such as CBS), one might as well just say that more or less everyone has at some time or other recorded at Abbey Road.

So what about the equipment, then? Another tradition of studio reporting is to list the equipment available. But again, that's an article on its own. Take two EMI 44 in/16 out consoles; two EMI 24 in/8-16 out; a Neve 36 in/24 out; 45 AKG microphones; 215 Neumanns; 70 Quad monitor amplifiers; 70 JBL and Tannoy monitor speakers; six cutting lathes; two Studer 24-track machines; three 16-track; 16 eight-track; and 56 two-track machines—and there you have just the start. So, obviously, listing the equipment isn't going to get us anywhere. More important, perhaps, to mention that the maintenance team to keep the gear in order includes six technical operators for lining up and first line service, and five second line engineers for repairs and modifications. Perhaps even more relevant is a remark made by a musician colleague when I said I was writing on Abbey Road.

'They're so helpful there', he told me. 'At some sessions spread over two days recently I suggested on the first night that I would like a telephone rigged through to the harp booth—next morning at nine o'clock it was there.'

It might also be worthwhile looking at the names of Abbey Road men who have come up through the studios and moved on elsewhere—like Malcolm Davies, Geoff Emerick, Ken Scott, Jerry Boys, Malcolm Addey, Bob Goodman, Keith Slaughter, Dave Harries and



so on and so on.

But what I finally settled for was a 'day in the life' of Abbey Road. (It seems that even with the best intentions one just can't escape from the Beatles' influence.)

When I arrived Ken Townsend was in his first floor manager's office, talking to deputy manager Michael Gray about the problem of rationalising, reorganising and insuring all the 90 000 EMI master tapes now in store. Most are kept underground at Perivale but 10 000 are at Abbey Road. A fresh headache was the request by Paul McCartney that all his own tapes be stored at



Above: Chris Blair, currently one of the best known disc cutters in the pop field.

Abbey Road; a special cupboard now has to be built because there are around 500 to cope with. You can't copy everything, so some of the masters are irreplaceable. If the stereo master of *Sergeant Pepper* disappeared it would be a problem, but not the end of the world—there are pristine disc cuts available as safeties. But what if the original four track master of *Sergeant Pepper* (yes, only four track) or the eight track master of *Abbey Road* were to go missing? Doubtless, with this awful possibility in mind EMI is currently copying all the Beatles masters. What practical use are they? Well, two years ago the studio used the *Sergeant Pepper* four track to mock-up a quadraphonic version, and it would be even easier to produce a quadraphonic release of *Abbey Road!* With the current Beatles revival, Ken Townsend is obviously well aware of what unreleased Beatle material is still available but he was guarded about the contents of the vaults. I do however happen to know of a 1964 live recording of 'The Beatles at the Hollywood Bowl'. It's all there, nearly half an hour of edited stereo labelled as a 'rough remix with equalisation, reverberation and limiting' and with George Martin credited as producer.

Apart from the matter of insurance, storage and Beatles re-issues, there was also the problem of Paul McCartney's goldfish. PM was off on tour with Wings, and Linda knew there was an engineer at Abbey Road who is good with fish. So he went off up the road to McCartney's house once a week to feed them and do whatever you do with goldfish if you are good with them. While I was there a card from Linda wishing him (the goldfish) well arrived from sunny Martinique.

Despite hard times in general in the industry, Abbey Road is working to reasonable capacity. Last October, for instance, at around the time that one North London studio was refusing to let me through the front door (doubtless for fear of what I might see) Studio Three at Abbey Road was 93.5 per cent fully utilised, Studio Two 84 per cent and Studio One 57 per cent. The ratio of Studio One to Three utilisation is fairly standard. Three is small and mainly pop music; Two is medium and middle-of-the-road; One is enormous (29m x 18m and 6200 cubic metres) and used mainly for orchestral sessions. Inevitably Studio Three brings in more revenue than Studio One but the income from all three

studios is clearly decidedly healthy. Apart from a small discount for EMI artists, it makes no difference to the studio clerical system whether the artist is EMI or an outsider. The basic rates (plus VAT and tape costs) are gauged to track usage, 24 or 16 track costing a basic £39 per hour, eight or four track £37, and two track facility £35 per hour. There is also a reduction room available at £30 per hour. A couple of mobile units are available at £220 per day for recording or remixing, and at half price for rigging or travelling. After 7.30 in the evening there's a 25 per cent overtime surcharge on studio time. Cancellation between 24 hours' and four days' notice is subject to a 50 per cent charge, and within 24 hours' notice it's 100 per cent.

Earlier this year, Paul McCartney and Wings solidly booked 24/16 time for 12 hours a day for a month, which can't be bad for business.

Abbey Road is also heavily into disc cutting, with six cutting rooms and lathes and a basic rate of £17.50 per 30 cm master side and £13 per 18 cm master side, plus lacquer costs. One of EMI's current star cutters is Chris Blair, one of the new breed of disc cutters who (like George Peckham and Malcolm Davies) is sought out and asked for by independents and EMI artists alike. Blair, who specialises in cutting singles (but sometimes cuts albums like the Queen lp) cut 12 number ones in 1975 alone and in one week had cut one, two and three in the charts. Like most modern cutters, he likes to see as much level as possible on a single. He regards Mickie Most as the pioneer of putting more level on to singles. 'He's obsessed with level', says Blair.

'I try out everything I cut on a cheap gramophone', he explains, 'I want the record to leap out.' Clearly there is now a good deal of friendly rivalry between top cutters, with one trying to pile on that bit more level than the other without trading off too much for distortion. The days of producers regarding their job as done when the master tape is finished are long gone. Not only producers, but artists as well, now like to be present for the cut. Blair's EMI control desk for the Neumann cutter has 186 000 million different equalisation combinations in mono, and the square of that number in stereo. Modestly, he reckons he hasn't yet tried them all out. Like Peckham, who signs his records *Pecko* or *Porky*, Blair signs *Blair's*. I asked him whether, like Peckham, he only signed those that he had enjoyed cutting.

'I sign *Blair's* if I like them—and *Porky* or *Pecko* if I don't', he explained.

On Chris Blair's cutting console I noticed a mysterious knob with five switch settings—funky, laid-back, mean, motown and rak. The knob is, of course, a dummy, and actually held on by chewing gum. But artists and producers new to the game have been known to pounce on it with enthusiasm. Another knob, now defunct, had fifty click stops, numbered 1-50, to help artists and producers select the preferred hit parade rating for their efforts.

While going round the studios, the idea dawned on me that EMI Abbey Road is the ideal place to produce a home, British grown, direct-cut record *à la* Sheffield in California. There are six cutting rooms at Abbey Road, each with its own lathe and each capable of cutting an album. Any of the three studios can be routed through direct to any one of these six cutting rooms or, more to the point, to all six at the same time if necessary. Thus, an orchestra in Studio One, Two or Three could, if necessary, make six direct-cut masters simultaneously, thereby overcoming the main problem of direct-cut disc production—the finite life of the lacquer master in terms of total reliable pressing run. Armed with what I thought was a novel idea, I sounded out Ken Townsend on the possibility.

'It would be no problem technically', he agreed; but other than that he was noncommittal. However, hand on heart, I can say that, by coincidence on the very day that I raised the idea, there was a full range of Sheffield direct-cut discs just arrived at his 'in' tray from the USA. Your guess is as good as mine as to whether we shall soon be seeing an EMI direct-cut issue. But all the hi-fi enthusiasts who are now paying £6 or £7 a time for direct-cut imports would surely make a ready-made market for a disc featuring British musicians.

The Soft Machine group followed Olivia Newton-John into Studio Three during my visit but virtually only the name is the same as the original 'underground' group. During the EMI

## A DAY IN THE LIFE

sessions, organist Mike Ratledge was missing, coming in only for keyboard overdubs when necessary. A couple of weeks later the musical press carried news of his official departure from the group. John Leckie was balance engineer for the session, with Pat Stapley as second engineer. There was no single producer, the whole being jointly responsible for production, and as an outsider I would say it showed. For example the group recorded one short track some half-dozen times while I was there, and after each take filed silently into the control room for a replay. Each time they'd listen, and equally silently file back into the studio for a re-take, presumably communicating dissatisfaction between themselves by telepathy. An unsettling approach for the engineers, I would guess. But as always in the recording business, the proof of the pudding is in the eating: if the final product sells and makes money for the record company it matters not one jot how that final product was produced.

Leckie has been at Abbey Road seven years now. It was after two years of tape opping and balancing a couple of albums with Chris Spedding and Roy Harper that he was thrown in at the deep end as engineer on Wings' *Red Rose Speedway*. Since then he has engineered consistently for Roy Harper and co-produced artists such as Be Bop de Luxe. On behalf of would-be Abbey Roaders, I asked about how to get a job there.

'We get about ten applications a day', he told me, 'and take on about one a year.' Ken Townsend had already told me that in the current climate fewer people are leaving Abbey Road—so there you have it: vacancies are very few and far between.

Studio Three has for several years now been 24 track and all concerned seem anything but anxious to move on up to 32 or even more. The consensus of opinion was that if necessary, and a paying customer insisted, a pair of Studer 24 tracks could be ganged together to produce 30 or 40; but, as Townsend says, the problems 'are more likely to square than double when you sync two separate machines together'. The Studio Three desk is an EmiNeve which replaced the original EMI console and has 36 channels in, 24 out and 12 groups. The old EMI desks were built on a modular basis, with quadrant faders and sophisticated eq, limiting and compression; but the modules take up rather too much room to be easily banked in dozens in a control room as small as Studio Three, and the Neve has extra facilities anyway. Incidentally, the installation of the EmiNeve desk in Studio Three is the first time that a non-EMI console has found its way into Abbey Road.

Soft Machine were on their eleventh session (they concentrate heavily on overdubs) and were clearly making the most of the facilities available in Three. There were ten mics alone on John Marshall's drum kit (sending to four tracks) and the group of four had so far used up nine of the available tracks. One problem at the session was the group's use of fairly large, PA type guitar and bass amplifiers, which really only sound 'right'

when loud, and thus are hard to mic in a small studio. It's another instance of how an overall producer with a tight grip and liaison between musicians and engineer can make life easier for everyone. But by shielding and using a mixture of di and live sound Leckie seemed to me to be achieving a good sound.

A producer with an obviously tight grip was working in Studio One. This, the largest studio in Europe, except for the Rome Film Studios, is like a concert hall and thus used mainly, if not exclusively, for classical and orchestral work. Henry Mancini was there recently making film recordings, and a year or so ago I covered an independent session by the Spanish record label Ensayo. It was, however, rival record company CBS who had booked Studio One on the occasion of my visit. Producer Paul Myers was working with EMI engineer Bob Gooch, and Daniel Barenboim, the LPO and Mezzo Yvonne Minton, for a release in the CBS International Masterworks series later this year. In a way it's odd for EMI (who are currently litigating against CBS for British mis-use of their trademark 'Columbia') to hire out their prize studio to a direct competitor. But on the other hand, of course, it's not so odd: if CBS didn't use Abbey Road they would use somewhere else, and clearly not even a company the size of EMI could keep the vast Studio One continually busy on its own orchestral sessions.

Bob Gooch has positive ideas on most things, including which instruments should go on the outside tracks. Looking for a tactful word, he chose 'inessential' to describe instruments like organ in the *Sea Pictures* recording. 'If the worst comes to the worst and the tape folds, we shan't be losing voice or violins which are safely in the middle. And of course if the tape transport ever does give problems it will affect the outside tracks far more than the others.'

Being a rock-and-jazz-liking Philistine, I knew little of Yvonne Minton, but was astonished by her powerful and controlled voice. Gooch showed on the vu meters the acid scientific test of a good singer. 'The deficiencies show up as they come off a note', he said. 'A singer may produce consistent power as she holds the note, but as the diaphragm releases a poor singer will peak briefly in level.' Sure enough, only on one occasion did Yvonne Minton throw the meter up 3 dB into the red when she came off a note—for the rest of the time each sustained note fell away smoothly as it ceased. Perhaps one day we shall see vu meters used at vocal auditions.

Clearly Paul Myers had created a little consternation by his instructions for the session (to record Elgar's *Sea Pictures*). To understand why, it is necessary to recall that EMI classical recording policy is fairly steady. The acoustics of Studio One have been tinkered with over the years to produce a natural ambient sound, and regular Studio One engineers like Bob Gooch know that sound well and how to mic it. Townsend, Gray, Gooch and everyone else I spoke to at Abbey Road dismissed the possibility of recording an orchestra with a single crossed pair as a Utopian fantasy ('It's all very well writing articles about it', 50 ▶



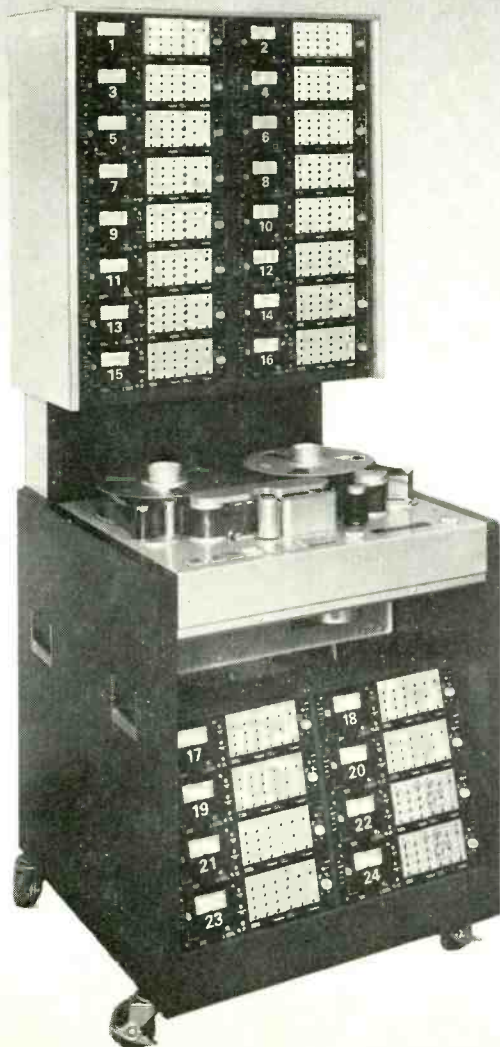
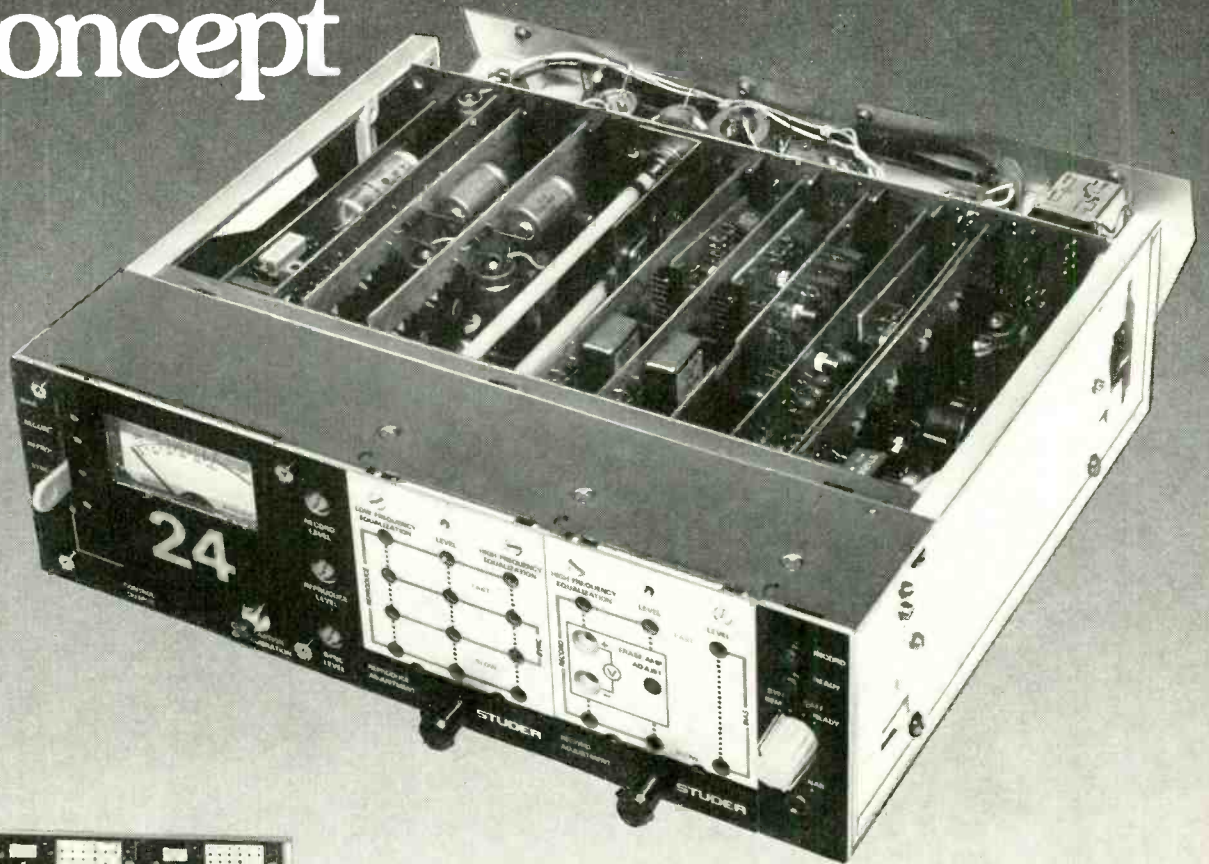
**Left:**  
Daniel Barenboim  
and  
Paul Myers.



**Right:**  
Recording  
the  
*Soft Machine*.



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## A DAY IN THE LIFE

I was told, 'but when you come to re-arrange a choir and orchestra to suit the engineers you soon find the difference between theory and practice'. But it is normal for EMI classical sessions to be recorded eight track, with the main orchestra mics in pairs, a few spot mics and at least a stereo pair for ambience. This was, in fact, the setup in use when I looked in on the *Ensayo* session, and it is doubtless one reason why *Ensayo* repeatedly comes over from Spain to record at Abbey Road. Whereas Paul Myers has in the past used a generally similar approach (but perhaps with rather more spot mics), he was, on this occasion, recording 16 track with around two dozen mics moved in very close by classical standards. For obvious reasons (for instance, the customer being always right) there was no question of anyone at EMI criticising the approach. But there were certainly some interested queries and I detected a general, unspoken feeling that it seemed something of a pity to use a studio like Abbey Road Number One with its natural ambience, but close-mic the orchestra and record relatively dry, adding artificial ambience at the remix stage. I phoned Paul Myers at CBS the following day, and found him only too ready to explain his philosophy about natural and unnatural acoustics and reverberation.

'For a start, I question your use of the term "natural reverberation"', he explained. 'In recording we are talking about controlled distortion—just as any photograph of the Grand Canyon has to be a controlled distortion.'

'I am in any case not altogether convinced that EMI Number One has the best acoustics—it's a fine place to work, but when the sound gets loud it does tend to get somewhat confused. When I remix and edit the master tapes at CBS I shall add what sounds to be the right amount of reverb, using tape, plate and chamber. My aim is to produce a pleasant ambience for listeners, and I prefer to keep my options open. Of course, I realise it is a relatively unsatisfying job for the engineers, and where the situation is right I am happy to record in EMI style. If one uses technology for the sake of it one has failed; but equally, to ignore technology that is available is a mistake—it's like working in the most elaborate film studio, with robot camera control and every facility under the sun, and then shooting hand-held.'

I queried whether the album would be released in quadraphonic form as well as stereo, and whether the rear channel information would be surround or ambience material. EMI (who share use of the SQ system with CBS) is currently issuing virtually all its classical material in single inventory SQ, but places only ambience information at the rear.

'Yes, the issue will be quadraphonic,' said Myers, 'and it will be in surround sound style. This is another reason for using 16 track even though most of the time I was actually only using ten of the 16 tracks. I want to get it all down in detail; I can then paint a surround sound picture—though not, of course, in "mixed doubles", the modern equivalent of ping-pong stereo!'

As to whether you prefer the EMI 'natural' approach to recording or the CBS approach, you pay your money, you buy your record and you make up your own mind.

Studio Two at Abbey Road is, in many respects, a hybrid of One and Three. The original studio in the building, it is large, curiously shaped, with the control room high up one wall, and can cope with most types of music. On the day of my visit the Mike Sammes Singers were overdubbing vocals to finish an album

*Reissuing old 78s. Some of the equipment responsible for squeezing the best possible quality out of old 78s for reissue.*



which for the most part had been recorded live, band-plus-vocals. Apart from a general feeling in some quarters that live recording of this type (as opposed to overdubbing on pre-recorded rhythm tracks) makes for a better, spontaneous feel, there is of course always the financial consideration that it is only on sessions of this 'live' type that the British Musicians' Union allows any overtime. On any session that involves overdubbing, overtime is *verboten*, and a full three-hour session must be paid for to cover any extra time.

Even the ancillary equipment at Abbey Road could take up an article on its own. There are seven echo plates, digital echo equipment and three chambers. The latter are fascinating old cellars out of the back of Studio Two, into which sound from any source can be piped at high level (provided the fan vents are closed to ward off complaints from local residents whose gardens back on to the EMI property). An odd aggregation of sewer pipes stands in what appears to be random arrangement throughout the chambers, but actually the layout was arrived at over years of trial and error, to produce the best added reverb. Studio Two, incidentally, has its own natural reverb, controlled by a cladding of seaweed-filled panels, also arrived at over years of trial and error. The digital echo system is one of many 'toys' at Abbey Road, many of them produced by the EMI Research Department at Hayes, along with the console modules. Some of the ancillary equipment is more successful and popular than others. There is for instance, a highly successful automatic panning arrangement which can throw an instrument, such as a tambourine, from left to right track in time with the beat. This was constructed by Abbey Road engineer Neil Aldridge. From Hayes came a frequency translator that produces a fishy sort of noise, and a 'Sparkey's Magic Piano' (or Harmony Vocoder if you want to be precise) by means of which a voice can modulate a keyboard sound. This was used by Wings on their *Speed of Sound* album.

Currently rather less popular as a toy is a fuzz box which Hayes once produced with enthusiasm. It limits, damps, modulates, vibrates, delays, rises, falls and makes the tea; and probably also adds fuzz, if anyone can find out exactly how to use it.

Another busy toy from Hayes is a digital delay which can produce from 0-600 ms delay in 1 ms steps, with no discernible quality loss and the addition of only a little noise. Also, despite the undoubted popularity of the EmiNeve, the EMI desk modules are still favourite with many engineers, not so much because of the facilities which they offer, but because of the infallibly reliable 2 dB step switching.

'The point about these modules is that they will do exactly what the knobs say they are doing', said one engineer.

Incidentally, one reason why equipment like this seldom finds its way on to the secondhand market, even when newer equipment takes over at Abbey Road, is that it has usually found its way into EMI studios abroad. There are EMI studios all round the world, including India, Singapore, Mexico, Cologne, Australia, Hong Kong, Paris (Pathe-Marconi), Amsterdam and Lagos (where Paul McCartney recorded some of *Band On The Run* because at the time he fancied some sunshine). All the Abbey Road Studers have Vari-pitch control, and in Studio Three there is an EMI-built remote control which enables just about everything on the tape machines to be handled from the EmiNeve desk. 'The danger is that you forget you're working with tape', said one engineer. The Vari-pitch remote, incidentally, has a digital readout which makes it especially useful for phasing with Studers which have both line and sync outputs. All the remote controls can be plugged to whatever machine is chosen via a wall box; in fact, it is safe to say that virtually anything in the building can be hooked to more or less anything else if the need arises. For instance, on one Beatles session, Ken Townsend linked all the EMT plates and echo chambers together—'It sounded terrible', he admits.

Abbey Road is standardised on Tannoy *Lancaster Golds* and JBLs. For instance, in Studio One there are both *Golds* and JBLs (plus, while I was there, a pair of B & W *DM6* speakers on test loan); the *Golds* are used for classical work and the JBLs for middle-of-the-road-and-there-on-down-the-brow scale. The *Ensayo* team used to keep their own pair of AR *LST* speakers at Abbey Road for *Ensayo* use but, in the words of an engineer, have now learned to live with the *Golds*. Although the engineers



liked the sounds that the *LSTs* produced, they couldn't come to terms with the rather diffuse stereo image that they create. Elsewhere it's all JBL, with four in Studio Three and four also in the new quadraphonic remix room.

A playback room, where tapes and pressings are checked for quality, is equipped with a Thorens *TD 125 MkII*, SME arm with Stanton cartridge and Quad *50E* amplifier feeding a pair of Tannoys. I shall remember this next time a self-styled hi-fi pundit performs the usual, dogmatic trick of criticising JBLs and Tannoys as being 'too warm'. How, I wonder, will they support the 'too warm' argument when faced with the fact that every recording out of Abbey Road has been monitored and usually remixed and quality control checked on 'too warm' speakers?

While on the subject of quality, there is a curious little room down one of the corridors where secret happenings occur. Bernard Speight has been technically responsible for this transcription room for several years now and is quick to point out that it was the foresight of Gus Cook, that made it all possible. The purpose of the room is to transcribe old 78 rpm discs (or, more accurately, anything from 70-90 rpm discs, because speeds were not standardised then) on to tape for re-issue. A massive EMT turntable with a modern tone arm can be fitted with a wide range of modern cartridges each with a different stylus radius ranging from 56 to 112 microns. Both lateral and hill-and-dale cut discs have to be coped with, the hill-and-dales being tracked by a stereo cartridge wired out of phase and connected as mono. The speed of the EMT can be continuously varied from 63 to 90 rpm, and there is a complicated electronic speed control and stroboscopic check arrangement. But no amount of electronic control is any use if you don't know what the original recording speed was—and even if the label gives a speed it may not necessarily be correct. In any case, the transcription room is often working from nickel mothers or fresh vinyl pressings from stampers, rather than original labelled shellac discs. The EMI answer is to employ Mr Gadsby-Toni, an ex-violin player, who quite simply uses a pitchfork and a fine musical ear to find the right tempo for the recording.

Highly sophisticated equalisation circuitry is available to clean up as much of the 78 rpm noise as possible, but unfortunately this is frequently wide band and varies in characteristic across the disc. A-B switching is used between filter 'in' and filter 'out' positions, to enable the best possible cut position to be found at any given part of the disc. But on old discs by far the worst problem is impulsive noise. It's here that the trade secrets take over, ten years of work having produced two different types of dynamic de-clicker which work in ways which I am, on my honour, bound not to reveal.

In general, however, the avowed aim of the transcription room

is to do as little as possible because excessive 'treatment' can easily worsen the overall effect. Also, although it does not always conform to company policy, Bernard Speight's personal preference is to leave all 78 recordings in original mono.

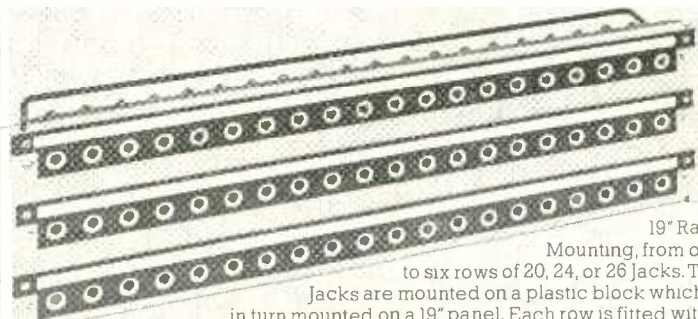
While on the subject of 'new is not necessarily best', it is worth noting that Abbey Road engineers still use Fairchild valve limiters and Altec valve compressors wherever possible. Pop group guitarists are now paying over the odds for solid state amplifiers custom-built to provide 'a valve sound', and in a recent hi-fi test survey run blindfold, a cheap valve amplifier scored higher marks with the technical press than many far more expensive, transistor models, largely due to its inherently softer clipping sound. It will be interesting to see how long it is before new valve equipment or solid state equipment with 'a valve sound' starts re-appearing in studios. Certainly I got the impression that it wouldn't be unwelcome in some areas of Abbey Road.

What else for the future? As one engineer at Abbey Road put it, 'this whole business is about good sound'. But of course it is also about earning a living and staying viable under inclement financial conditions. However well the Beatles re-issues sell, they won't keep the doors of Abbey Road open. My impression, gained after many days spent there talking to not a few people, is that the whole operation is run as a tight, though friendly ship. For instance, everyone in the building knows what is going on elsewhere: details from a wall chart in the central office are typed up weekly and circulated round the building. And when I first asked Ken Townsend about computer mixing he guardedly expressed interest in the new Neve system, but admitted that so far he was unconvinced.

'You don't spend thirty, forty or even more thousand pounds just to modify for the sake of a new fad', he said, 'because sooner or later someone will always get dissatisfied with it. In many respects, EMI at Abbey Road is like an elephant: a kick at the rear takes a long time to get through to the head.' Although that kind of attitude may frustrate some of the staff, it gives the studio a far greater chance of long-term survival. And after a demonstration of the Neve system, Townsend has now ordered one enthusiastically.

It is no secret that some young rock musicians new to Abbey Road and used only to kindergarten, whizz-kid engineers in flashy new independent studios, are put off by what they regard as 'too many suits and too much short hair' around during the day. The Abbey Road atmosphere changes considerably at night, but apart from that the message always gets home sooner or later that nowadays recording is very much a business. Reliable organisation, technical competence and overall ability to deliver whatever goods the artists require are more important in practice than a flash and groovy facade. ■

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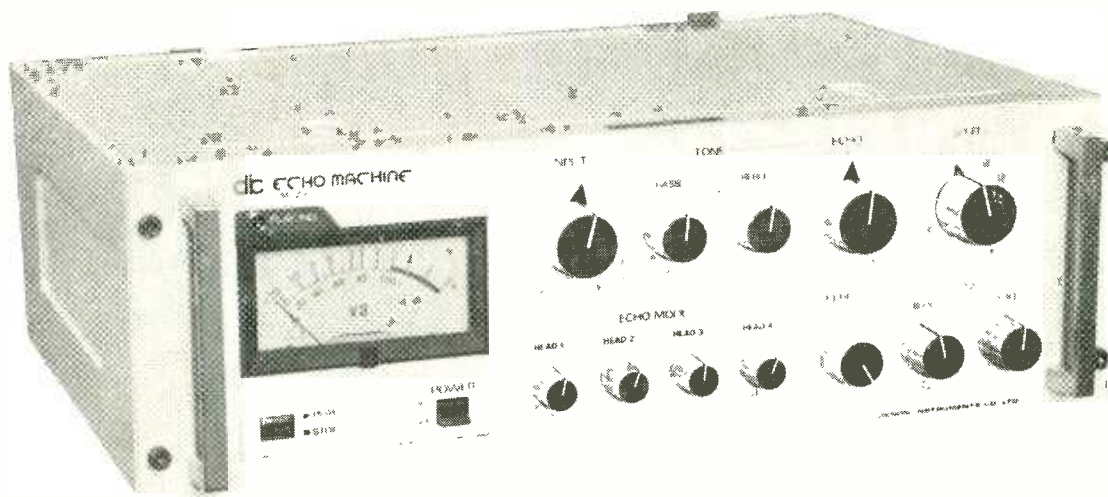
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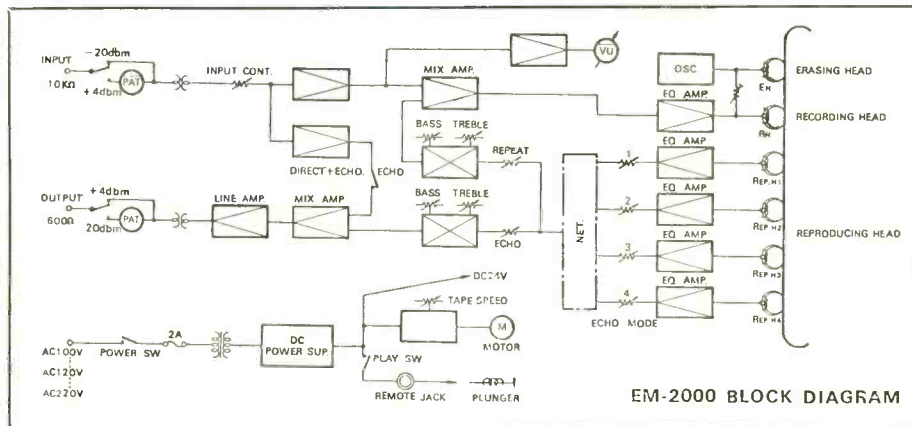
The **EM-2000** is fitted with an electronic servo motor which greatly improves the versatility of the unit, enabling it to produce reverberation over a wider scale and variety than previously possible. The incorporation of a unique new head design and advanced electronic techniques enhances the ability of the **EM-2000** to produce a more nearly natural echo than competitive machines of this principle.

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# APRS 76~report

**FRANK OGDEN**

*The tenth exhibition took place on June 17 and 18 at the Connaught Rooms, London.*

ONCE AGAIN, the amiably parochial nature of the UK recording industry was in evidence at this year's Association of Professional Recording Studios show, the tenth since its inception. Business was brisk as was well reflected in the faces of the exhibitors dealing with nearly 2000 visitors (exact figures aren't available at the time of writing). One aspect of the show that stood out was the obvious overseas interest; the chat in the bar, the natural focal point of APRS shows, and the occasional hand waving on the stands was distinctly cosmopolitan, mostly pertaining to upward business trends first noticeable at the Zurich AES earlier this year. There seemed to be no special bias but spread right across the board from sound re-inforcement to many multitracks.

Concerning the show *modus operandi*, the revised layout of the exhibition, made necessary due to fire damage in the main hall, caused much dark muttering from the visitors tramp-

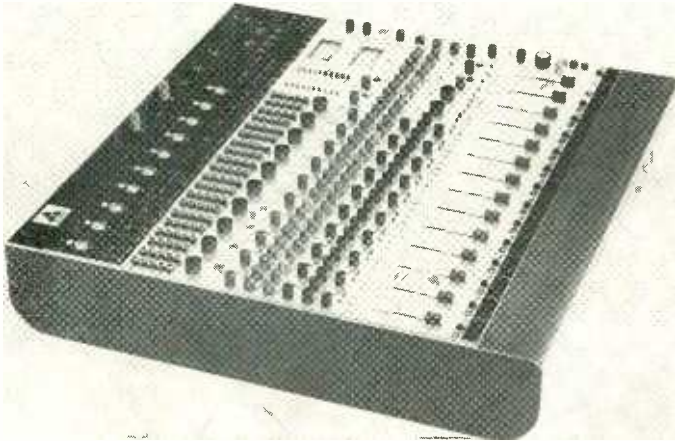
ing up and down between the five levels of exhibits; their plight was less than helped by profligate but rather incomprehensible colour-coded direction arrows and charts. 'Level 1, 2, 4' or whatever would have been much clearer. Right up to the close, one or two desultory-looking characters could still be observed wandering around in circles. There was a considerable groundswell of opinion that the opening hours, particularly on the first day, should have been extended to 2100h or even later with the kick-off put back to about 1100h. While some members of the APRS committee might have a certain amount of spring in their step at nine in the morning, the majority of the recording industry, including this one, would much rather still be in bed in keeping with the nocturnal species that we are. A re-arrangement of hours would probably be welcomed by most of the exhibitors since many were up late the night before trying to put a signal on group 13/drinking. Roughly the same things are going for a later start on the last day of the show.

In spite of the interest and volume of business, the hardware display proved something of a disappointment; there was little that hadn't been seen last year and what there was concerned mostly the peripherals. In retrospect, this might not prove a bad thing as it indicates a new era of stability and consolidation in an industry that has seen much technological development in the past few years. Perhaps this could form part of the incentive for studios to lay hard cash on even more tracks and automated, wide desks which form part and parcel, knowing that future updates will be far away. However, it would have been interesting to see operational automation systems; although Neve provided a videotape display up the road, it wasn't the same thing as getting to kick the tyres.

One of the exhibits not included in the STUDIO SOUND preview (July p42) was a very

compact desk manufactured by Harrison Systems of Nashville, Tennessee. Overhanging the Scenic Sounds Equipment stand, it drew large crowds throughout the exhibition mostly on account of function multiplicity, control layout and inevitably high price—around \$74 000 for a 32/32 with equivalent to 32 monitor channels. The system organisation relies on full-scale use of fet switching matrices to elect the individual operational status of the input channels from four options corresponding to the usual mic/machine/monitor etc. It becomes a very simple matter to monitor sync on some channels while going from mic to machine input on others at the push of a single button—no patch overdubs. The channel panning facilities are extensive with normal odd/even pan for the 32 channel routing; channels also incorporate a full quad positioning module with outputs to a quad buss for use in mixdown and monitoring. The vca faders serve three basic requirements for the desk. A thumbwheel at the base of each channel allows up to nine subgroups using the single voltage buss principle, they fulfil the normal fader requirements and they offer the potential for automation organised through a central read / write / update / manual control panel. The channel equaliser section offers two band parametric middle plus hi and lo shelf/pass facilities. An individual solo button directs the eq-ed output from that channel direct to the monitors for a-b comparison.

It could be that quite a few people missed out on the MCI demonstration staged at the Kenilworth Hotel of the new *JH-500* desk destined for installation at Gus Dudgeon's studio, Surrey. It featured the big, beautiful and comprehensive console lashed up to an MCI 24 track with the whole put through Crown amps into JBL monitors. Despite the vc faders, quad mixdown buss and the work on the system to the early hours of the morning, quite a few snags hit the operation. It was no



Left: Example from Trident Fleximix range



Right: Tweed 12/2 portable mixer

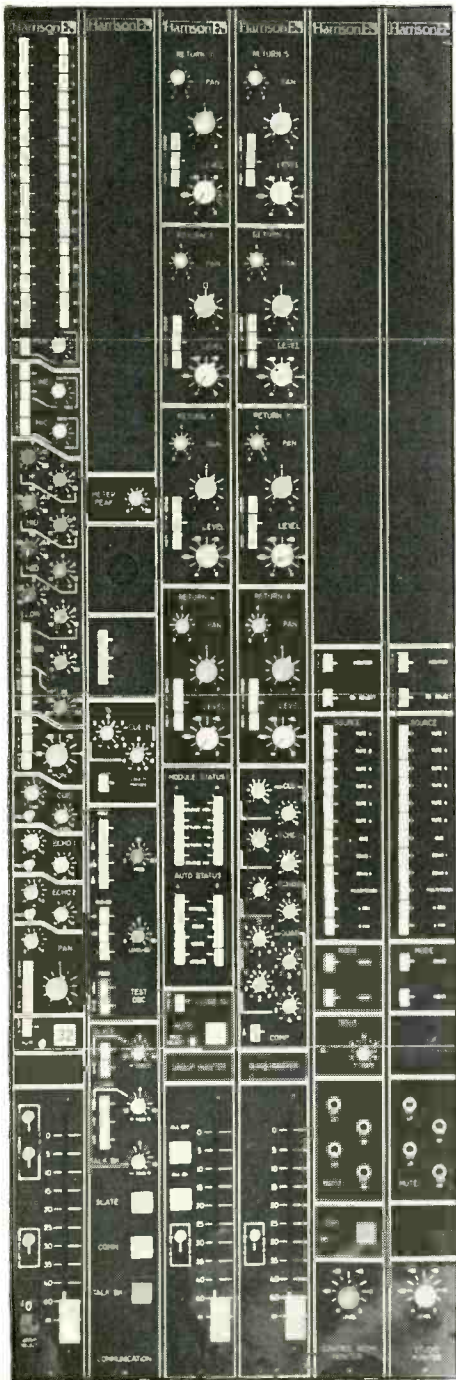


reflection on the equipment, however. You can't expect to set up 24 tracks in rather less hours without hitches. In any case, Dag Felner, the UK MCI supremo, lashed so many Harvey Wallbangers (one part Galliano, two parts vodka and three parts orange juice) that it didn't even matter when some bright spark decided to play the master the wrong way up—nobody really noticed.

Still on the topic of new style consoles, Raindirk introduced their *Quantum* expandable mixing system offering 24 channel mix, remix, jumping and overdub much in the organisational style of American counterparts—except in terms of price. The basic premise is to put

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## APRS REPORT

as much as possible on the desk at channel level. This includes individual monitor/mix-down quad busses, standard routing and push-buttons to decide the status of the channel—record, overdub, track jump and remix. Naturally, this requires the use of separate quad panning and many ancillary status controls but it really does help operationally, particularly in respect of overdub and mix-down. Apparent simplicity might disguise the potential of the thoughtfully-designed eq section. Although incorporating only three basic sections—high, mid and low—the two outers can be switched to shelf or bell with fully-parametric roll/centre frequencies. The mid range is a straight parametric. All sections feature a variable 'Q' when in the bell mode. Moreover, the overall desk size is compact: a basic 40 input model requires only 2.5m.

Feldon Audio offered effects and sensation seekers a useful line in sound bending—the 910 Eventide *Harmonizer*—first shown at the Los Angeles AES Convention (STUDIO SOUND, July p58). The APRS demonstration featured an a/b comparison between the input/output signal sourced from microphone into headphones. It amply showed the potential of the instrument in terms of harmonising an input signal without creating dissonances (it keeps fundamental frequency components to the original ratio despite upward and downward key shifts). The input rhythm is maintained in



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realtime. Employing the re-circulation feature enabled an interesting demonstration of decay of input signal accompanied by a rise or fall in the decay pitch. STUDIO SOUND hopes to review the *Harmonizer* in a later issue.

The other effects unit producing floccillation among the visitors was the EMT multimode digital reverb first shown at the Zurich AES (STUDIO SOUND May, p42). For those who didn't get it the first time round, the all electronic £6000 unit offers a digital delay line which forms the basis for a random reverberation generator (as in echo plate), repeat and decay (as in high speed Revox), Haas effect generator (as in Cooper time cube), and one shot echo/adt (as in delay line etc). The various subtleties are achieved by pseudo-random and straight digital re-circulation back into the delay line. Naturally with so many functions, the unit is programmable over a very wide range of delay and decay times which can be set in real time, or set up and punched in to cue from a previous setting combination.

But then the voice came over the pa '15 minutes to close'. People forgot their heavy lunches and once more spiralled to the top floor, anxious not to miss anything. They then went back to the bar only to find the glasses washed and the bar staff gone. The visitors drifted downstairs and got tangled up with white-coated men grunting and sweating over immovable multitrack machines trapped in lifts. After extrication, it was once more over to the pub for the second time that day and the end of another show, leaving a melee of removal vans and a bit more hope for next year. ■



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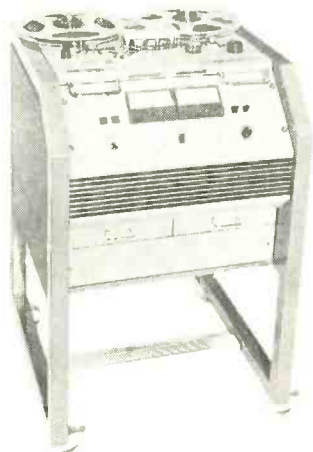
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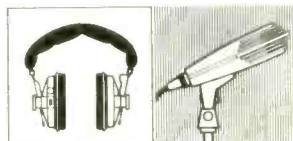
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 dynes/cm<sup>2</sup>). EIA Sensitivity Rating:  
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 5 μV/5 μ Tesla (50 Hz). Polar Pattern:  
 Hypercardioid. Output Impedance:  
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 200 Ω, 1 = ground. M 201 N = 3-pin  
 DIN plug T 3262: 1+3 = 200 Ω,  
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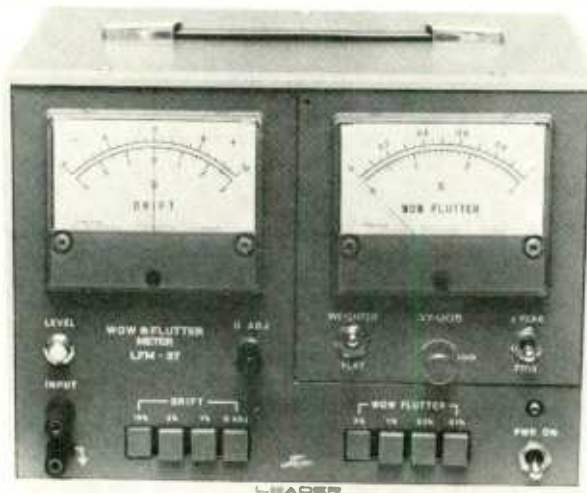


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# reviews

## Leader LFM 37 wow and flutter meter



Hugh Ford

### MANUFACTURER'S SPECIFICATION

#### MAIN FRAME

##### Input characteristics

Frequency: 3 kHz  $\pm 10\%$ .

Voltage range: 15 mV — 10V rms.

Impedance: over 100k ohms; unbalanced.

##### Measuring Ranges

Wow and flutter: 0.1%, 0.3%, 1% and 3%.

Drift:  $\pm 1\%$ ,  $\pm 3\%$  and  $\pm 10\%$ , referred to 3 kHz at 0%, and 1% = 30 Hz.

Accuracy: within  $\pm 5\%$  of end of scale value.

##### Wow and Flutter Scope Output

Frequency response: —3 dB: 0.2 - 250 Hz.

Output voltage: 1V at full scale of each range.

Output impedance: 1k ohm approximately.

##### Reference Oscillator

Frequency: 3 kHz; accuracy within  $\pm 0.05\%$ .

Output voltage: 0.5V  $\pm 0.3V$  rms.

Output impedance: less than 5k ohms.

Distortion: less than 2%.

Power supply: 100, 115 or 230V as specified, 50/60 Hz; 15 VA including plug-in unit.

Size and weight: 200 (H) x 270 (W) x 200 (D) mm; 5.5 kg approximate.

### PLUG-IN UNITS

37-U02 NAB effective value

37-U03 JIS effective value

37-U04 CCIR peak-to-peak value

37-U05 JIS and CCIR values, switch selection

For various wow and flutter characteristics.

1) Each plug-in is provided with a switch for weighted or flat response operation.

2) The weighted characteristic meets with the standards of CCIR REC 409-1, JIS C 5551 and NAB.

3) Meter Calibration. The meter indication characteristic depends on the mode in use: rms (effective) —speed of response is 2.5  $\pm 0.5s$  after the application of the input signal to reach the 95% value.

$\pm$  Peak —in accordance with CCIR REC 409-1, Rms, NAB—effective value of a sine wave.

Price: main frame £265.20 without plug-in. Plug-ins: 37-U02 £95.80, 37-U05 £113.30, 37-U06 £205.80.

Manufacturer: Leader Electronics Corporation, 2-6-33 Tsunashima Higashi, Kohoku-Ku, Yokohama, Japan.

UK agent: C. E. Hammond & Co Ltd, 111 Chertsey Road, Byfleet, Surrey.

measurement modules are available for NAB effective value, JIS (Japanese) effective value or CCIR peak-to-peak value. The fourth optional module, as reviewed here, deals with both the CCIR peak-to-peak measurement and also the NAB weighted rms measurement by switch selection of the meter function, with a further switch providing for weighted or unweighted measurements.

Fortunately, wow and flutter measurements are one of the few audio measurements which are subject to standardisation so far as the measuring instruments are concerned, and the comments in this review are based upon British Standard 4847:1972, German Standard DIN 45507, CCIR Recommendation 409-1, all of which agree in general. These are the basis of the proposed IEC standard for wow and flutter measurement to the quasi-peak method, and also on the American NAB Standard 'Tape Recording and Reproducing (Reel-to-Reel)' which, in essence, uses the rms measurement but the same weighting network as the other standards above.

### Overall construction

It has already been said that the instrument comprises a main frame and a plug-in wow and flutter module and the mechanical design of this facility was excellent, enabling the module to be changed in a few seconds. The only facilities on the module supplied were a clearly calibrated meter scaled in two ranges of wow and flutter percentage reading from 0 to 1 and 0 to 3, a toggle switch for 'weighted' or 'flat' measurements and a second toggle switch for ' $\pm$  peak' or rms metering.

The actual range is controlled by four interlocked press switches on the main frame, which provide for ranges of 3%, 1%, 0.3% and 0.1% full scale meter deflection. A second clearly calibrated meter on the main frame is used for drift measurement, and this is a centre zero meter with ranges  $\pm 10$  and  $\pm 3$  which operate in conjunction with a second set of four interlocked press switches. These give full scale drift ranges of  $\pm 10\%$ ,  $\pm 3\%$  and  $\pm 1\%$  and a 'zero adjust' drift calibration function which operates in conjunction with the internal oscillator and a front panel 'zero adjust' potentiometer.

Signal input is by means of two terminals/banana sockets on the front panel, with an adjacent indicator lamp illuminated when an adequate signal of the correct frequency is applied to the input. The remaining front panel facility is the power on/off switch and an adjacent neon power indicator.

On the rear panel, there are two further pairs of terminals/banana sockets which, like the front panel pair, are on the standard 19.1 mm spacing and in this instance provide the 3 kHz oscillator output and also a 'scope' output for examination or analysis of the unweighted wow and flutter spectrum.

The rear panel also incorporates the fixed two core power lead which can be wound on to a cable retainer when not in use, and a power fuse holder which is of the non-metric type and is not identified with the required fuse rating.

The cabinet, which is painted grey, has a functional appearance and is provided with a good carrying handle and substantial feet. However, there is no tilting foot which would be a useful addition when the instrument is

FOR SOME reason which I have never understood there has always been a lack of choice of wow and flutter meters, and so far as the British market is concerned, most engineers would be hard put to think of more than two available makes. Outside Europe there are a number of rms measuring instruments to be found, but these do little to help measurements to quasi-peak weighted standards which are common in Europe and are now rapidly becoming international.

The Leader instrument under review is the first instrument, to my knowledge, which can

cope with all the generally accepted wow and flutter measurement standards and, furthermore, because it uses plug-in modules the cost of measuring to unwanted standards is not involved.

The instrument comprises a main frame which includes the power supplies and a drift measurement facility in addition to a fixed frequency 3 kHz oscillator. Five different modules are available to plug into this main frame, four of which cope with wow and flutter measurement, the fifth offering low frequency analysis for wow and flutter. Individual



operated at bench level. Internal inspection of the main frame showed that all the electronic components were, effectively, housed on four printed circuit boards of reasonable quality and that the wiring was generally tidy but not to the highest standards. No component identifications were printed on the boards, and the service manual, while it included circuits, did not include board layouts which would assist with servicing. However, the manual was comprehensive and well written.

The electrical safety aspects on the main frame caused particular concern, to the extent that the review sample was positively dangerous: this was the result of the clearance between the end contact on the power fuseholder and the shell of the power transformer being too small, to the extent that twisting the fuse holder cap could short the power supply to the chassis!

Further inspection showed that the following clearances between the incoming power and the chassis or parts connected thereto would fail to comply with British safety standards: (1) Power switch contacts to body. (2) Power between pins on the module connector. (3) Possibly power around the neon power indicator. Clearly the manufacturer must modify the instrument for improved safety, for samples similar to the review sample are definitely dangerous.

While the printed boards in the main frame were retained by a clamp, the three boards in the plug-in had no retainer and were found to be almost out of their sockets upon receipt of the instrument—this requires attention, but in other respects there was no cause for complaint about the construction of the plug-in module.

#### Oscillator

While none of the measurement standards specify oscillator performance, it is, of course, important that it should be free from deficiencies which would appear as wow, flutter or drift. Measurement of oscillator frequency showed that from turn-on, the drift was less than 0.01% which is more than adequate and furthermore the frequency was completely unaffected by power line voltage even down to less than 200V when operated on the 230V nominal transformer tapping.

However, the nominal oscillator frequency is 3 kHz (which was exact on switch-on) which complies with the NAB standard but does not meet the requirements of the other standards which call for a carrier frequency of 3.15 kHz. Really the instrument should include both frequencies, more will be said of this problem.

The oscillator output voltage was found to be 410 mV from a source impedance of 1005 ohms, both of which will deal with most measurement requirements. While the manufacturer specifies oscillator distortion, this is really of little practical significance for wow and flutter measurement; however, it was noted that the manufacturer's specification of less than 2% was not met because of the high second harmonic content which was measured as 2.7%.

#### Drift measurement

The necessary input to the instrument to actuate drift and the wow and flutter sections was found to be 14.5 mV over the input frequency range of 3 kHz  $\pm 10\%$ , under which

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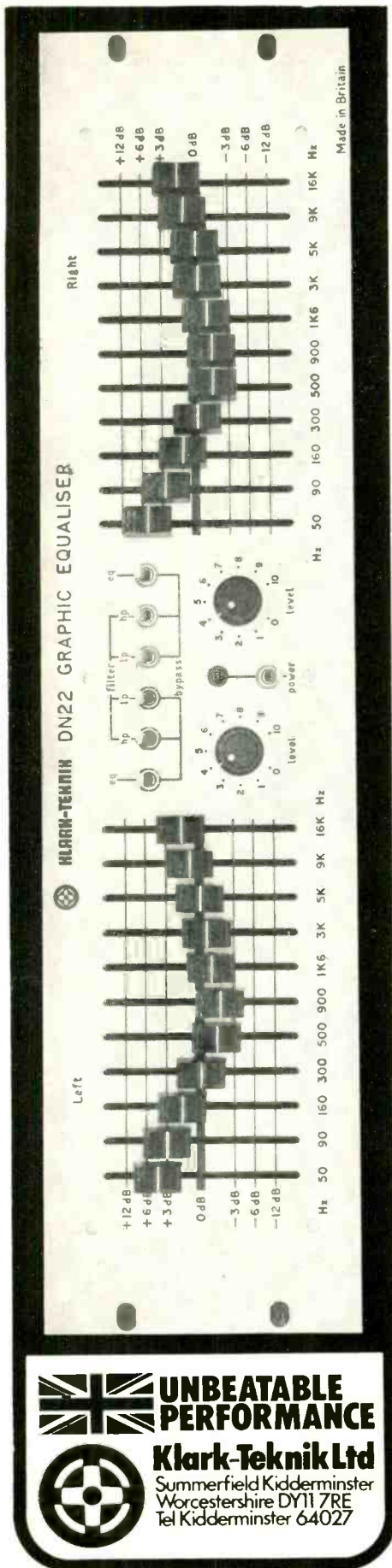
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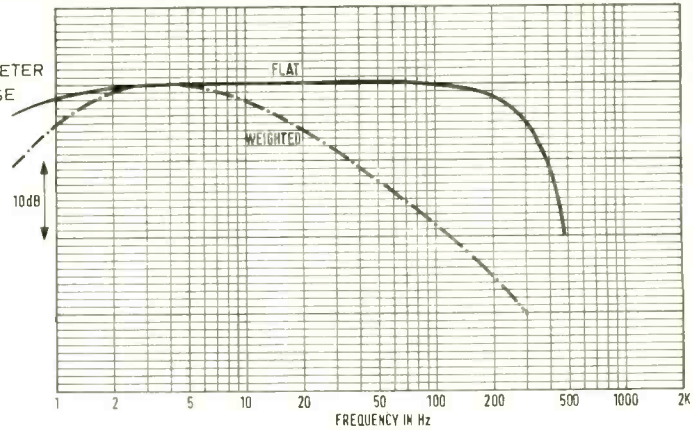
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**FIG. 2**  
LEADER LFM 37  
WOW AND FLUTTER METER  
FREQUENCY RESPONSE



### LEADER LFM 37 WOW AND FLUTTER METER

Similarly it is quite apparent at the 'scope' output which has a drive of  $\pm 1.4V$  peak for full scale deflection of the wow and flutter meter, from a source impedance of about 1000 ohms. Loading of this output has no effect upon the meter and the output is always unweighted such that frequency analysis of the output shows the predominant wow and flutter products, but does not necessarily reflect the products which affect the weighted measurements.

Fig. 2 shows the frequency response of the wow and flutter meter in both the 'flat' and the 'weighted' modes, the response in the latter mode being within the limits imposed by the appropriate standards.

The accuracy of the meter was checked in the

rms and the  $\pm$  peak modes of operation at two points on each range, the results being excellent, as is shown in the above table.

This accuracy was unaffected by power line voltage variations down to 200V on the 230V input setting and was also unaffected by signal input voltage variations in the form of pulses or hum as specified by the wow and flutter meter standards.

As called for by the quasi-peak measurement standards the instrument was subjected to bursts of frequency variations to check the ballistics and rectifier of the meter with the following results:

Burst length	100 ms	60 ms	30 ms	10 ms
<b>Specified indication</b>	$100 \pm 4$	$90 \pm 6$	$62 \pm 6$	$21 \pm 3$
<b>Actual indication</b>	103	86	58	22

Range	Indication	Actual rms	Actual $\pm$ peak
3%	3%	3.03%	2.96%
3%	1%	0.996%	0.981%
1%	1%	1.009%	0.981%
1%	0.3%	0.303%	0.296%
0.3%	0.3%	0.303%	0.296%
0.3%	0.1%	0.101%	0.986%
0.1%	0.1%	0.101%	0.988%
0.1%	0.03%	0.033%	0.032%

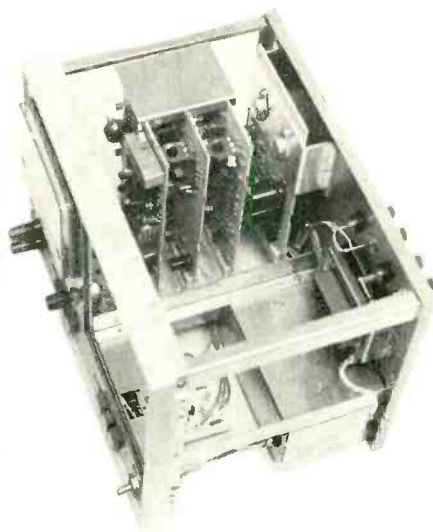
In the rms mode this characteristic is not of course required, and in the NAB standard an instrument having the ballistics of a vu meter is called for. The *Leader* instrument did not meet this requirement, as in the rms mode the meter was found to be much slower than a vu meter, the standard 300 ms burst test giving a deflection in the order of 40% in lieu of the required 100%. However, the rectifier was satisfactory.

### Summary

The *Leader* wow and flutter meter is an ambitious instrument which sells at a competitive price for its performance, and is clearly an excellent instrument for most applications. However the manufacturer must rectify the serious deficiencies in its electrical safety.

So far as measurement standards are concerned, with the minor exception of the input impedance, the quasi-peak standards requirements are met with ease and, with the exception of the meter characteristic in the rms mode not being to the vu meter ballistics, the instrument also complies with the NAB standard. The problem of the internal oscillator beating with the incoming signal and giving a residual low level wow and flutter can easily be overcome by disconnecting the internal oscillator during low level measurements, but the manufacturer should do something about this problem.

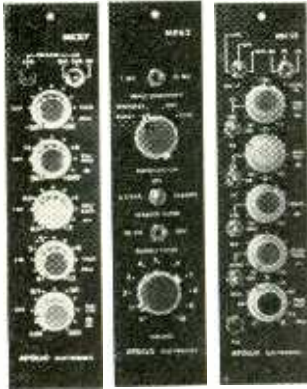
In spite of these minor criticisms the *Leader* instrument is generally all that is required for normal measurements, and furthermore it is relatively inexpensive.





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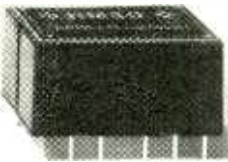


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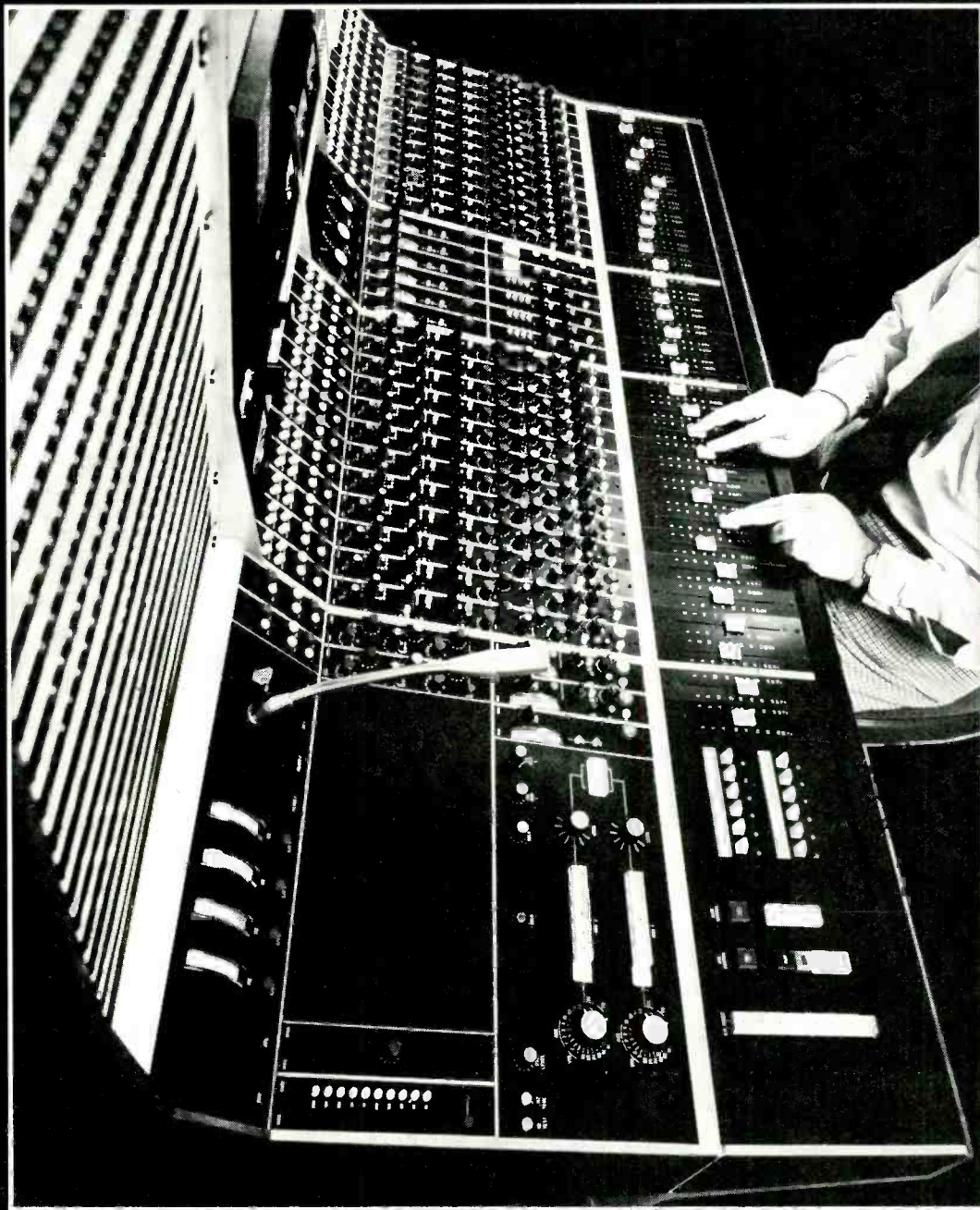
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