

SEPTEMBER 1970

# TAPE

RECORDING MAGAZINE

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15NP



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WITH OVERSEAS SCHOOLS

**AUDIO 70**

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ELECTROSTATIC  
HEADPHONES

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## **B & W** *the demonstrators*

### Model 70

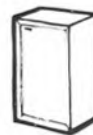
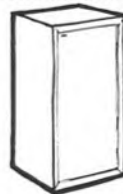
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This 3-motor unit is equipped with four newly developed heads, including one recording and two playback heads that not only permit a higher input, but ensure pickup of very low frequency signals below 20Hz. Which means, among other things, a frequency response of 15 to 25,000Hz, wow and flutter of less than 0.06% at 7½ ips, and a high 60dB S/N ratio. In short, tonal quality of a degree that puts it in a class by itself.

A 4-track 2-channel relay/solenoid controlled deck, the SD-7000 is heads up

on the field in other important aspects, too, providing more tape protection devices, for example, than can be found on any other unit now on the market.

And achieving new standards in ease of operation, with such hard-to-find features as Automatic Rewind and Repeat in addition to Automatic Reverse.

The days when it was a tossup among the best tape deck features are over.

Sansui's high performance heads have seen to that.

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A Stereo Tape Deck, 3 head system, possibly Britain's best selling Hi-Fi unit. List Price £89 19. Cash Price £71 19.

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It's the difference between every day, ordinary, performance and highest possible quality perfection—AKAI perfection.

Just what is a one micron gap head? It's a head whose width is one-micron—one astounding micron, to be precise.

Up to now, 2-micron heads or 4-micron heads have been the standards for comparing tape recorders.

But AKAI has pushed forward and narrowed the head-gap—narrowed the distance between tape recording results and actual sound. The result is AKAI perfection. One micron heads have these distinctive advantages over heads with wider gaps:

(A) They have excellent frequency characteristics even at low tape speed. (This means extremely high intense recording and playback is achieved)

(B) Clear high pitched tone can be regenerated as a high frequency tone and recorded smoothly. (A high frequency tone is recorded with a low distortion rate.)

The frequency characteristics resulting from one micron heads are amazing in recording, but certainly more noticeable during playback.

The frequency which can be regenerated is determined—theoretically—by the width of the head-gap ( $\lambda H$ ). Generally, it is conceded that head output comes to zero when the record pattern wavelength ( $\lambda s$ ) of the recorded frequency is equal to the head-gap length ( $\lambda H$ ).

Actually, the frequency ( $f_{1/2}$ ) whose record pattern wave length is twice the head-gap length ( $\lambda H$ ) can be used for the actual frequency band.

The relationship of the frequency and the head-gap to the tape speed is given in these quotations:

$f = v/\lambda s$ ...General formula for tape speed frequency and record pattern relationship.

$f_0 = v/\lambda H$ ...Frequency at which head output comes to zero.

$f_{1/2} = v/2 \times (\lambda H)$ ... Actual frequency band.

These equations prove what more and more satisfied AKAI users know—that the narrower the head-gap the higher are the tones that can be regenerated.



Model 4000D

Using these equations, let's calculate for a moment.

When tape speed is 9.5cm/s, the actual frequency bands ( $f_{1/2}$ ) will be:

$f_{1/2} = 47.5\text{kHz}$  For one-micron heads

$f_{1/2} = 12\text{kHz}$  For four-micron heads

Let's suppose that a 20kHz tone is to be regenerated. The frequency will be out of the actual frequency band whenever a 4 micron head is used. However, whenever AKAI's one-micron head is used the tone can be regenerated.

Why—you may ask—can only AKAI make one micron heads?

In answering, let's list some of the problems that must be overcome in narrowing head-gaps. First, there is regeneration power degradation, then there is s/n degradation and recording performance deterioration—to mention a few.

These and many other obstacles have been surmounted by AKAI's diversified experience in this and related fields.

From this experience has blossomed AKAI's own, unique technique—technique that leaves absolutely nothing to chance.

Special adhesives and precision plus correct alloy materials for the head-gap have also been distinguished results of AKAI research to successfully narrow wide-gap heads with no defects.

This is all another step-by-step success story in what tape recorder users call "AKAI PERFECTION."

#### 4 TRACK STEREO TAPE DECK—4000D

\*4 track stereo/monaural recording and playback \*2 speeds, 3 heads \*All silicon transistorized pre-amplifier \*Automatic shut off, instant stop control \*Tape cleaner \*ONE MICRON GAP HEAD \*Magnificent oil-finished wooden cabinet \*For increased stereo enjoyment, use the matching AA-6000, 120 watt solid state amplifier and the matching speaker SW130 (2 way, 25 watt input).

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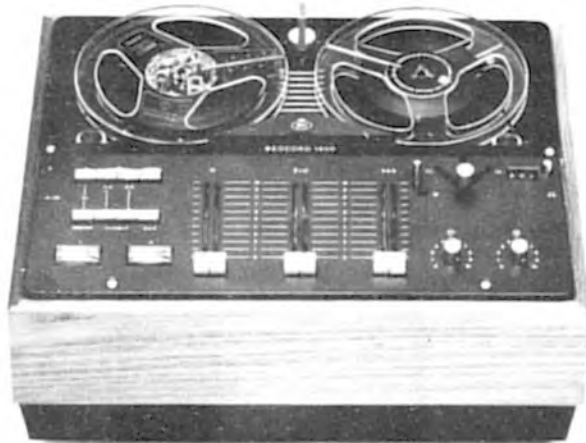
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BEOCORD 1800



BEOCORD 2400

## Made by Bang & Olufsen for those who consider design and quality before price.

Whether you prefer to centre your High Fidelity system around a separate amplifier, or to base it on an amplifier integrated into one of the audio units, your needs for a tape recorder to complete your system can be satisfied by choosing one of these new Beocords. Both machines exceed the minimum requirements for DIN 45.500, and have operational facilities comprehensive enough to attract the semi-professional as well as the domestic user. These include a 3 digit tape counter with push button

**The Beocord 1800** – designed for use with a High Fidelity amplifier such as the Beolab 5000 or Beomaster 1400.

Available in 2 versions: (a)  $\frac{1}{2}$  track record and replay with extra switched  $\frac{1}{4}$  track replay head, (b)  $\frac{1}{4}$  track record and replay only. Sockets duplicated in DIN and phono type to simplify connection. Special amplifier and volume control for output to headphone sockets.

reset. Foil operated auto stop plus thyristor controlled photo-stop for end of tape, tape break or programme scanning. Push button selection of A-B monitoring, sound on sound, echo, syncroplay, mono left, mono right, mixed mono, or stereo play. New hyperbolically ground tape heads with special patented machining give greatly improved contact between tape and tape head and less friction and noise during operation, resulting in less wear to tapes and tape heads.

**The Beocord 2400** – complete with its own stereo amplifier section giving 2 x 10 watts RMS output.  $\frac{1}{4}$  track record and replay. 4 dual channel inputs in mixer section including a magnetic P.U. input. Bass, treble and split channel volume controls. Switched output for 2 pairs of speakers. The amplifier may be operated independent of the motor.

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# TAPE

RECORDING  
MAGAZINE

Incorporating TAPE RECORDING & HI-FI MAGAZINE  
and STEREO SOUND MAGAZINE

Vol. 14 No. 9 September 1970

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Cover Photograph: Some of the intricacies of tape recorder manufacture being explained to the Editor, right, by executives of British Radio Corporation at their Newhaven, Sussex, factory during a recent visit.

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# Tape trends and tape talk

By Douglas Brown

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FINAL JUDGING of the entries in this year's British Amateur Tape Recording Contest takes place in London later this month. The awards will be presented and the winning tapes will be played during the third week in October, at the Audio Festival at Olympia. And the best British entries will be heard a few days after that at the radio station in Geneva, where the international jury will be sitting to judge the 19th international contest (CIMES).

The total entry in this year's British Contest was up to the highest of any previous years and I hear in some classes the standard was significantly better. The judging procedure may not be known to every reader: a panel of judges with wide experience of *amateur recording* does a preliminary sifting of the tapes and short-lists the best entries in each category. For example, Donald Aldous, one of the most respected of audio journalists, has listened to all the music tapes this year; as in previous years, I have heard all the documentary tapes.

The limited number of tapes shortlisted then go on to the final judging panel, who meet in the superbly-equipped Mullard Theatre. The panel includes all who have been responsible for preliminary sifting, plus a number of outside experts, usually including a B.B.C. expert and a professional critic. They listen to tapes for several hours before pronouncing the Tape of the Year winner and the best entries in each class of the Contest.

There is no doubt in my mind that this Contest remains as it always has been, the most effective available outlet for amateur creativity. I hope the function at this year's Audio Festival will attract wide attention and give the Contest a boost.

\* \* \*

PLANS ARE AFOOT to launch another B.B.C. tape recording contest of a type which should prove really popular. I am not free to reveal more yet: watch for details soon.

\* \* \*

SOME VERY STRANGE technological developments in the tape field have recently been announced. Du Pont has developed a new method of copying tapes — not electronically but thermally.

Using the company's chromium dioxide coated tape, the master and a blank are brought into contact and heat is applied. The signal is transferred by a process similar to the "print-through" against which amateurs are always warned if they do not store their tapes in satisfactory conditions.

Now, it seems, Du Pont has found a way of copying tapes at 90 inches per second in this way, which is faster than the present method. It is claimed that there is no loss of quality and that copies can be

satisfactorily made from "secondary masters" copied from the originals.

The whole process is not much beyond the laboratory stage yet, but Du Pont is concentrating on developing suitable machines. Presumably this new process, if all goes well, may make its contribution in due time to reduced prices for tape records.

\* \* \*

THE OTHER INTERESTING new development is also reported from across the Atlantic. A sound engineer called Tony Schwartz has been trying his hand at a special form of tape editing. He has spliced so that the words are made to overlap one another, up to the point at which the total duration of the original speech is reduced by half.

If you think that would produce gobbledegook, Mr Schwartz says otherwise. He calls the process "Mnemonic overlapping" and he argues that the brain calls upon memory to supply the missing parts of the words. Example: the word "icy" suggests the following word "cold", which will be understood even if only partly heard.

Now why would anyone want to do all this?

Clue: commercial television. An advertiser might cram a 30 seconds message into 15 seconds of purchased time on the air. Mr Schwartz says he has tried it out and the impact was *increased*: a commercial using "mnemonic overlapping" brought greater response than those in plain speech.

Someone has suggested that the method might be applied to a novel like War and Peace, so that it could be absorbed in half the normal time. But who, I wonder, would do all the cutting and splicing?

\* \* \*

HOW FAR WILL the amateur be able to get involved in video recording in the foreseeable future? The answer to that question is still a matter of debate.

The example of the municipal authorities of the Swedish town of Solna would, if widely emulated, give the amateur exciting opportunities. A superbly-equipped studio for the production of programmes on videotape has recently been opened there.

Its main purpose is to produce educational programmes for use in the municipality's schools and information and promotional material about the town itself. But the studio is available for hire to companies and organisations able to use television and recording facilities, and the local adult education programme now includes a course on "electronic photography", with the studio used as a workshop.

Why is it always an *overseas* municipality which has the imagination to do something like this?

I CONSIDER it fortunate to have been allowed to experiment with international exchanges of tape recordings for twelve years. The work began with a class of eleven and twelve-year-olds (who are now grown up, some with children of their own). For the past six years I have tried it with six to eight-year-olds. In some ways the work is more difficult, but the compensation is an entertaining exuberance with which young ones so easily win hearts. *Exuberance is beauty*, said Blake.

The pioneering effort was made at Wimborne St. Giles School, Dorset, in 1958; it was then all-age. Although we had no tape recorder of our own, the international exchange went ahead. At first it called for the assistance of the local policeman, a County Education Department technician, the help of one other Dorset school and the goodwill of the head-teacher. Owing to the high cost of apparatus and postage, and my reluctance to impose too much upon the children's patience, there is not much archive material to trace the story down through the years.

In 1958-59, when exploiting a link with Rhodesia, the racial problem intruded. It was edifying to hear children of the mixed European enclave talking constructively with their enlightened teacher about the indigenous Africans. Our classroom in rural Dorset seemed to be an unsympathetic setting in which to appreciate fully, from a surviving veteran, the arduous transplanting of civilisation in the southern part of the Dark Continent. The voice of that old voortrekker described for our children the tiring northward thrust. Outspanning and inspanning were terms that came alive for us. The foothold in Africa, it became clear, brought both blessings and suffering to white and black alike.

As word of the international venture spread through the news-hungry media of press and radio, schools in other places overseas tried to establish links with Wimborne St. Giles. It was then that the innovation could easily have been swamped by too much pressure inside and outside the classroom. Ebullient Americans, heritage-conscious Canadians, and an Australian Sunday School caused us some overtiredness. We felt that we were being exploited. It is not easy to ignore so much earnest goodwill.

In recent years the work has settled down to the comfortable momentum of a yearly exchange sponsored by the School Broadcasts Branch of the Saskatchewan Department of Education. Such well-financed resources excite one's envy; that they still value their loyal, though poverty-stricken, link in Dorset is a consolation. They admire the direct speech of our young children, largely still

**MANY SCHOOLS HAVE TO WORK  
WITH SERIOUSLY LIMITED EQUIPMENT  
ONE TEACHER TELLS THE STORY OF  
SUCCESS WHERE CHILDREN ARE MORE  
IMPORTANT THAN MACHINES.**



# **EXCHANGING TAPES WITH OVERSEAS SCHOOLS**

By Allan T. Cooper

at a stage when it is uncluttered in spite of the unceasing attrition of careless adult *cliche*. The clear joined-script too, which our children use for their letters, descriptions of class visits, and book reviews, is often praised. A facsimile of one sample was published in a Saskatchewan teachers' bulletin. That was most pleasing.

A staunch tape recording friend of St Giles' School is Mr Norman Kelly. He has taken part in several exchanges with us in Dorset from far off Philadelphia. His collection includes a tape on British castles with accompanying photographic slides and Maori chants from a New Zealander. One warm Sunday morning he pointed his microphone in the direction of neighbouring gardens to pick up the gossip. The result was part of a conversation about restoring a grandfather clock and a crop of peaches succumbing to blight. With that tape he started a kind of composite effort that returned to him six months later. Additional items included one of a Scotsman repairing his fence, a Dutch couple arguing, motor scooters in a Paris street and English country sounds with a background of quiet rainfall!

Part of a tape from Arizona described the fascinating attempts of the cactus wren, which builds six or seven nests to confuse other marauding creatures. We still join in the tuneful songs recorded by children in Regina to celebrate Canada's Centennial Year and Expo '67. There are other benefits for us as well. One is the incentive to try hard in order to please school children in distant places. It is a

sacrifice to part with the end product, written and recorded, after such painstaking application. How we wish for a copying machine!

Our boys and girls are keen to learn about children in other lands. The information has greater meaning for them than the text-book kind; and it is up-to-date.

The recording work has been mentioned in *The Times Educational Supplement*; *The Western Gazette* (Yeovil); *The Chronicle* (Bulawayo); *The Weekly* (South Peel, Ontario); *The National Education Association Journal* (U.S.A.); *Tape Recording Magazine*; and, briefly, in *Schools and the Commonwealth* (H.M.S.O.).

Our tapes have gone to schools in Rhodesia, Ohio, Pennsylvania, Arizona, Colorado, Oregon, Louisiana, Ontario and Saskatchewan. Even though our tape recorder is in some ways out-of-date, determination helps us to overcome its deficiencies. Year by year boys and girls continue to take part and, incidentally, to provide themselves with more to talk about at home.

In return a little of the romance of far-away places should remain so that all of us may better endure the occasional tedium of life at school. Thus, for a few years, may be postponed the necessary but unwelcome standardisation of collective schooling; that of fitting into prescribed patterns. At such a stage, school society may become like a collection of prickly hedgehogs where, said Schopenhauer, *the risk of friction will be reduced to a minimum if all the hedgehogs behave in the same way.*

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Listen to the hush-hush TK 147 soon - it's something to make a noise about. TK 147 - £96.4.0.



SAD, SAD NEWS from The London Club. It seems only a short time ago that I was attending their tenth anniversary celebrations; now I learn from the Chairman, Ron Tucker, that the club will cease to exist from July 20th. this year.

Founded twelve years ago, membership has been dwindling during the past two years and at an Extraordinary General Meeting the remaining members decided the club had outlived its usefulness. A special vote of thanks was passed for Richard Keene, vice-president, and all the guest speakers who in the past gave up a great deal of their private time for the sake of members. It was decided that any remaining club funds should be donated to a registered charity, Tape Recorders for the Blind. And yet another chapter of recording history is closed.

"What", I ask myself, "is wrong?" The success of club activities has always been variable. Much seems to depend on the enthusiasm of a small number of devoted members; the rest come to meetings to be entertained rather than to add to the interest. Creativity is in the hands of the few, whilst the majority are content to ride along. But there's little personal satisfaction in passive participation within a creative group, so members drop out and there's always a struggle to keep up the numbers. What is wrong? How does one overcome these problems?

After all, London is the capital city. It should be the centre of interest. And this was *The London Club*. But, in Ron Tucker's words, it had outlived its usefulness. What was its usefulness in the past? Has the hobby interest in creative recording declined? Would a club frankly based on non-creative activities succeed where others have failed? Is tape recording just not suitable as a group activity? Are people apathetic about recording, or is the apathy aroused only by conventional club programmes?

There will always be those who wish to go out and record, but, as Richard Margoschis stresses in his *Nature Notes* this month, they will tend to do it on their own. More people are using tape recording equipment than ever before; fewer than ever are treating the creative side of the hobby as an all-consuming passion. The tape recorder is moving out of the do-it-yourself hobby field to take its place as an adjunct to the less obsessive leisure activities, and in this capacity it is being enjoyed by more owners than ever before.

I am sure that some highly successful club's secretary would now like to write and cross swords with me. Please don't because I know quite well that there are exceptions. I have been referring to a general trend, and the fact that it exists is

# CROSS TALK

## By Audios

beyond dispute. Better to ask whether or not an entirely new kind of club structure is not required to meet the needs of the present users of tape recorders? Or even whether club interest is necessary at all?

Of course people with a common interest, whatever it might be, like to get together and chat about their pastime. Perhaps the fault has been that recording clubs have been inclined to model themselves on the existing pattern of camera clubs. But film is a totally different medium and the group photographic session will never have its recording equivalent. How about gramophone societies? They exist and prosper, but none of the members pretends to *make* anything. When meeting recording enthusiasts at fairs and exhibitions they all love to talk and discuss their problems. One cannot help wondering again if a purely social organisation is not the answer? Or an institution based on a very few very good lectures given by acknowledged experts before a large audience at infrequent intervals? Or should we all just carry on, doing our own thing on our own, and give up all ideas of togetherness?

Whatever the future might be for the remaining clubs the future for recording is assured. Some-one, some day, might have a brilliant idea for a new kind of organisation that will attract members in their hundreds – or thousands. Until then we shall all of us, club members or non-club members, just keep on recording and enjoying it.

\* \* \*

*SPEAKING of interest as opposed to apathy I have been glad to learn that the new Open University has received more than 40,000 applications for the 25,000 places that will be available for the year commencing 1971. By the time this is in print we shall have passed the final date for application, so if you intend to register I'm afraid you have missed the bus this time.*

*Just to remind you of what it is all about, the Open University was founded to offer further education facilities to all those persons who either could not attend a conventional institution owing to business or domestic difficulties, or who have been barred from entrance to higher courses because of the lack of qualifications. There is no entry qualification*

*for the Open University other than an ability potential to benefit from the courses offered. Tuition will be by a combination of radio and television broadcasts with correspondence courses.*

*An interesting fact about educational methods emerged from a conversation I had with one of the exhibitors at the recent NAVEX event at Olympia. He referred to an investigation carried out at one of the centres of higher education. Two classes of students were carefully selected to provide identical ability standards. Each was given the same lecture, but one class had the live lecturer and the other had a television recording reproduced on a number of large-screen sets. Both classes were then given the same examination paper on the subject and comparisons were made to discover which teaching method had been the more successful. It was thought that the live lecturer would certainly prove the best, the only question was by how much.*

*But, to everyone's surprise, the class subjected to television treatment far surpassed the others in their results. In this instance television instruction had proved itself to be superior to the live lecturer. One cannot assume that this result would apply in all cases, but this fact might reassure those who propose to study at the Open University. It might be that they will not be at such a disadvantage as they thought compared to full-time university students.*

\* \* \*

I HAVE ADVANCE NEWS of an international contest that should interest all British recording enthusiasts. It is the third Echo van Schoten organised by the Schoten Tape Recording Club of Belgium. It is different to any other contest because for the "Class A" entries competitors will stay at Schoten for three days. They will have to actually take recordings in the village and edit on the spot.

Perhaps this is the fairest contest of them all. The challenge is simple. All entrants work under the same conditions and limitations; success will be the reward for the greatest skill and understanding of the medium. "Class B" is for youngsters and "Class C" is for a sound track to a film or slide show and is by entry. For full details please contact Mr P. Lawson-Smith of 4 Fishermen's way, Bourne End, Bucks, or Mr Sydney Hall of 46 Whittaker Road, Britwell Estate, Slough, Bucks. This is an annual contest. The first year Mr Lawson-Smith came third; last year he was second. Will Britain be first this year?

By the way, don't worry about language – entries are acceptable in English. And the social side of this event plays an important part. So for an interesting few days in Belgium please write to the addresses given above.

\* \* \*

ONE NEWS ITEM that had to be held back owing to lack of space refers to four well-known figures who set off from Heathrow for Bergen, Norway, one day last May. Our Norwegian friends are strongly pro-British, so They arranged for a Shakesperian entertainment in English as one of the major events in the Bergen Festival.

Top artistes of international repute were required to deliver readings from a number of extracts from the plays and also to perform new settings of Shakesperian words by Joseph Horowitz as well as familiar arrangements by Roger Quilter and Peter Warlock.

The readings were given by Patrick Wymark and Karin Fernald, both stars of BBC television and numerous films; our own Katinka Seiner performed the soprano solos accompanied by the distinguished pianist Rhondda Gillespie. Well done, Katinka!

# Ferrograph Series 7 tape recorder

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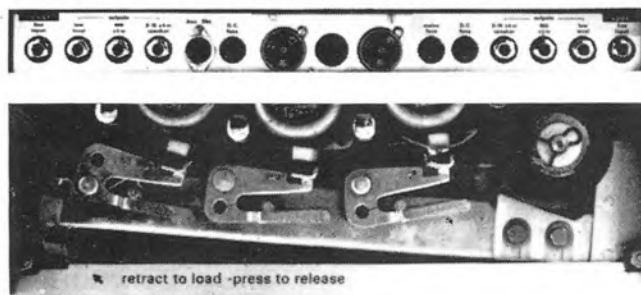
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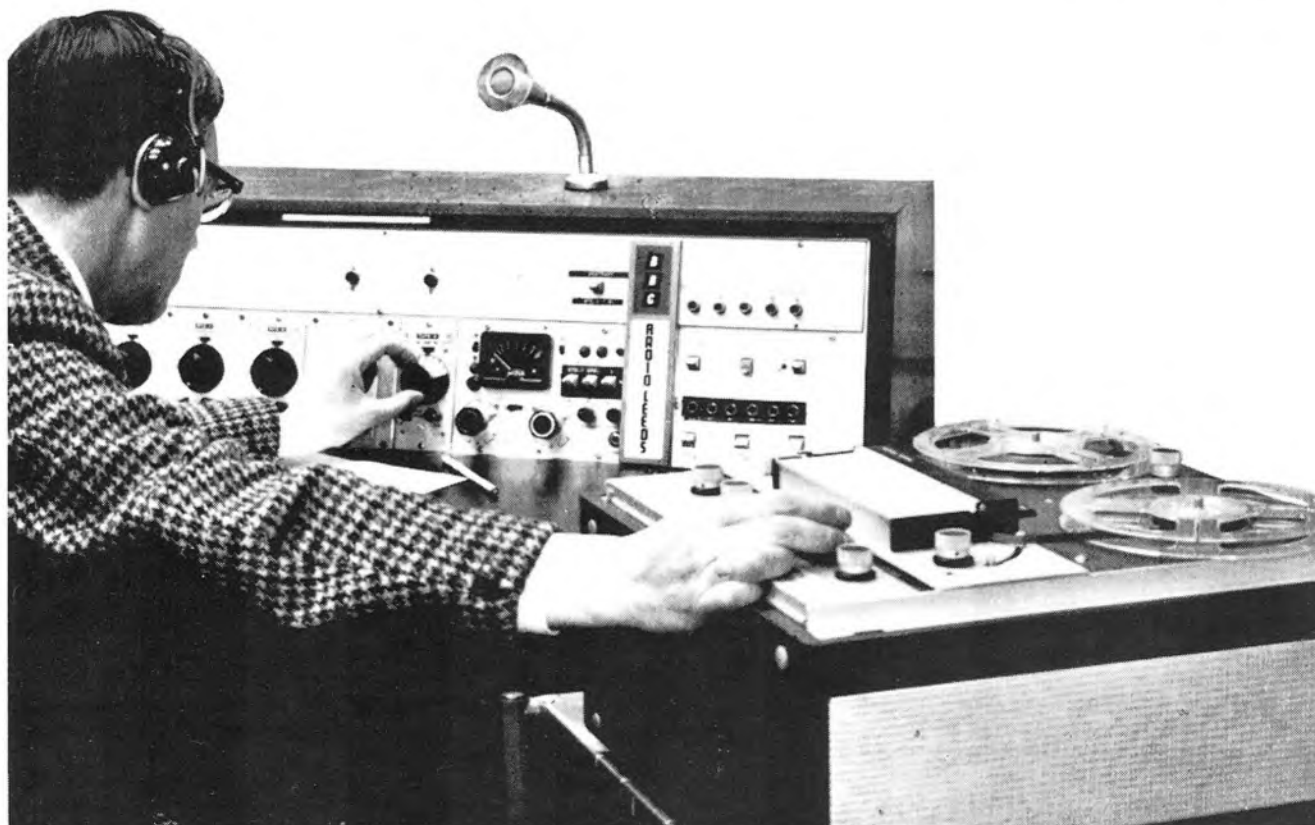
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## Ferrograph



# Calling the North! to AUDIO 70

How to get your ticket Page 292. Exhibitors Page 289

IT IS NOW several years since we had the pleasure of an audio exhibition in the North. Now, at Harrogate, the same town as before, we are to have a completely new event in this coming September under the title of "Audio 70".

Audio 70 will differ in many respects from anything we have seen before. Could you believe a fashion show? Well that will be one of the attractions in an event that claims to offer special interest for the ladies and to relate the styling and use of audio equipment to the reality of practical applications within the home.

This is a point of view with which we entirely sympathise. Audio is *not* reserved exclusively for the male members of the population. To hear some enthusiasts – and some manufacurrers – talking one would suppose that females were born without ears or appreciation of music. Yet how many famous women musicians do we have? And is a home not normally a place where both a man and a woman live?

To integrate the ladies more fully we have to forget the mumbo-jumbo about hi-fi. It was all nonsense anyway. Men loved to make the whole thing sound more complicated than it really is, probably to frighten their ladies away for no other reason than pure selfishness. Quality sound was too good for them... Ladies, you are about to be encouraged to rebel, and about time too.

In fact the female ear is just as critical, if not more critical, than its male equivalent. The truth is that men have always been more interested in things technical or things mechanical, and a man can be more easily persuaded to part with fairly considerable sums of money in order to possess what he regards as a

particularly fine piece of engineering. This is a quality his wife will not understand and for which she will probably not give a fig. She is far more concerned with how the thing *looks*. So at Harrogate we should find less emphasis on science and more on appearance. We should like to think that both of these would be secondary to the sound heard.

There can be fewer more pleasant towns than Harrogate in which to spend a day. The hotel in which Audio 70 will be held stands in its own private grounds within a minute or two of the centre. The exhibition will be open to the public from 4 p.m. on Friday September 18th, from 11 a.m. to 9 p.m. on Saturday and from 11 a.m. to 8 p.m. on Sunday. Trade visitors only will be admitted between 11 a.m. and 4 p.m. on Friday.

This is a wonderful opportunity for our friends in the North to see a really first-class audio show. It is said that the population accessible to Harrogate numbers no fewer than eight million, so don't leave it to the last minute. If you have not visited an audio show before remember that many of the exhibitors will be demonstrating their products in separate rooms and it takes a great deal of time to see and hear everything in which one is interested. Allow a full day if you possibly can. Don't imagine that the last two hours on Sunday will be enough. They will not. Allow time to walk around at leisure, and, above all, *please* don't leave the ladies at home!

So here's a tip for exhibitors and visitors alike. To sell audio to the ladies (and every husband who wants to buy it has to do that to his wife) give the charmers credit for being possessed of all

the normal human faculties and let them hear it and form their own judgements. And if they should express a preference for one sound over another, remember they could just be right. It is a possibility. Few have admitted it in the past.

If the equipment *sounds* right, rule it out if it doesn't *look* right. We have to force manufacturers to give us the design and styling with which we can live in comfort. An ugly appliance will be hidden away and not used. It makes sense. The only way to compel these gentlemen to see the light is to hit them where it hurts – in their pockets – by absolutely refusing to consider the purchase of appliances that will not fit perfectly into the home decor.

Take loudspeakers, for instance. Their purpose is to reproduce sound, and ideally they should be as unobtrusive as possible. The whole point of high fidelity is to give the subjective impression that we are *not* listening to speakers but to the real thing. So why make them in such a way that they demand visual attention? The perfect loudspeaker would be totally invisible. But if you search Harrogate for perfection you are bound to be disappointed. It is the one thing that will not be there. It doesn't exist.

So we compromise. Sometimes the compromise is good, at other times bad. Here you can show your own discrimination by making sensible selections.

Selections? Surely this implies that every visitor will arrive, cheque book in hand, convinced that he will leave many hundreds of pounds poorer? Nonsense! No-one is going to ask you to buy anything. That's more than half the fun of an audio exhibition. One can ask, one can see and one can listen without it costing a single penny. Even the ticket to get in is free. The only obligation on the visitor is to take the whole thing seriously and to form sincere opinions on the merits (or de-merits!) of what he hears. It's the finest way in the world for you, and your wife, to learn about audio, to discover what it really means and to come to appreciate the great benefits good quality sound reproduction brings into the home.

---

*AT THE TIME of going to press the only exhibitors' list available was provisional, and room numbers have not yet been allocated. We give overleaf the names published by the organisers, together with a note of firms from whom confirmation is still awaited. There might well be changes to this list with deletions and inclusions, but it does give some indication of the breadth and scope of the show.*

# Ferrograph stereo amplifier F307

Ferrograph's F307 is one of the finest stereo amplifiers in the world. It has been designed to make the heart of great hi-fi systems.

It is an integrated stereo amplifier, built in the Ferrograph tradition to provide a unique combination of performance and facilities. Power output is 20 watts RMS per channel into a load of 8 ohms. Total harmonic distortion is less than 0.25% at 1 kHz at all levels up to its rated output. Silicon solid state devices are

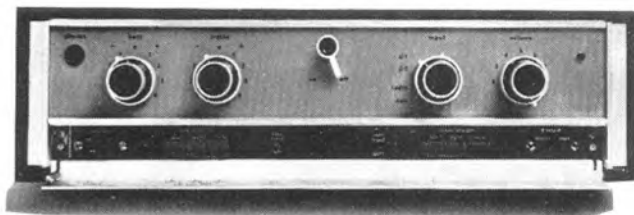
used throughout, with F.E.T.'s in certain input stages to provide high input impedances and large overload margins and thus to accommodate a wide range of input sources, including tape, ceramic and magnetic pick-ups, radio and auxiliary inputs, at their optimum levels. The signal-to-noise ratio, measured with volume control at maximum, is better than 65 dB. Controls include four-input selector switch, switched mains outlets, press-button HF filter, comprehensive mono/stereo input

and output switching. The main controls are readily to hand on the front panels; all others are conveniently placed under a hinged flap.

In appearance, the F307 amplifier continues the uncluttered lines of the Ferrograph Series 7 recorder, the two making an ideal combination which is matched both visually and technically. But the amplifier is equally compatible with most other good recorders and hi-fi installations, suits innumerable

amateur and professional uses, blends with any decor, stands attractively on any bookshelf or room-divider.

When planning your hi-fi system the F307 deserves your serious consideration. Your local Ferrograph specialist will be pleased to demonstrate it to you. Alternatively, please write or ring for details and address of nearest stockist. The Ferrograph Co. Ltd, The Hyde, Edgware Road, Colindale, London NW9  
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# AUDIO 70

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## NATURE NOTES FOR SEPTEMBER

BY RICHARD MARGOSCHIS

I HOPE you will agree that it is permissible for one to have a moan occasionally. Anyway, that is what I intend to do now, if only to get one or two sore points 'off my chest', and in the hope that it might be helpful to somebody.

First, misleading advertisements. You will see regularly in a large dealer's advertisement, an item listing portable and cassette recorders, and in the list you will find reference to the Tandberg *Cassette* Series 11.2. That excellent machine will do a lot of things but it is news to me that it will take a cassette — mine will certainly not do so! I have also seen the Uher 4200 and 4400 listed, in a different advertisement, with an "S" following the reference number — e.g. 4200 S. The S in this case is, in fact, the *advertiser's* own symbol to indicate that it is a stereo machine, but it is misleading because there used to be a 4000-S; it has been superseded by the 4000-L.

There are difficulties enough in purchasing a good quality field recorder without these complications; and they are expensive tools too. There is little chance of a dealer letting you have one to try out, as he would let your wife try out a washing machine, with the option of taking it back. Except in the very large centres your dealer will have to order such a machine specially; and when it comes you've got it, like it or not. I am not suggesting that this is necessarily entirely the dealers' fault; they have their problems, but I think you should be firm if you

find that you have been supplied with a machine which you find does not come up to the standard you expect from it. A friend of mine recently took delivery of a machine which had been given a very good review, but when he tried it out he was shocked at its performance. He stood his ground, told the dealer he would not accept it and promptly purchased a more expensive model.

That brings me to another point, because he was still in trouble! Why do so many of these machines have to go back to the works within weeks, sometimes days, because they have failed in one way or another? I doubt if delivery transport can carry *all* the blame. I know of half a dozen machines which have had to go back for attention immediately after delivery; my own two field recorders, neither British, had to go back almost at once. On the other hand my old Ficord 1A, British made you will note, never went back to the works in 5 years' constant use and one of my Brenells is still going after 15 years' hard bashing.

The time taken for servicing has also been a sore point but I will say no more about that; at least one firm has given assurances that the matter is to be improved.

Now people! One type who annoys me is he who says he is not doing a lot a present because he has recorded all British bird songs — lucky man! I wonder why the B.B.C. Natural History Unit, and others are still prepared to accept recordings?

This is essentially lonely work. There is no point whatsoever in two people going out on an expedition, both expecting to make recordings, unless they are prepared to separate. If they do not, then one will inevitably record the sound of the other operating. At times my wife and I operate two sets of equipment, but only when we are anything up to a quarter of a mile apart. When we have only one machine we do tend to stay close, but then we know how to work together from long experience.

When human voices are a long way off they can spoil a good recording, but what if they are close? We recently got out of the car on a park at the head of Loch Trool in Scotland to find a pied wagtail singing beautifully from a post. Taking no notice of all the people around I started recording. All talking gradually ceased and I got a perfect recording while a dozen people stood silently watching! Yes, there is still some respect for others' 'activities' in the countryside.

I'll not write in this mood again for a long time, but I feel better for having done so!

# THE TONMEISTERS OF SURREY

The Editor visits the University

ON A BLEAK HILLSIDE next to the industrial bulk of Guildford cathedral the new buildings of the University of Surrey appear to have sprung from the mud-scarred ground. With the freshness of a young green plant, but, alas, with nothing of its beauty, they now stand to overlook the town below. There was no hint of summer in the air as cold winds gusted across the vast empty spaces silently announcing themselves to the visitor as "destined for future expansion". A mechanical excavator stood motionless with its outstretched arm angled grotesquely against the sky and caterpillar tracks embedded in the soft, yellow mud. A handful of students unenthusiastically kicked at a ball made sluggish by the heavy, clinging stuff.

Such was my impression of the university when I called in search of what must be regarded as one of the most exciting developments in recording ever to have taken place in Great Britain. And it required the courage and original thought of a brand new academic institution to bring it about. I am referring to the first university course with its own accompanying degree in the subject of sound recording.

On the Continent would-be students have been more fortunate. Soon after the war the Tonmeister Institute in Detmold, Germany, was founded by D. Tienhaus, a physicist and musician who died only a few years ago. The object of the Institute was not merely to teach recording techniques and award a suitable degree to successful students, but to relate the technical side of recording to musical ability and appreciation. More than twenty years ago it was felt in Germany that the rapid technological progress of recording methods and the wide diversity of their uses required a completely new breed of artist-technician. Up until then the sound engineer required no particular knowledge of, or aptitude for, music; to the musical performer the technical rites of the engineer remained mysteries he had no wish to unravel. The two travelled separate roads in separate ways and rarely felt they had more than a little in



A view of Surrey University from the air, showing from left to right the academic blocks, "core" buildings and residences with Guildford Cathedral on the extreme right and the town centre in the background.

common.

But it is not a coincidence that much of the research and experiment into the new musical forms dependent on the tape recorder, the signal generator and the computer has been carried out in that country. The climate for such an approach was right; in Detmold they had the facilities and an ever increasing number of Tonmeisters were eager to develop the complexities of the subject they had been studying at the Institute.

Neither is it a coincidence that the standard of commercial recording in Germany is amongst the highest in the world. It should be; for some time it was the only country producing properly qualified personnel who knew as much about music as they did about recording. But now, thanks to the foresight of Surrey University, we too are about to have all the advantages of a similar academic training available to suitable

students.

I was calling at Surrey to find out how a prospective student could gain admission to the degree course in music and what he would have to do to graduate as B. Mus. (Tonmeister). My guides in the Department of Music were Brian Brockless, Musical Director, and Dr. Hans Heimler, Lecturer. The Professor and Head of Department, Professor Reginald Smith Brindle, had not yet taken up his new chair.

First the concept of the course was explained. There will be a single degree course in music and for the first year instruction will be common to all students. Thereafter one of two options will be open: either Academic and Practical Music (option A) or Tonmeister (option B). The full course will cover a period of four years' duration including time spent away from the university obtaining practical experience.

# THE TONMEISTERS OF SURREY

*continued...*

Entrance requirements will depend upon which option the intending student proposes to take up. Minimum general requirements are three G.C.E. "A" levels in approved subjects plus one other subject at "O" level, or two "A" levels plus three approved "O" levels. For the Tonmeister option a basic grounding in maths and science is obviously a prime requirement and these will normally be regarded as obligatory. A G.C.E. pass in music is also mandatory, as is a good performance standard on at least two musical instruments, one of which must be keyboard. For the option A emphasis is more firmly fixed on musical qualifications without the need for a scientific background.

It might be thought that these entrance requirements are stringent, as indeed they are. Dr. Heimler told me that more than forty applications for the Tonmeister option had been received, out of which only eight students were accepted. Even this small number is greater than was originally intended. For option A there will be only five students.

It must be appreciated that this is not only the first course of its kind in Surrey, but the first in Britain. The Department is in the fortunate position of being able to draw on the long experience of Detmold in this field, and it is understood that out of the thirty or forty who apply for admission to that Institute each year only three (never more than six) are accepted.

As Brian Brockless explained, the limitations are space, time and money. Full of enthusiasm the Surrey Department of Music looks forward to all manner of possible future extensions of its programme, perhaps with extra-mural courses or internal part-time facilities for the benefit of those who are already working in the recording industry or who are concerned with recording in other ways. But for the time being all the effort and facilities must be concentrated on the one single objective of the main degree course.

Speaking of facilities I was taken to

the new recording studio where we found Dr. Bowsher taking noise measurements with a B. & K. sound level meter. Precisely the same studio difficulties arise in Guildford as would have to be solved anywhere else. On the floor immediately above is an examination room with heavy foot traffic . . . . Outside aircraft appear from nowhere to produce a dull roar in the studio . . . . The control room is smaller than they would wish for . . . . Only part of the recording equipment has been installed . . . . All these familiar problems are being met and solved before the first of the students arrive at the beginning of the next academic year.

One interesting feature of the structure of this course lies in the fact that much of the programme material on which the student Tonmeisters will work will be produced within the university itself by the Academic and Practical Music students, the Collegium Musicum, and through associated recitals and performances held in the cathedral immediately next door. Although this will give an excellent grounding in the subject it will of necessity be limited in scope. It is therefore intended that all students shall leave the university for one year before graduating so as to acquire practical outside experience before undertaking their final year's study.

The range and variety of equipment that would be needed to give students every facility they might need in professional work is truly frightening to contemplate. As every aspect of recording will have to be covered the very important pop recordings cannot be ignored. I know from personal experience how much easier it is to deal adequately with classical repertoire rather than the complexities of the pop world.

At present the university recording facility is limited to a professional half-track Philips stereo machine with a fairly simple mixing desk and a bunch of AKG microphones. This will have to be extended to include the multi-track machines that are now in use in all the

major studios; these demand the use of highly complex mixing desks and the total cost involved will be awesome.

One reason why the amateur is never able to produce a truly commercial sound from a pop group is his lack of this extremely sophisticated and costly equipment. Surrey will have to provide it if they are to cover the entire field of recording realistically.

Much of the success of pop records lies in the expertise of the recording engineers. It is they who, through their technical skill and knowledge of the commercial need, produce a marketable commodity. Many have already moved in the direction of composition, interpolating within their works all manner of recorded sounds and effects to produce specific desired results. They are relating music to engineering in much the same way as the Tonmeisters, but without the academic background behind them.

It is not difficult to imagine what new thoughts and new approaches to the subject will be stimulated by such a comprehensive course as has been envisaged here. The artist-technician will no longer be a semi-amateur groping in the dark but a polished professional. There will be opportunities for post-graduate study with awards higher than the B. Mus. to be won. These will be the elite of the recording-musical world.

All this is a long way from the days of the make-shift studio and the equally make-shift equipment. There is only one way to do a proper job and that is to understand every facet of the undertaking from conducting the orchestra to balancing the soloists. If four-channel stereo should ever become commercially acceptable then the need for university trained staff will be even more acute.

Quoting from the prospectus it is said that the Tonmeister will be responsible for the success of an original broadcast transmission from either a studio, concert hall or opera house, or in the record industry he will be responsible for the recording itself. A mere knowledge of sound engineering is not sufficient, so the Tonmeister will be familiar with problems of interpretation and the composer's intention as related to both artistic and sound quality. Graduates from Detmold are to be found all over the world and with increasing preoccupation with communications media of all kinds the Surrey Tonmeisters should find themselves in the fortunate position of being much sought-after employees.

At least as significant, the performing musicians graduating from the other option course will have a realistic and thoroughly practical knowledge of the

Please turn to Page 297.

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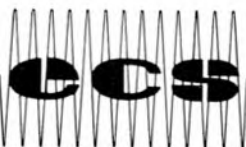
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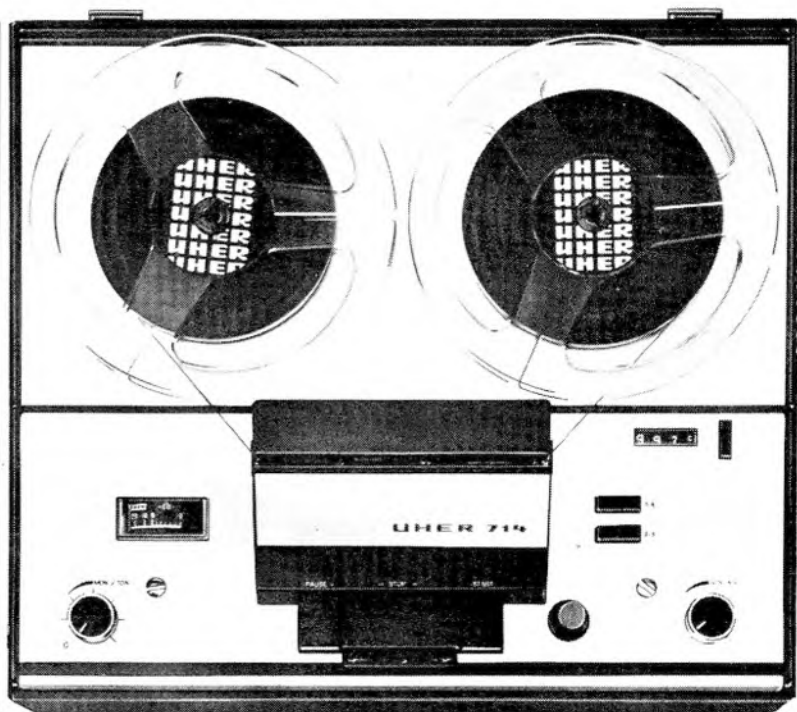
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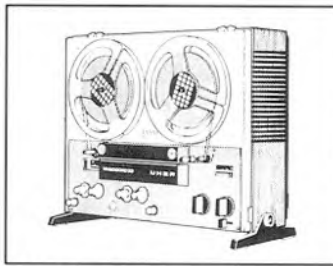
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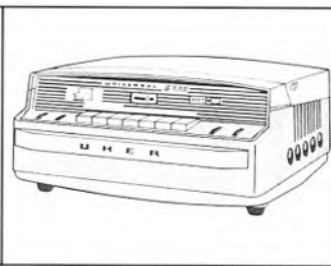
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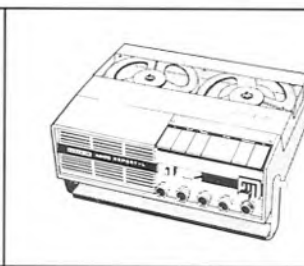
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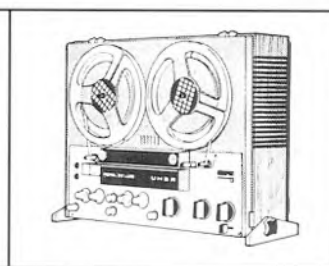
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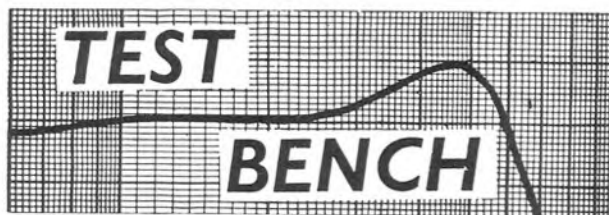
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OUR CHOICE of review equipment this month has been influenced by our preoccupation with what we regard as the basis of audio – an appreciation of the sound one hears. If it were not for the pleasure and enjoyment we get from listening to recordings there would be no recordings taken in the first place. And yet in this area of listening we enter a region where opinion is preferred to measurement, where the precision of the laboratory must give way to the subjective impression of the educated ear. It has been said that the ear is the most delicate measuring instrument of all; so it is, but it is also the most unreliable. In this review we are therefore attempting to relate measurement to what we believe we hear, or would like to hear.

When recordings are reproduced the sound we hear is that created by the vibrations of the cones in the loudspeakers. It is possible to measure the “fidelity” of a loudspeaker by placing it in a specially constructed room devoid of all sound reflective properties. Here one can feed the speaker with a series of tones at a fixed level and pick up the audio output on a very accurate measuring microphone that will tell us precisely how efficiently the cones are dealing with sound over the full width of the audio spectrum *under the circumstances in which the measurements were taken.*

If we all lived in anechoic chambers that would be the end of the matter; thank goodness we don't because under these conditions any loudspeaker would sound terrible to our subjectively sensitive ears. The moment we take that loudspeaker into the home using it in normal domestic surroundings then the sound it produces will be coloured by the acoustic properties of the listening room. Standing waves can build up to give very objectionable peaks at frequencies that will depend on the shape and dimensions of the room; even if the speaker is capable of reproducing sounds right down to the extreme lower limits of human hearing they will not be audible if the room is too small. It is difficult enough to make a “good” loudspeaker but those difficulties are multiplied as soon as we attempt to maintain the quality standard under conditions of practical use.

\*Hugh Ford is the proprietor of H.F. Engineering of Sunbury-on-Thames, where all the standard B & K measuring equipment was used in this review.

# KOSS ELECTROSTATIC HEADSETS

INVESTIGATED BY D. KILLICK  
WITH HUGH FORD\*

## MANUFACTURER'S SPECIFICATIONS.

### Koss ESP6 Electrostatic Headphones

Frequency Response Range: 27 to 19,000 Hz  $\pm$  5dB 35 to 10,000 Hz. 2½ dB Individual response curves are supplied with every headset.

Sensitivity: 90 dB SPL at 1 kHz with 1 Volt at the input

Total Harmonic Distortion: Less than 0.2% at 110 dB SPL

External Noise: 40 dB average through fluid-filled cushions provided.

Power Handling Capability: Maximum continuous programme material should not exceed 10 Volts (12 Watts)

Source Impedance: 4 to 16 Ohms; at higher impedances the response at the extremes of the range will progressively reduce; e.g. 50 Ohms causes a 5 dB loss at 30 and 10,000 Hz.

External Power Requirements: None

Accessories Provided: Model T/3 speaker/headphone transfer switch and 3 circuit jack assembly with cables and lugs for amplifier and loudspeaker connection. Carrying case with foam padding and compartment for T/3

Cushions: Fluid filled

Cord: 4-conductor; 3 feet coiled, 10 feet extended

Plug: Standard tip, ring and sleeve

Knurled Knob: Universal mount for boom arm (not included)

Weight: Headset only 27 ounces

Recommended Price: £45 tax free

Distributors: Tape-Music Distributors Ltd., 11, Redvers Road, London, N.22.

### Koss ESP9 Electrostatic Headphones

Frequency Response Range: 10 to 19,000 Hz  $\pm$  5dB 15 to 15,000 Hz  $\pm$  2dB. Individual response curves

are supplied with every headset  
Sensitivity: 90 dB SPL at 1,000 Hz. with 1 Volt at the input

Total Harmonic Distribution: Less than 0.2% at 110 dB SPL

Isolation from External Noise: 40 dB average through fluid-filled cushions provided

Power Handling Capability: Maximum continuous programme material should not exceed 10 Volts (12 Watts)

Source Impedance: 4 to 16 Ohms; at higher impedances the response at the extremes of the range will progressively reduce: e.g. 50 Ohms causes a 5 dB loss at 30 and 10,000 Hz.

External Power Requirements: None, except when used for precise low level signal measurement when external A.C. line can be selected on E9 energiser supplied.

E9 Energiser: Contains two coupling transformers, self-energising circuitry, speaker/headphone transfer key-switch and A.C. pilot light. Has 6 feet cable connector for amplifier with lugs.

Cushions: Fluid filled.

Boom Mount for Microphone: Knurled knob on left cup; accepts all standard booms.

Headset Cable: Flexible 5-conductor, 6 feet long. with special plug to suit receptacle in E9 energiser

Accessory Provided: A.C. power line, 6 feet long.

Weight: Headset only 19 ounces

Recommended Price: £69 tax free

Distributors: Tape-Music Distributors Ltd., 11, Redvers Road, London, N.22.

At this point one might well ask: is it worth it? Does it really matter? The answer depends upon one's point of view. Having spent (invested) what must be a relatively large sum of money on various items of equipment we should feel cheated if unable to hear what had been recorded. And if a tympani note sounds like the thump of a heavy footstep in the flat above then we are not hearing what we should and we are not getting value for money.

But one must draw the line somewhere. Ideally the correct solution would probably be to select a pair of "ideal" loudspeakers with the flattest possible response curve, lowest distortion and best handling of transients and then to adapt the listening room to suit them. This could give us good sound but at the cost of great expense and considerable domestic upheaval. So in search for an alternative we considered a situation where the acoustics of the listening room in no way affect the quality of the sound heard. To arrive at this state we have to bring the loudspeakers right up to the ears and to seal them against any outside interference. In other words we turn to headphones.

At once there is a snag. Headphones are notorious for their weaknesses at the extreme ends of the audio range. It has been quite impossible to achieve pure reproduction of sounds down to 27 Hertz and in the upper frequencies all manner of strange things can happen. This limitation of performance is inherent in the moving coil system and up until a few years ago it was believed that the headset had progressed as far as it ever could at any price. Its performance was still inferior to that of good, or even medium quality, loudspeakers. What was needed was a different *kind* of sound reproducer built into the cans. And that is what the engineers of the American firm of Koss finally achieved with their electrostatic 'phones.

Their aim was said to be *not* to produce a headset as good as a good loudspeaker, but *better*. They claim to have met that objective. Thanks to the courtesy of the U.K. distributors, Tape-Music Distributors Ltd. of London, we have been able to examine and measure the performance of the two electrostatic models available in this country, the ESP6 and the ESP9.

At first glance the cost of these instruments seems frightening, but it must be remembered that we are talking about appliances that claim to give us *better* sound than we could expect to hear from loudspeakers and we all know how a pair of good enclosures will set the bank balance back. £69 – the price of the ESP9 – would be an outrageous price to

pay for "ordinary" cans; but if, for that money, we could get a performance standard better than that to be expected from a pair of speakers of similar total cost then the proposition becomes more sensible. If the performance standard approaches, or equals, that which we could expect from a pair of loudspeakers costing, say, £300, then the whole thing becomes very interesting indeed. And that is roughly what the manufacturer claims in his literature.

But there are other important aspects of listening on headphones. Stereo recordings reproduced in this way have been described as "binaural", that is the listening is "two-eared" rather than stereophonic. Whatever name tag one ties to it the impression received by the listener is very different to that he would experience from a pair of loudspeakers. The headset might be called anti-social because the user's ears are sealed and he is cut off from the sounds and people around him. This could be an advantage where private listening is required or a disadvantage for those gregariously inclined. Then there is the physical discomfort (indignity?) of having the ironmongery attached to one's body. The pros and cons are almost endless, but none of these arguments are relevant until we know just what the headphones will do, so our first problem was to establish measurements methods.

It was here that Tape-Music Distributors Ltd. very kindly came to our aid by supplying us with a specially constructed frame, or "coupler", designed to hold a microphone immediately below one half of the headset in such a way that the cavity between corresponds to the actual cavity of the human ear. The volume of this cavity is critical for accurate response measurements; too much or too little would throw the curve wildly out. As the volume of this cavity is only 6 c.cs. the setting up of the equipment involved some very delicate adjustment and even so we would hesitate to claim absolute accuracy for our results. They do, however, give a very fair indication of overall performance and in fact they relate closely to the findings of other investigators in this field.

Before discussing our technical investigation we should explain the principle of operation of electrostatic phones. Just as an electrostatic loudspeaker or microphone ("condenser") requires a polarising voltage to charge the plates, so does an electrostatic headset. This energising voltage is usually derived from either the mains power supply or (in the case of microphones) from small batteries. Neither of these methods is very convenient, so the Koss research staff



The Koss ESP9 headset with its associated energiser.



Model ESP6 comes in a padded plastic case complete with accessory switchbox.

came up with a new idea. They made it possible to energise the plates in their headsets without either mains or batteries by making use of the signal voltage from the amplifier. Consequently their model ESP6 is entirely "self-energised", whilst the more costly ESP9 comes with a separate mains power pack which can be used with the supplied mains lead to give AC powering or it can be switched to SE (self-energised) when the lead can be dispensed with.

Since the ESP6 is an entirely self-contained unit with the electronic circuitry built into the cans themselves the weight is greater than that of the ESP9. However they do have one feature that is not included in the dearer model. A red neon is fitted to each phone and these give a flickering light on peaks to indicate listening intensity. A check showed that illumination occurs between 90 and 100 dB Sound Pressure Level and this would be regarded as "loud" in domestic terms, perhaps even "very loud" to some ears. In view of the fact that both models claim to be able to

reproduce down to very low frequencies it is important to use them at reasonably high levels if advantage is to be taken of this ability; at low levels the ear discriminates against low frequencies and they would appear to be attenuated.

Our first response tests were taken using the ESP6 and a considerable amount of time was spent adjusting the microphone and coupler to get the relationship with the phone as nearly right as possible. It will be noted that the manufacturer claims a response for this model of from 27 to 19,000 Hz with a tolerance of plus or minus 5 dB, and 35 to 10,000 Hz. at the closer tolerance of plus or minus 2½ dB. To prove the point they supply two pen graphs with every set showing the response of that individual pair of cans

It would not be fair for us to publish our figures as tiny variations in coupler adjustment can produce startling troughs or peaks in the curve. However we satisfied ourselves completely that not only were the ESP6s performing very closely to spec. and to the pen graphs supplied, but perhaps even more important the response of the two sides, left and right, was as nearly identical as it would be possible to get. The graph from the right-hand phone was to all practical purposes a carbon copy of that from the left.

The claim to reproduce low frequencies is, like Caesar's wife, above suspicion. Our measuring equipment did not go below 20 Hz., but from that point up to around 1,000 Hz. there was less than 1 dB variation on all the phones we measured. This is much better than the claim; the graph could have been drawn with a ruler it was so straight. A common feature in all our graphs was a "dip" at around 7,000 Hz. falling a little below specified limits. The published curves show a similar fall-off in this area, though not so great as ours, and the difference could be accounted for by coupler adjustment.

Electrostatic phones do not have the advantage of the extreme sensitivity of moving coil models but our first check showed that the ESP6s. required 1 Volt to produce 90 dB at 1,000 Hz., which is precisely the specification figure. We found later in our investigation that there are certain complications arising in the relationship between sensitivity and input level when using either the self-energised ESP6 or the ESP9 in its self-energised mode, and we will deal with these later.

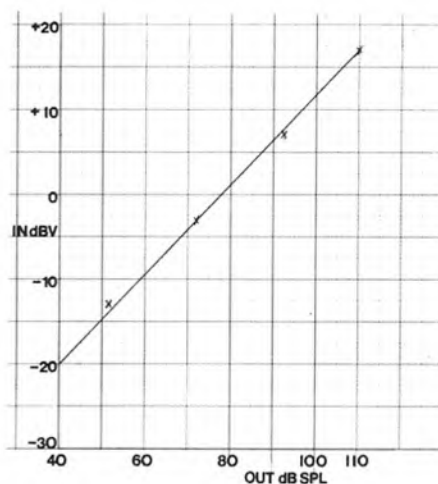
In their technical literature Koss state that although the ear will tolerate a certain amount of distortion there is a limit of around 3% above which the listener will react violently against it. They add, rightly, that smoothness and freedom from distortion are important

factors in the reduction of listening fatigue and they comment with regret that no systematic study of this phenomenon has yet been undertaken. This was a point we emphasised in our recent editorial on music reproducing systems in motor cars. Measuring the distortion present in a 1,000 Hz. signal at 110 dB (very loud for domestic use) we established a third harmonic distortion content of 0.34% and this fell to 0.2% when the signal was reduced to 90 dB. All our distortion measurements at 1,000 Hz. were excellent; probably better than could be expected from any loudspeaker enclosure.

Bearing in mind the fact that one reason for purchasing electrostatic phones would be to acquire the benefits of extended low frequency response we felt we would be justified in checking again towards the lower end of the audio spectrum, so the measurements were repeated at 50 Hz. Here we had something of a shock, because we found distortion rose to an alarming degree in the ESP6s at 50 Hz. with a Sound Pressure Level of 110 dB. The figure was so high as to be absurd, but it quickly fell as the input was reduced although it was still unacceptable at 100 dB. We would suggest that for optimum performance the ESP6 headset should be run at around 90 dB (neon lights just on the point of flickering on the loudest passages) when low frequency distortion will not be a problem.

At this point we turned to the ESP9 model with its separate mains power pack. As this offers two modes of operation we ran our response tests twice to check on the differences between the two. Holding the two graphs one on top of the other it was seen that there was less than 1 dB variation between them. The curves followed the general pattern of those from the ESP6s with a long, dead straight line from the lowest limits but in this case there was no practical deviation until after the 2,000 Hz. mark. Again we had the "dip" at about 7,000 Hz. but it was rather less than with the lower cost pair. Variations in response between the two models were so small as to be, in our opinion, undetectable on ordinary listening tests. Once more the curves left to right were as near to identical as one could get.

When we looked at sensitivity we found that the 9s were slightly less sensitive than the 6s, requiring 1.3 Volts to produce 90 dB Sound Level Pressure at 1,000 Hz. when mains energised; switching to SE we obtained what appeared to be conflicting results. Our first check showed that 1.8 Volts was needed to produce 90 dB SPL at 1,000 Hz. but subsequently this figure became 3.15 Volts. Leaving this rather strange



Graph showing the relationship between input and output measured on the ESP6 anomaly for the moment we measured distortion content with particular interest in the low frequency area in view of our findings on the ESP6 model.

To our pleasure we found that the distortion content in the ESP9s relating to a 50 Hz. tone at a Sound Pressure Level of 100 dB was below 1% whilst at the same level there was a 0.3% third harmonic distortion content in a 5,000 Hz. tone. At other frequencies distortion was also well down below 0.5% although we could not substantiate the manufacturer's claim of 0.2% over the entire bandwidth. When dealing with figures of such a low order it probably makes little difference whether or not they are plus or minus the odd tenth of one per cent. We concluded that the ESP9 phones would be run at a level 10 dB higher than that applicable to the other model, so would recommend 100 dB SPL (domestically very loud) as the maximum distortion-free output. This presents no problems for home use but we do feel that sound engineers might well wish to listen at levels up to 110 dB SPL, when, on the sample we examined, there would be excessive low frequency distortion.

The last part of our technical investigation was concerned with resolving the sensitivity difficulties we had encountered when either headset was self energised. Switching the ESP9 to the SE mode we found that there was an unaccountable gain in sensitivity of 5.5 dB when the input signal was increased by 10 dB from 90 to 100 dB and held there for 10 seconds. On reverting back to 90 dB it took 30 seconds for the phone to come within 2 dB of its original sensitivity.

This struck us as being extremely curious so we turned back to the ESP6s and measured output over a wide range of input voltages and these figures are published in graph form. It will be seen



that for a 10 dB increase at the input we have approximately 20 dB increase in output, whereas ideally we should have linear reproduction with changes in input having identical changes in output.

We must here acknowledge the extreme lengths to which the American firm of Koss, and their British agents, went to help to resolve this problem. Not only did we have lengthy telephone conversations with their technical representative in Milan, but finally their head office in America called us to chat for some twenty minutes about variable sensitivities and distortion at the lower end.

The explanations given are quite simple. We were measuring *steady tones* whereas the charging voltage for the electrostatic plates is derived from *transients*. It therefore follows that in repertoire with plenty of "crash, bang, wallop" there will be no difficulty. Trouble arises only during sustained quiet passages and these, of course, will only occur in classical music. The longer the "decay time" of the plates the less important becomes the problem. We had measured a decay time of some 30 seconds; Howard Souther in the States told us that the research and development people over there are working continuously to improve this and longer decay times can be anticipated in future models. This variable sensitivity does *not* occur in the ESP9s when mains energised.

With regard to low frequency distortion it was agreed that the phones are not capable of handling the same power at the low end as they do in the middle and upper ranges. There is a school of thought that suggests that rarely, if ever, is the same power produced in the low frequency area in musical performance as occurs higher up the spectrum. We do not agree, because in, say, the reproduction of the organ one can have some very powerful low frequency notes on which high distortion would be apparent as an objectionable rattle.

Whilst speaking to America the point was also made that the actual fitting and adjustment of the plates within the cans is of critical importance, particularly in relation to distortion. Checking back with Tape-Music Distributors in London they confirmed that they have full technical facilities available to carry out repair or adjustment if it should be necessary, although they add that only a very tiny percentage of phones sold are ever subject to complaint.

Throughout these laboratory tests we were very conscious of the fact that the appliances we were putting through the mill had been designed for listening to, not for measuring, so it was something of a relief to turn away from the dials and

instruments to actually hear some music. For these user tests we not only listened ourselves but also brought in some "guinea-pigs" with various levels of musical and audio appreciation.

There was complete agreement on all sides that the sound heard was not just good but startlingly good. Certainly well up to the standard that can be obtained from loudspeaker equipment costing many times the price of the phones. Little difference, if any, could be detected between the two models. Best part of this game was watching the expressions on the unsuspecting listeners' faces when they heard them for the first time. Frank incredulity was the normal reaction, with "love-at-first-hearing" from the audiophiles.

Our music specialist, Katinka Seiner, made an interesting comment. She remarked that the subjective effect was almost like turning one's body into a single musical instrument, and that expresses rather well one of the differences between listening on phones as opposed to loudspeakers.

Another important point brought out by our listening panel was the observation that the headset was found to be an aid to concentration. Instead of being subject to all manner of external distractions, as happens when using speakers, the headphone listener much more closely approaches the mental isolation that occurs in the audience at the concert hall, although of course the subjective effect will be very different. Another interesting remark was that by using phones the listener shifts his own perspective, placing himself within the orchestra rather than in the audience.

We are sorry to say that the variable sensitivity measured in the laboratory was noted by some of our listeners. When hearing the *Beethoven 4th Symphony*, which opens with a long, quiet passage followed by a crescendo, the tape first appears to be quite devoid of background noise or hiss. As the dynamics of the music increases so does the hiss; on subsequent quiet passages the hiss fades once more. This applies only to the ESP6 and the ESP9 in its SE mode. When the latter model was mains energised sensitivity was constant. There is no other difference in frequency response or subjective sound.

Our conclusions about the Koss Electrostatic Headsets are that they represent a sincere and significant approach towards the ideal of perfection. As one might expect, perfection is not to be found, so they do have certain limitations and we have tried to explain what these are and how they might be overcome. They are better than any other headset we have heard, and better too than very many loudspeaker enclosures.

In fact they are so good we have arranged, through the courtesy of Tape-Music Distributors Ltd., to retain the use of the ESP9s as a standard against which to evaluate loudspeakers and some pre-recorded music.

From the recording enthusiast's point of view there are many advantages in using good headphones for monitoring purposes. As compared to loudspeaker listening the sound has an added "transparency" through which any faults in the tape will show quite clearly. Drop-out is at once obvious, as is hiss or any other unwanted noise.

In spite of their high price – or perhaps it should be because of – we regard both models as representing very fine value for money, although we would recommend using the ESP9s, mains energised, for critical work. The firm of Koss also make conventional moving coil headsets (at more conventional prices!) and it was our intention to examine one of these as well. Unfortunately our time and space has been entirely taken up with what for us has been one of the most interesting investigations we have ever carried out, so the dynamics will have to be deferred to another occasion.

## SURREY TONMEISTERS

From Page 291

technical side of their art. The time has long since passed when a performer needed nothing more than the ability and courage to stand on a stage and sing or play. Today the microphone is invariably standing inscrutably in the background and all too often the television camera is peering down as well. The artist who fears either will never reach the top of his (or her) profession. Through collaboration with the Tonmeisters the performers will come to terms with the equipment and techniques with which they will have to work in the future to the mutual benefit of both.

Four years will pass before the first of the Surrey graduates pass out into industry, and even then we shall have only eight of them. Hardly enough to make an immediate dramatic impact. But the time will come in the future when record production, sound radio transmissions and television broadcasts will be in the hands of people who really understand all the aspects of what they are doing, both musically and scientifically. And when that happens we shall be producing programme material of such a standard that it will compete with anything produced anywhere in the world. Four years is a long time in the world of audio. By then we should have specially noise-reduced recordings and improved domestic equipment, so perhaps "high fidelity" will at last mean what it says.

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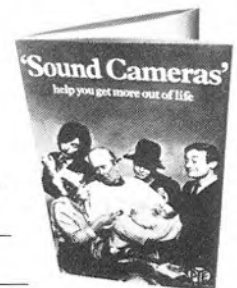
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## Musicassette Reviews

Consultant Critic Katinka Seiner

FAIRPORT CONVENTION. Liege & Lief. Island CIR 15016. 47s. 6d. including purchase tax.

Set firmly in the modern folk tradition with plenty of narrative songs this album has a curiously melancholic attraction all of its own. Sandy Denny attacks the vocals with a throaty enthusiasm that is very suitable to the traditional words that must go back a good many hundreds of years. In the arrangements the Fairport scoring has managed to retain a period feeling whilst still presenting a modern sound.

Unlike some albums of this kind where lyrics degenerate into a background mutter, we can listen to every word. This is so important in the narrative song—if the words are unintelligible the story has gone and the whole point of the piece is lost. No danger of that with a careful recording balance such as we find here.

On the first side we have: *Come all ye. Reynardine, Matty Groves and Farewell farewell.* Side two gives us: *The deserter* followed by a medley made up of *The lark in the morning, Rakish Paddy, Foxhunters' jig and Toss the feathers.* This is followed by *Tam lin* (best of the bunch? I think so) and *Crazy man Michael.*

A thoroughly interesting collection displaying considerable thought and talent in arrangement and presentation. I enjoyed hearing it, although some of the instrumental passages might be thought to be more noisy than musical. Nevertheless it's all good fun with more than a hint of pathos well in the foreground.

IN THE COURT OF THE CRIMSON KING. An observation by King Crimson. Island CIR 15013. 47s. 6d. including purchase tax.

Perhaps I should first give the titles, as from the repertoire one can get a pretty good idea of the kind of programme we are in for. As listed they are: *21st century schizoid man* (including *Mirrors*), *I talk to the wind*, *Epitaph* (including *March for no reason and Tomorrow and tomorrow*) *Moonchild* (including *The dream and The illusion*) and finally *The court of the crimson king* (including *The return of the Fire Witch and The dance of the puppets*).

So we're way, way out. So far out that contact is all but lost. The probability of a universal schizophrenia in the plastics millenium beginning with the next century can hardly be doubted. Dare one suggest that listening to the first item of this album is likely to anticipate the joys to come by driving the "patient" right around the bend without requiring him to patiently await the passing of the next thirty years? If so could that be regarded as a criticism? Is it not a compliment?

There is no little evidence within this collection of a generally ambivalent attitude, so perhaps the King's personality is already split right down the centre. Or are we being treated to a courageous sight of our own reflections in the mirror of passing time? We have much here to which I strongly object from a musical point of view, but equally there is a great deal in life

A number of "double l.p." Musicassettes have been received from Philips Records Ltd. for review. Amongst them are: *Herb Alpert and the Tijuana Brass* 7420 001, *Dusty Springfield* 7564 001, *Sinatra at the Sands with Count Basie* 7420 002, *Scott Engel* 7564 002, *13 Classical Masterpieces* 7505 002 and *After Midnight* 7560 001.

Detailed notes on these will be published in due course, but we should firstly like to acknowledge the very excellent audio quality of all these cassettes. As they contain twice the repertoire of ordinary Musicassettes they must use thinner tape; it would be reasonable to assume that the quality improvement is therefore due, in part at least, to the better head contact obtained through the reduction in tape thickness. This is an interesting speculation that would bear further investigation.

to which I also take exception. Perhaps, after all, this album is a perfectly valid "observation". I don't like it, but I am prepared to believe it is.

QUINTESSENCE. In Blissful Company. Island CIR 15014. 47s. 6d. including purchase tax.

Oriental music has been making significant incursions into classical and popular repertoire, and it is no longer unusual to come across Eastern instruments in a Western setting. As the world shrinks in size so do we all become more cosmopolitan in outlook. This collection is nothing if not cosmopolitan with sitar, tamboura and rasps featured amongst the guitars and vocals that appear to be influenced by temple chants plus the current pop vogue for what passes as Indian philosophy.

The individual titles do not mean a lot, but for what they are worth here goes: *Giants, Pearl and Bird, Body, Ganga mai, Chant, Manco capac, Notting Hill Gate and Midnight mode.* Instrumentation includes drums, flutes, bells, percussion and keyboards as well as the more exotic sounds already mentioned.

Presumably the "blissful" of the title alludes to that state of "divine bliss" attainable through devotion to the mysteries of religions whose chief claim to attention seems to lie in their fundamental foreign-ness. And whether or not it works depends entirely on the state of mind of the "congregation".

The ability of our pop culture to absorb material from other unrelated sources is a mark of its strength. But such experiment doesn't always come off and I found this album to be more full of trivia than bliss. Or am I not receptive enough? Oh well, it just means that I shall have to look further and longer before attaining that state of grace.

RENAISSANCE. Island CIR 15019. 47s. 6d. including purchase tax.

This album is chiefly remarkable for the

excellence of its recorded quality, which at times is quite outstanding, and the way in which this fine sound quality is lost through the muddle of noise resulting from the arrangements of the items. All groups feel compelled to produce their own characteristic sound by which they will be instantly recognised. There should have been plenty of scope here with guitar, harmonica, percussion, piano, harpsichord etc. Surely we could have had a delightfully individualistic blend of instrumental sound? Instead the piano (beautifully recorded) contrasts with a muddy muddle in which vocals are drowned and music is lost.

The numbers are: *Kings and queens, Innocence, The sea, Island, Wanderer and Bullet.* None of them impress sufficiently to warrant special mention; all of them left me with a feeling of hopeless confusion. And frustration. Because with more careful attention to production this collection could so easily have succeeded. As it is they've missed the boat. Pity.

At present pop music is in a state of transition, evolving from the inconsequential to the serious. It is not surprising that there should be some casualties on the way and I would count this one as "walking wounded". But a brave effort, none the less.

HOME BOYS HOME. The Clancy Brothers and Tommy Makem. CBS 40-63249. 47s 6d including purchase tax.

"The contents of this album are as assorted as the contents of an Irish emigrant's travelling bag: razor and strap, tin whistle, love letters, prayer book, old photographs, a little whiskey and a fluttering heart". That's what the sleeve note says, and it's quite right. What isn't said is that in this album we have a pure collection of rollicking good fun recorded and presented with consummate skill and artistry.

Within the travelling bag we find: *Mountain, Whiskey is the life of man, B for Barney, Black Cavalry, I once loved a lass, Home boys home, Old maid in the garret, Bard of Armagh, D-Day dodgers, Four greenfields and New South Wales.*

This is a one hundred per cent masculine collection. It smells of pint tankards, muscles and brawn. Even the romantic item, one only, has more in common with the saloon bar than the lady's boudoir. *New South Wales* is a song-and-a-half with all the swashbuckling fun that one expects from a crowd of young men who live by the sweat of their brows and are damned proud of it.

Of its kind this is one of the very best albums I have come across. The Irish are a musical, fun-loving people. Here we have their music and their fun, all realistically offered with a degree of technical excellence that could hardly be bettered in any medium. Very strongly recommended for those who love a good Irish sing-song.

# Music

## 8-Track Stereo Reviews

Consultant Critic Katinka Seiner

### 7½ ips STEREO

STAN GETZ GREATEST HITS. Prestige MP 7256 7½ ips four-track stereo. 61s 6d, including purchase tax.

Stan Getz is one of the greatest names in the jazz world, reaching far back to the by-gone days of the 78 rpm disc. We would not then have been treated to the quality that can be heard on this 7½ ips tape album, although even that could be slightly better. In fact there was a fault on our review copy; one track of the first side was not properly recorded over part of its length, although the second side was normal. In addition some of the more sustained notes reveal very obvious traces of distortion beneath the breath sounds.

Having said which we must stop carping about quality because the performance is really excellent in every way. What else would one expect from Stan Getz? I am not sure of the origin of the recordings, but I suspect that some of them date back quite a few years. However old they are a joy and a pleasure to listen to.

Stan gives us *Long Island sound, Marcia, Indian summer, Crazy chords, The lady in red, Wrap your troubles in dreams, There's a small hotel, I've got you under my skin, What's new, Too marvellous for words and My old flame.*

Recorded quality does vary from item to item. Although it can be disturbing at times (depending on the listener's sensitivity) it by no means renders the whole unacceptable. One can only wish that more recordings of this performance standard were available, hi-fi or not.

HIP SOUL. Shirley Scott. Music Tapes MP-7205 7½ ips four-track stereo. 61s 6d, including purchase tax.

As American as the Statue of Liberty, soul music has been sweeping across Europe. It is one of the more successful exports from God's Own Country. Here we have an album with prominence awarded to my least favourite instrument, the Hammond organ. But this is Hammond organ with a difference. It forms part of an instrumental ensemble together with Stan Turner on tenor sax, Herb Lewis, bass, and Roy Brooks drums. These are fine musicians and together the combination attempts to carve out a niche for the organ in the most serious of ways. As such it's a tape well worth buying and keeping.

Recording is generally excellent, although I would have preferred to modify the balances just a little. Sax, bass and drums are fine – the whole thing becomes a let-down from my point of view as soon as I hear the organ. Which is precisely what the album was designed *not* to

do, but then perhaps I am so prejudiced as to be beyond all hope.

The collection is made up of no more than six items, and these are: *Hip soul, 411 West, By myself, Trane's blues, Stanley's time* and *Out of this world.*

In spite of my discouraging remarks about the Hammond organ, and I would be making them whoever was playing and whatever they were performing, this is still worth hearing. It has a quality and a professionalism that many other albums lack. I don't like the organ sound but the rest of it is quite inspired. You might well like it.

THE FABULOUS RAY CHARLES. Music Tapes MTR-24. 7½ ips four-track stereo. 61s 6d, including purchase tax.

The title here is accurate, for Ray Charles has indeed become something of a fable. Those not kindly disposed towards him have attributed his success to his total blindness, and there's no doubt that the figure of this sightless negro on the stage does stir one's compassion. But he has a much more realistic claim to fame. Like many of his countrymen he has both talent and ability, and these early recordings of his are described as "12 vault masters that started a legend".

We are advised on the rear of the box that the recording has been "electronically converted" to stereo. Whatever the engineers might have done the result on our review sample is a heavy level of hiss obtruding more into the foreground than hiding away behind the usual tape noise. It is suggested that anyone who wishes to purchase the album should ask for a playback first because this might be peculiar to our copy only. So please check and make sure.

Ray Charles himself is not all that old, so these "vault masters" can't date back too far. The hiss could hardly originate from pre-electric days . . . ! Apart from that one criticism the performance is good – typical Charles.

His programme includes: *Ain't that fine, Honey, honey, Ray Charles blues, Don't put all your dreams in one basket, St Pete Florida blues, You always miss the water, Jack she's on the ball, Can anyone ask for more, Let's have a ball, If I give you my love, Sitting on top of the world and I've had my fun.*

Every word that Ray sings can be clearly heard. That lazy, gravelled voice with more than a touch of pathos comes right out of the loudspeakers to caress the listener and induce an immediate feeling of sympathy. You can't help it. Not so much sympathy for the singer's sightless condition but for his feeling towards life.

It would be a pity to miss this collection because of recorded quality, so I would like to strongly recommend it with that one qualifi-

cation. Provided you buy a good copy it will be an album you can live with for a long time.

### 3¼ ips MONO

YEHUDI MENUHIN, violin. Concerto No. 1 in G Minor, Opus 26, Bruch, and Concerto in E Minor, Opus 64, Mendelssohn, with the Philharmonia Orchestra conducted by Efrem Kurtz. HMV TA-ALP 1669 3¼ ips half-track mono. 42s including purchase tax.

Virtuoso performance on the violin is always impressive; the beauty of tone and flexibility of range that can be produced from what is basically a simple instrument is quite breath-taking. Here we have one of our leading masters giving us two works which enable him to demonstrate both the potentialities of the instrument and his own remarkable ability with it.

Did I refer to the "simplicity" of the violin? That is an understatement if ever there was one. What I meant, of course, was the simplicity of its construction – just four strings and a sound box. But having said that one has said nothing. The subtleties involved in its manufacture are equal to the skill required of its performer. When we have a fine instrument well played we have a beauty and delicacy of sound that presents one of the greatest challenges to the audio engineer.

It is interesting to relate the dates of the two composers whose works appear here. Mendelssohn was born in 1809, Bruch some thirty years later in 1838. But Mendelssohn died as long ago as 1847, whereas Bruch's death did not occur until as recently as 1920. Both lived and worked for a time in England; Bruch was director of the Liverpool Philharmonic Society for three years and Mendelssohn was, of course, a frequent visitor to our shores.

The *Concerto in E minor, Opus 64* by Mendelssohn is the only violin concerto by that composer. Many regard it as the finest work ever written for the instrument and no violinist of repute could fail to include it in his repertoire. It is familiar to concert-goers all over the world. The Bruch concerto is less well known, and is one of a number written for the violin by him. Musically it is satisfying, and, like the Mendelssohn, is a romantic work full of melody. But, like most people, I prefer the Mendelssohn of the two.

This is an excellent album, offering two works of the greatest interest and value. In addition we have the performance of Menuhin plus some first-class quality on the tape.

As I conclude these notes I am listening to the Mendelssohn yet again. This is indeed the most popular violin concerto of all time. No library of music is complete without it. This version can be strongly recommended.

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## NEW PRODUCTS

### GRUNDIG PRESENT NO FEWER THAN EIGHT COMPLETELY NEW RECORDERS INCLUDING A 3-HEAD 7½ ips OPEN SPOOL MACHINE

AN IMPRESSIVE RANGE of completely new cassette and open spool orders is announced by Grundig. The same firm is also releasing a "systemised" high quality audio installation and new transistorised portable radios. There is insufficient space to deal with all these items so this month we will detail the recording equipment only, leaving the other products for a future occasion.



Fully automated Grundig Compact Cassette model C 200SL can be operated by internal dry cells or accessory mains power pack supplied as an optional extra.

With claimed "full automation" the Compact Cassette battery portable C 200SL uses a single switch for stop, start, pause and wind. Recording levels are set automatically and the tape will stop and eject equally automatically when the end of a cassette is reached. By using the Grundig TN 12A accessory mains power pack the machine is converted to mains operation.

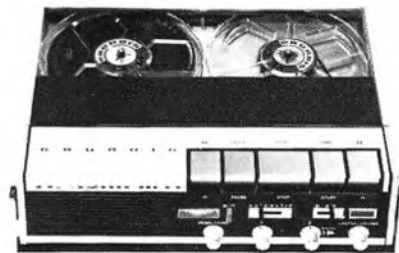
Specification claims a frequency response of from 80 to 10,000 Hz., wow and flutter less than 0.4% and signal to noise ratio 45 dB. Supplied complete with microphone etc. the recommended cost is £39. 18s. 1d.

At the other end of the portable range comes the open spool, three-speed "professional" machine, TK 3200. This half-track recorder has fully automatic record level setting plus manual over-ride and can be operated by internal dry cells, rechargeable DEAC accumulators, car or boat batteries or from the mains by the use of the accessory TN/14/TN 12A mains unit.

The sophisticated automatic gain

control system permits a choice between delay times for either music or speech and there are separate controls for manual record level, volume, bass and treble. Stop, start, pause and fast are by piano key press buttons.

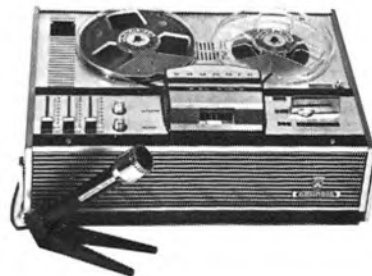
Separate record and playback amplifiers are used in conjunction with three heads to give full A/B monitoring facilities. Spool size is 5¾-inches and the three operational speeds are: 1 7/8, 3¾ and 7½ ips.



A long awaited model from Grundig — the TK 3200 open spool battery portable with three speeds and three heads.

Performance claims in the specification include: frequency response of 40 to 16,000 Hz at 7½ ips, 40 to 12,500 Hz at 3¾ ips and 80 to 8,000 Hz at 1 7/8 ips, wow and flutter less than 0.4%, 0.2% and 0.1% respectively and signal to noise better than 48 dB at 1 7/8 ips and 50 dB at 3¾ and 7½ ips. Recommended retail price including accessory microphone etc. is £178. 3s.

Coming now to the more modest open spool machines we have the TK 121, a mains powered half-track machine running at 3¾ ips that is claimed to approach hi-fi standards. Slider controls are fitted for volume, tone and record level adjustment whilst tape transport is operated via a single rotary lever. Maximum spool size is 5¾-inches.



TK 121 is the most modest of the new Grundig range, running at 3¾ ips half-track.

The specification quotes a 4 Watt output into 4 Ohms, frequency response of 40 to 12,500 Hz., wow and flutter less than 0.2% and signal to noise ratio better than 52 dB. The recommended price, complete with microphone etc. is £54. 15s. 7d.

Model TK 141 has a similar technical specification but is designed for

four-track operation. Two of the four tracks may be played back together so that a commentary can be added to background music, and with the aid of a monitoring amplifier and headset it is said to be possible to synchronise recordings.



First of the four-track machines, TK 141.

The single lever control has illuminated panels to indicate function (as in the TK 121) and also as the TK 121 slide controls are provided for volume, tone and record level. Recommended price, complete with microphone etc. is £59. 4s. 8d.

Performance of the four-track TK 146 is again similar to that of the previous models, but the difference lies in the provision of additional facilities for more sophisticated recording work.



More sophisticated with a range of facilities for the recording enthusiast, the Grundig TK 146 is basically a mono machine.

Superimposition of one recording on another is possible, or two tracks can be played back together to give a synchronised recording. Recommended price with microphone is £68. 2s. 10d.

All the above open-spool machines are for monaural operation, but model TK 147 with an almost identical specification (signal to noise for this one is quoted as better than 47 dB) is for fully automatic stereo recording. It is said that the circuitry of the automatic gain control is so designed that the distortion levels, frequency response and dynamic range remain constant whatever the composition or volume of the recording might be.

Inputs and outputs are duplicated for stereo and the recommended price with a single mono microphone is £96. 4s.



TK 147 is the lowest cost four-track stereo machine, taking spools up to 5¼-inches diameter.

First of the full-sized machines to take 7-inch spools is the two-speed, four-track stereo recorder TK 246. Again featuring slider controls there is a choice between automatic level setting or manual over-ride. Output power is 4 Watts per channel into 4 Ohms.



Accepting full-sized 7-inch spools, the TK 246 is a full stereo record/playback mechanism for vertical or horizontal use.

Claimed performance figures include: frequency response- 40 to 12,500 Hz at 3¼ ips and 40 to 16,000 Hz. at 7½ ips with wow and flutter better than 0.2% and better than 0.15% at each speed. Signal to noise is quoted as 50 dB, irrespective of running speed.

The recorder can be used horizontally or vertically and touch button keys are used for the tape transport control. Recommended price, without microphone, is £128. 17s. 8d.

Top model of the range is the four-track stereo machine, TK 248, fitted with three heads and separate record and playback amplifiers. All the most sophisticated recording techniques can be used, including echo effects and multiple playback. Four speakers are built in, two



Top of the range, the TK 248 is a three-head stereo machine with full A/B monitoring facilities.

per channel to give a total audio output of a claimed 8 Watts. Technical specification is similar to that of the TK 246, but the machine will accept an accessory remote foot control and there is space within the cabinet to house a synchronising unit for the projection of colour slides.

Recommended price of the TK 248, without microphone, is £157. 14s.

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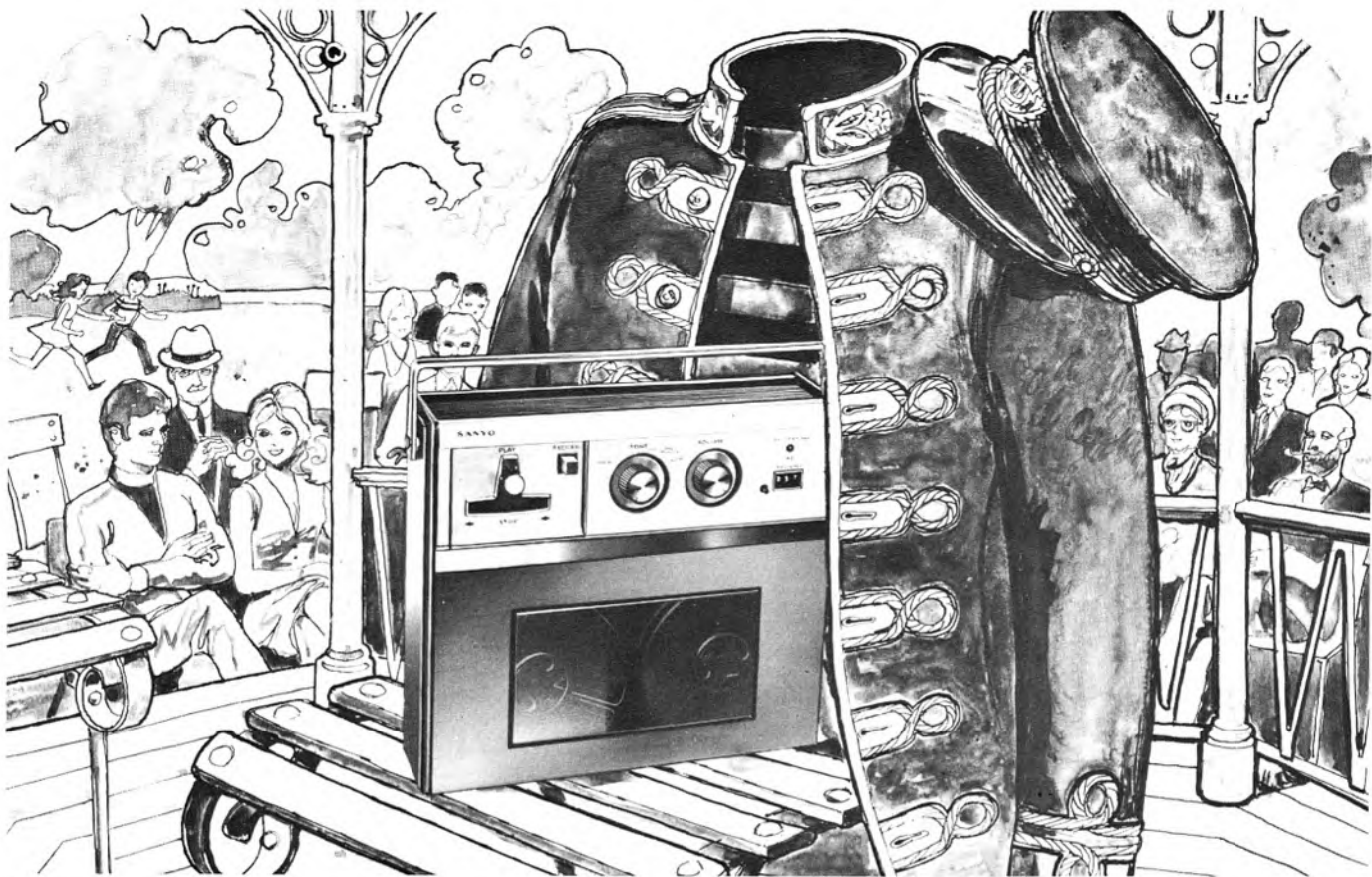
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