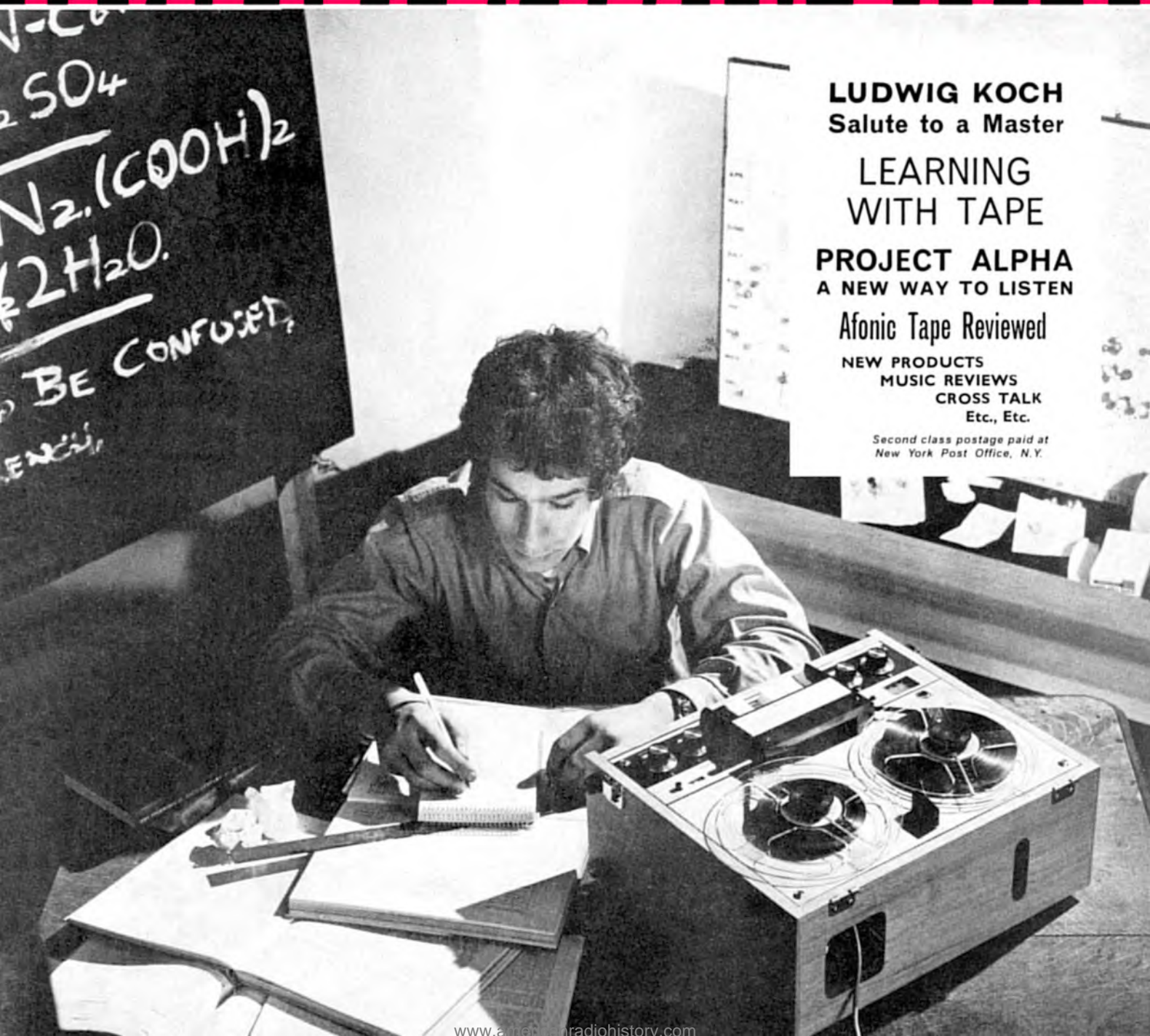


MAY 1969

2'6

TAPE

RECORDING MAGAZINE



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4"		450' - 12/-	600' - 18/-	900' - 27/-
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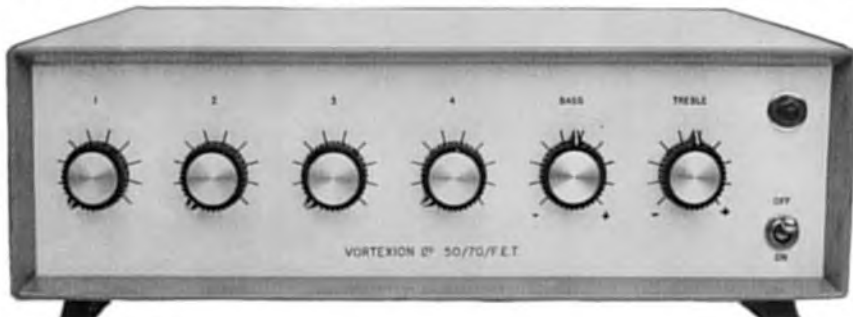
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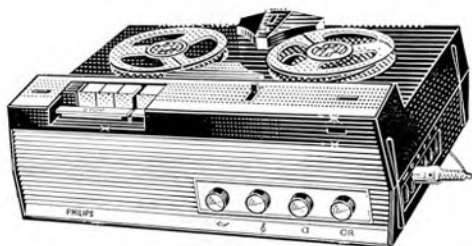
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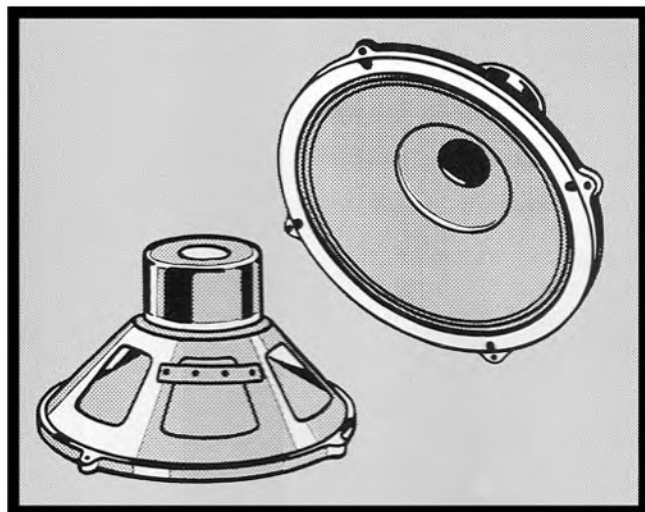
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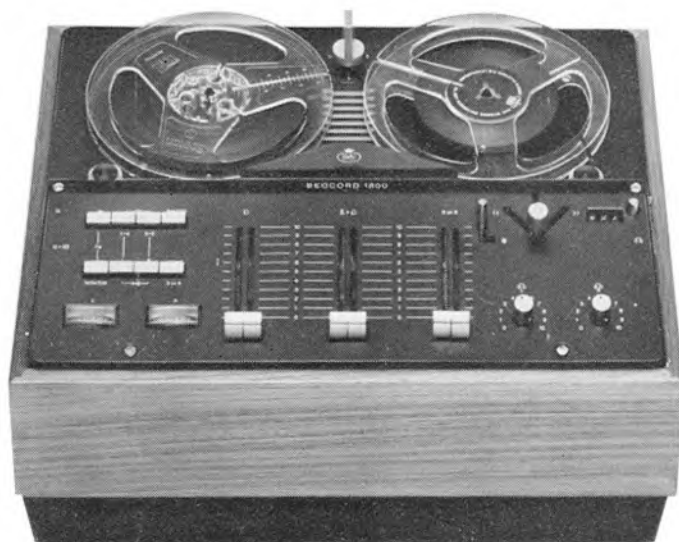
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Designed especially for use in conjunction with a high fidelity amplifier such as the Beomaster 1400 or Beolab, this new tape deck from B & O has an impressive specification. Available in twin or 4 track and finished in either teak or rosewood. The twin track model has an additional switched 4 track stereo head for the playback of pre-recorded 4 track tapes.



Specification (Exceeding the DIN 45.500 requirements)

FREQUENCY RESPONSE:

7½" per sec. 20-20,000 Hz
(± 2 dB 30-18,000Hz). DIN 45.500.
3¾" per sec. 20-15,000 Hz
(± 2 dB 30-13,000 Hz) DIN 45.500.
1¾" per sec. 30-7500 Hz
(± 2 dB 40-6000 Hz). DIN 45.500.

EQUALIZATION: DIN 45.513
1966-67 = NAB 1965.

SIGNAL TO NOISE RATIO:
achieved without the use of special low noise tapes
>60 dB for ½ track version
(¼ track version >57 dB)
unweighted (DIN 45.405)

CHANNEL SEPARATION:
Mono: >60 dB at 1000 Hz
Stereo: >55 dB at 1000 Hz

TAPE HEADS: specially developed hyperbolically ground.
Two track machine: 2t erase, 2t record, 2t replay, 4t replay.
Four track machine: 4t erase, 4t record, 4t replay.

WOW AND FLUTTER: (Measured according to DIN 45.506)
7½" per/sec RMS Value <0.07%.
3¾" per/sec RMS Value <0.11%.
1¾" per/sec RMS Value <0.18%

EXTERNAL CONNECTIONS: Inputs to three Channel stereo mixer for microphone, radio/gramophone and line. Outputs for headphone, line and radio.

SPECIAL FACILITIES INCLUDE:
Fast acting thyristor controlled auto stop.

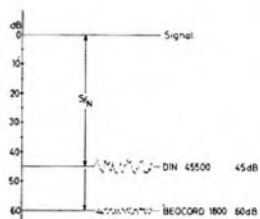
Three channel stereo mixer with split controls on each channel (6 inputs)

Separate headphone volume controls
Tape slack absorbers.

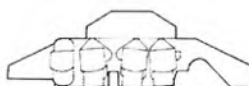
Push button selection of: A-B monitoring, sound on sound, echo, synchro play, mono left, mono right, mixed mono & stereo play.



Wide Frequency Response
7½" sec : 20-20,000 Hz.



Signal to noise ratio
60 dB on twin track version, 57 dB on 4 track. Results obtained without using special 'low noise' tapes.



Tape head bridge
Provides gentle tape handling with minimum wear to tape and tape heads (Tape heads are hyperbolic with a smaller contact face and a higher powered magnetic field for less noise)

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4 TRACK STEREO/MONO									
Philips EL3312 ...	23	4	1	3	14	5	67	17	1
Philips 4404... ..	26	17	0	4	5	0	77	17	0
Ferguson 3232 ...	33	5	0	5	1	10	93	5	0
Sanyo MR-929 ...	33	4	9	5	6	10	97	4	9
Sony TC260... ..	33	0	0	5	10	0	99	0	0
Philips 4407... ..	35	15	10	5	13	4	103	15	4
Akai 1710W ...	37	15	7	6	2	1	111	0	5
Sanyo MR939 ...	38	13	6	6	2	3	112	0	2
Telefunken 204TS... ..	41	13	0	6	18	10	124	19	0
Grundig TK247 ...	45	10	9	7	2	4	130	18	9
Philips 4408... ..	46	19	5	7	8	9	136	3	10
Sony TC530 ...	49	12	3	8	1	8	146	12	3
Beocord 2000K ...	53	5	0	8	17	6	159	15	0
Beocord 2000T ...	55	5	0	9	4	2	165	15	0
National Console-Aire ...	61	16	8	10	5	4	185	0	0
Ferrograph 722/4... ..	65	3	1	10	15	0	194	3	1
Akai M9 ...	68	12	4	10	16	8	198	12	4

STEREO TAPE UNITS									
Sanyo MR-801 ...	27	9	5	4	6	8	79	9	5
Sony TC355... ..	33	7	6	5	11	3	100	2	6
Akai 3000D... ..	35	0	3	5	10	7	101	6	11
Beocord 1500 ...	42	15	0	6	18	4	125	15	0
Ferrograph 702/704	58	8	5	9	11	8	173	8	5



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4 TRACK MONAURAL									
Fidelity Braemar... ..	11	12	8	1	17	4	34	4	8
Ferguson 3226 ...	15	9	0	2	11	7	46	6	0
Grundig TK140 ...	16	10	1	2	11	11	47	13	1
Philips 4307 ...	16	15	3	2	13	1	48	11	11
Ferguson 3238 ...	20	12	0	3	5	0	59	12	0
Ferguson 3216 ...	22	16	0	3	12	2	66	2	0
Wyndson Vanguard ...	25	4	0	4	4	0	75	12	0
Tandberg 1541 ...	26	15	3	4	10	0	80	15	3
Reps HW10 4-T ...	28	16	9	4	11	2	83	10	1

MAINS TWIN TRACK									
Fidelity Braemar... ..	10	9	8	1	15	0	31	9	0
Ferguson 3224 ...	11	12	8	1	16	10	33	14	0
Grundig TK120 ...	14	0	3	2	3	9	40	5	3
Beocord 1100 ...	28	5	0	4	14	2	84	15	0
Brenell Mk. V/3 Std. ...	36	8	2	5	16	7	106	16	8
Brenell Mk. V/3 Mtr. ...	39	8	3	6	4	6	114	1	9
Ferrograph 713 ...	51	6	3	8	10	0	153	6	3
Ferrograph 713H... ..	53	14	6	8	17	6	160	4	6

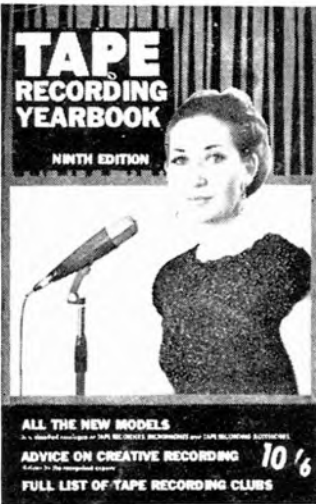
BATTERY OPERATED									
National RQ-113S ...	7	13	5	1	5	7	23	0	3
Philips 3302 Cassette	11	1	7	1	15	0	32	1	7
Sharp RD505 Bat./Mns. ...	13	12	8	2	5	0	40	12	8
Telefunken 300 ...	15	15	0	2	12	6	47	5	0
Sony TC210... ..	16	0	0	2	13	4	48	0	0
Telefunken 301 ...	17	17	0	2	19	6	53	11	0
Telefunken 302 ...	19	12	0	3	5	4	58	16	0
Sanyo MR151 Stereo	30	4	1	5	0	0	90	4	1
Uher 4000L ...	44	13	1	7	8	4	133	13	1

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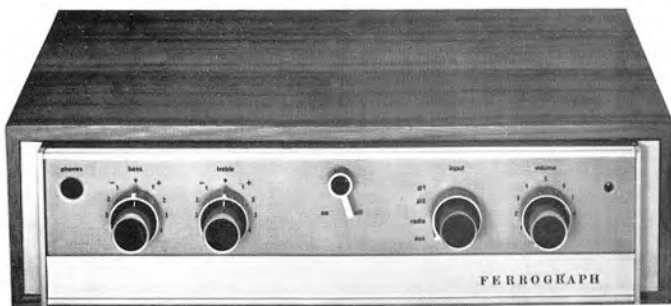
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TAPE RECORDING MAGAZINE

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

Vol. 13

No. 5

May 1969

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COVER PHOTOGRAPH: The tape recorder is still one of the simplest and most effective learning aids; it can be used as easily by the private individual at home as by the student in the classroom. Here we see a typical school scene with the student using a Truvox machine to record facts that must be remembered. Repeated playback will fix this information firmly in his mind. On page 158 we describe this method and also reveal details of a revolutionary learning aid that has now been released by Rank-R.E.C. Ltd., The Talking Page.

"TAPE Recording Magazine" is published on the third Wednesday in the month, by Print and Press Services Ltd., from Prestige House, 14, 18 Holborn, London, E.C.1.

"TAPE Recording Magazine" is available by a postal subscription of 25s. per annum (U.S.A. and Australia \$3.75) including postage, or it can be obtained at newsagents, bookstalls and radio and music dealers. In the event of difficulty, write to the Publishers at Prestige House, 14, 18, Holborn, London, E.C.1.

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EDITORIAL

01-242 4742

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Tape trends and tape talk

By Douglas Brown

I HAVE just enjoyed my annual task—the short-listing of entries in the British Amateur Tape Recording Contest as a preliminary to final judging later on. As most years, I have listened to the documentary entries, while my colleagues on the organising committee have looked after other classes.

I don't think I should say anything at the moment about the standard or the nature of the particular tapes I have heard—that must await a full report on the Contest. But a feature which greatly encouraged me was that four of the entries in this class came from women—one of whom was 86—plus a fifth from a husband-and-wife team.

From several sources I hear evidence that women are now becoming more interested in tape recording. It has always been the case that the lady enthusiasts could match male efforts with recorders when they tried—but not many seemed to be trying. For a time *TAPE Recording Magazine* ran a regular column for women readers, but reaction was limited and the feature was dropped. Is there a greater demand today?

LORD WILLIS (Ted Willis, TV playwright-tycoon) forecast in the *Sunday Times* recently that the introduction soon of pre-recorded programmes in cassette will mean “a revolution in television which will have as big an impact as the coming of the small screen.” The story was presented as a great revelation, which perhaps it was to the general public, but readers of *TAPE Recording Magazine* are, of course, well acquainted with developments. The interest, for them, lies in the assessment of the significance of the new technique offered by Lord Willis.

He called it “one of the most exciting developments in electronics and communications since the invention of television itself.” He declared that programmes in tape cassettes would rank as a “powerful third force” in entertainment and education, alongside television and the cinema.

He foresaw tape libraries and viewers able to choose their own programmes and the times at which they watch them. The impact on education, he argued, will be enormous and he thought there might need to be re-thinking on the form of the projected University of the Air.

Lord Willis's summing up: “The implications are endless, the possibilities enormous. . . . I believe the cassette wave will break slowly, but that as it gathers strength it will swamp more than a few of our established notions about film and television.”

THE MANUFACTURE of magnetic tape has become, in large degree, a speciality department of the world's largest chemical firms. With the massive resources these concerns command, we may have assumed that the potentialities of this market

had been fully explored and the product itself refined almost to the ultimate.

Not so. Du Pont de Nemours, the biggest of all the American chemical companies, have just come up with something entirely new. They have not been concerned, until now, with magnetic tape. Now they are moving in with a product called Crolyn, which uses a base of chromium dioxide instead of iron oxide.

The initial attack, naturally enough, is on the market for computer tape, which is likely to double over the next five years. Du Pont claim their product will pack more information on to a given length of tape than any other; and that long-term storage and usage problems are reduced.

LOCAL RADIO is back in the headlines, with the Conservatives promising a hundred of them, financed by advertising, and the Chairman of the BBC Governors foreseeing that “the day may not be far away when almost every major town in Britain will have its own radio station.”

Perhaps by the time these words appear, more will be known of the plans for extending the year-old BBC experiment with eight local stations. Amateur tape recordists have a special interest; as some have shown in towns which already have their own station, there are exciting and almost unlimited opportunities for enthusiasts to get their work on the air.

I see that the Managing Director of Grundig (Great Britain) Ltd., Mr. John Wagner, was asserting the other day that the market for hi-fi radio in Britain is more promising than ever before—and the local stations are an important factor.

Anyway, Grundig is backing its judgment confidently—it has just introduced a range of five new high quality radios (as well as five new tape recorders).

APART FROM the topical news and features which are the main content of *TAPE Recording Magazine*, there is an almost insatiable demand for basic information and guidance about the hobby at greater length than is possible in these columns, but without the technicalities which often make full-length books indigestible to the average enthusiast.

Starting in May the publishers of this magazine propose to publish a *Tape Handbook* every month. Each one will deal in depth, but in simple language, with a particular aspect of tape recording and the handbooks will be marketed at a popular price.

The first one will give advice on the making of documentary features on tape. It will be written by Peter Bastin, several times a prize-winner in the British Amateur Tape Recording Contest. It will sell at five shillings. Information about later handbooks in the series will be published next month.

THERE could be no more appropriate title for this short piece. It is also the title of a new gramophone record produced by BBC Radio Enterprises as both a tribute to a great man and as the first of the new series of BBC wildlife records.

Release of information about this disc happily coincided with the prize-giving for the winners of the 3M Wildlife Sound Recording Contest. So a joint event was planned and it took place on March 20 at the premises of the Institute of Recorded Sound in South Kensington.

Amongst those present were Mr. L. R. Gehrke, Managing Director of the 3M Company Limited, UK, Mr. David Attenborough, Director of Programmes, BBC Television, Mr. Peter Scott, the well-known naturalist, Mr. Desmond Hawkins, controller of the BBC South and West Region and Honorary Vice-President of the Wildlife Sound Recording Society and of course Dr. Ludwig Koch himself.

The first part of the afternoon was given over to presentation of prizes by Peter Scott and a playback session of the winning tapes in the 3M Contest. And what a pleasure it was to hear those excellent recordings. After discussing the success of this contest with the judges all were agreed that wildlife recording should appeal to even more enthusiasts. Certainly standards are high. But not so high that anyone need to be frightened off. Good luck plays quite a large part in this fascinating game. More than one of the prize winning tapes was an example of happy coincidence rather than consummate skill. But when Lady Luck smiles the man who can take advantage is the one who is there on the spot with his equipment; only those who are actively engaged in outdoor recording will ever get these lucky breaks.

But the greatest wildlife recordist of them all is Dr. Ludwig Koch, now a grand old gentleman in his eighty-eighth year. With sparkling eyes and ready wit he is still as sharp and as humorous as ever he was. Unfortunately advancing years have made it difficult for him to continue with his recording activities, but his enjoyment of life is none the less keen.

It was a joy to witness his pleasure as he heard the sound of his own voice on this new record, *A Salute to Ludwig Koch*. On Side 1 we have a brief account of the life and career of this famous pioneer recalled by Desmond Hawkins with extracts from some of Dr. Koch's well known broadcasts and recordings. These are now permanently preserved in the BBC sound archives. Included are the voices of Dr. Koch himself, Desmond Hawkins, Field Marshall Paul von Hindenberg, President of the German Weimar Republic, James Fisher, Sir Julian Huxley and Peter Scott. Also on Side 1 are some famous recordings from Dr. Koch's collection, including

S A L U T E T O



LUDWIG KOCH

the sound of an Indian shama—recorded in 1889 and said to be the first recording ever made of a bird—a blackbird mimicking Kaiser Wilhelm II's motor car horn, an icterine warbler imitating the voice of the Queen Mother of the Belgians, the first green woodpecker to have its voice recorded in England and the Surrey curlew whose voice became the signature tune of that famous radio series "The Naturalist."

Abounding in contrasts we have the sound of grey seals singing in a lonely Welsh sea cove and the street sounds of Paris recorded before the gendarmes stopped controlling the busy streets with piercing blasts on their whistles. And then in a moment we are listening to the wild exciting calls of the great northern diver on a remote Icelandic lake.

Such diversity of interest epitomises both the life and the work of Dr. Koch. Talking to him after the reception he referred modestly to his own efforts and agreed—with just a hint of nostalgia—that things are different now with magnetic equipment instead of the heavy disc recorders he used for most of his work.

Perhaps one can best describe Dr. Ludwig Koch as being a man whose love of

life, love of nature and love of sound recording have combined to enable him to devote his life to the creation of the first collection of wildlife recordings ever to exist. As a result his name is a household word and his work is a living monument to a great personality. But he is also a trained musician; music was to be his career before he became so engrossed in his cosmopolitan recording work.

The very first edition of *Tape Recording Magazine*, cover-dated February 1956, carried a feature entitled "Birds, Bach and Broadcasting, the unique recording life of Dr. Ludwig Koch." Now we are in our thirteenth year and it is our pleasure to join with the BBC Radio Enterprises in making this our own salute to Ludwig Koch. Here's hoping, Dr. Koch, you will enjoy the sounds of music and nature for many, many years to come.

The gramophone record referred to above entitled "A Salute to Ludwig Koch" is produced by B.B.C. Radio Enterprises under the reference number RED 34M and is available through ordinary record retailers at a cost of 21s. 6d. inclusive of purchase tax. The record is not being retailed directly by the B.B.C. or by the B.B.C. Publications Office.

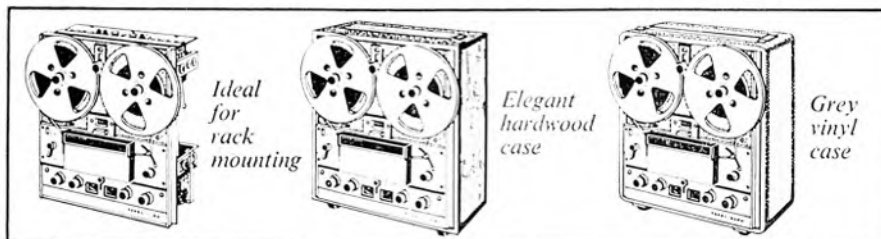
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ACTION

FIRST STEPS IN STEREO

By Basil Dawson and John Claxton

IT is now eight weeks since we first introduced ourselves. In our article in March we explained our reasons for extending our recording activities into the stereo field and at the same time we mentioned something of our misgivings. Since then we have acquired equipment and "had a go." So this then is the continuing story of our experiences.

When last we wrote we did not have any stereo equipment. A great deal of thought was given to this very knotty problem: what to buy?

It has always seemed to us to be a pity that British manufactured recording equipment too often takes second place to Continental imports. For many years this country led the world and set the standard for audio products of all kinds. It is our opinion that British goods tend to be over-shadowed somewhat unfairly by the heavier weight of foreign manufacturers' publicity. Not being concerned with "snob appeal," but only with all-round technical performance and reliability, we determined to use a British machine if we could.

For any kind of creative work the half-track machine is infinitely preferable to a four-track version. Apart from which our existing library of half-track mono tapes could be satisfactorily reproduced on a half-track stereo machine and since we already both owned Brenell Mark Vs in excellent condition it obviously made sense to ensure compatibility between existing and new equipment.

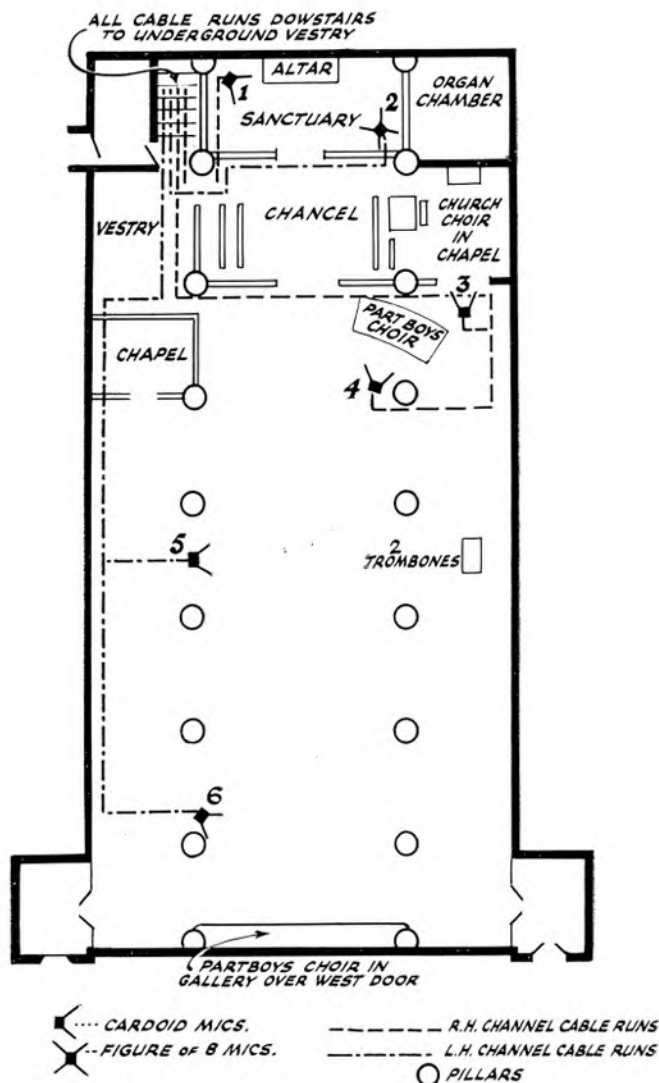
When considering tape speeds we came to the conclusion that $7\frac{1}{2}$ ips. should be our normal working speed—we would have liked to have used 15 ips. but it is frightfully expensive on tape. With modern equipment quality is surprisingly good at $3\frac{3}{4}$ ips. but editing does become extremely difficult at that slow speed.

Because cost is a limiting factor with us as with most other people we decided to use a "tape unit"—that is deck and pre-amp lacking final audio output stages—since by doing this we could make use of an existing stereo amplifier and loud-speaker set-up already available and at the same time reduce the purchase price to a figure roughly comparable to that at which the equipment was sold before purchase tax was imposed.

Provision of monitoring facilities is of prime consideration when undertaking any

serious recording work. Our Brenell machines are both "Model M" that is they are fitted with separate record and playback heads to enable a comparison to be made between the signal being fed into the machine and the recorded signal coming off the tape. We regard this as a vital facility and we would not consider any tape unit that did not permit "A B" monitoring.

We now had a fairly clear idea in our minds of the kind of machine we really wanted. It is at this stage that prospective purchasers begin to avidly read equipment reviews. For many long hours we pored over specifications, performance data and prices. It became increasingly obvious that the perfect machine for our requirements was just not to be found. As so often



The difficulties encountered in undertaking the stereo recording described in this article will be appreciated from a study of this floor plan of the church. The choir was divided into three separate sections, one of which was stationed at the rear end of the building, and two trombones were positioned half-way along one wall. As a result our Action team decided to think in terms of "fore and aft" rather than "left and right"

Please turn to page 157

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happens we were going to have to compromise, both on convenience and facilities; the one thing on which we would not compromise was the technical quality of the recordings the equipment would produce.

So with these thoughts well in mind we found ourselves coming back again and again to the review of the Truvox PD 202 that appeared in the February edition of *TAPE Recording Magazine*. Not only was it said that this machine is capable of producing an exceptionally flat frequency response but it also incorporated most of the facilities that we regard as essential. There then followed what was for us an unexpected piece of good fortune. Thanks to the co-operation of your Editor and the courtesy of Truvox Limited of Southampton we found ourselves to be in the enviable position of having the use of a PD 202 so that we could find from practical experience just how suitable this particular machine really is for the kind of work we undertake.

Delivery of a new machine is always an exciting moment. We spent some time studying the instruction manual and familiarising ourselves with controls and facilities. Our first actual recording work involved using the Truvox deck for copying existing recordings from the Brenell.

Unfortunately one cannot get away from the fact that half-track stereo recording uses twice as much tape as half-track mono. The time had obviously come for us to examine some of our old mono recordings and dub off items worth keeping, so creating a pool of spare tape. We were appalled to discover just how much recording tape had been tied up unnecessarily. Obviously we should have checked through our library of recordings long ago; a ruthless survey produced a surprisingly large stock of perfectly good and usable tape.

One small snag occurred in this copying process. It was realised with some dismay that the Truvox was not completely erasing tapes recorded on the Brenell. After a little head scratching the reason slowly dawned on us. Although both are half-track machines the layout of the tracks for mono is slightly different to that for stereo; it seemed as if existing half-track recordings were not being completely erased by the stereo machine.

Investigating this problem a little further we treated two pieces of tape with "developing fluid." This material makes visible the magnetic traces on the tape, and one could immediately see the differences in the tracking configuration. The only cure for this problem will be to bulk erase tapes instead of relying on the erase head.

During the course of these copying exercises we found many of the controls

of the Truvox deck very convenient to operate with the exception of the very small level controls on the record and replay pre-amps. Not only is the diameter too small but the satin smooth finish tends to allow some finger slip. We very much like the expanding nylon sleeves which lock the spools on to the spool carriers and the pause control was also found to be excellent. Connections to the deck are convenient because the cable entries have been provided in an accessible position near the front.

Having now made ourselves familiar with the deck and its controls and operation we had to think about our first live recording exercise. It so happens that a few weeks previously we had been given the opportunity to record a Mozart Mass which had formed part of a liturgical service in St. Augustine's Church at South Kensington. On that occasion the sound sources comprised a small choir and orchestra, both of which had a very high standard of performance. There was to be a similar service on Ash Wednesday at which a Mass by Dufay was to be performed and we had been invited to record this too.

Fools rush in. . . ! Our first mistake was to assume that the disposition of sound sources would be the same as on the previous occasion. Then the choir had been divided on the two sides of the chancel with the orchestra similarly placed. With this floor plan in mind we planned our layout accordingly and optimistically believed that all our arrangements had been nicely settled.

When we came to pack up the gear to take to the church we began to realise certain disadvantages of the Truvox deck for this kind of live recording. The most obvious snag is the absence of any sort of carrying case or handle. Handling is awkward and we were faced with the need for padding out the boot of the car so that the machine could travel in safety. Fortunately we found some quantities of sponge rubber underlay intended for use with ordinary carpeting and which we had used previously as anti-vibration mats beneath microphone stands. Wrapped like a swaddling babe the 202 was carefully placed in the boot.

Another drawback is the limitation of spool size to 7 inches. We have become accustomed to using 8½ in. spools on the Brenell, and we never use tape thinner than long play. This combination of an 8½ in. spool and long play tape gave over one hour's uninterrupted recording time at 7½ ips; with the PD 202 using 7 in. spools our programme limitation was 45 minutes.

When working live in public and at an unrehearsed performance this restricted programme time could be very dangerous indeed. There is nothing more ignomini-

ous for the recording engineer than to be caught out with his programme in progress as the red leader at the end of the spool is carried through the sound channel. However, for around £150 one can't expect to have everything, and we knew that our machine would be a compromise.

In the light of our last mono session in this church we had planned to use two "Siamese" pairs of Sennheiser MD 411s to cover the choir and orchestra, one to be fed via one channel of our mixer into the left-hand auxiliary input of the Truvox and the other pair via a separate microphone pre-amp into the right-hand auxiliary input of the machine. To cover the action at the altar we had planned to use an AKG DE 24 D via the second channel of the mixer for the left-hand channel and a Reslo RBTL via a line transformer into the microphone input of the right-hand channel of the Truvox.

All our theories were exploded when we arrived at the church to find that everything was different. In addition to the main church choir which was to be positioned in the chapel there was also a special boys choir split into two halves, one at the front of the nave at the right of the chancel steps and the other half in a gallery at the opposite end of the church. Instead of an orchestra there were to be just two trombones. Where would they be placed? At that moment no-one was quite sure!

All our previous planning had to be abandoned. Instead of thinking in terms of left and right we now had to readjust ourselves to what seemed to be the more appropriate nautical terminology of "fore and aft." We now had to cope with a completely changed layout and there was very little time available. We were at panic stations.

This was not a new experience for us; we have often found that those organising this kind of function often delay finalising their own arrangements until the very last moment. Do professionals have any idea of the difficulties under which amateurs often have to work? With our recording station established in a vestry at basement level beneath the chancel we already had very long runs of microphone leads. Now some of these would have to be extended right down the nave. Final microphone dispositions are shown in the accompanying diagram, from which it will be seen that the two trombones finally ended up in what was, from our point of view, an absolutely impossible position. Our microphone No. 5, a Sennheiser MD 411, had to be raised on its floor stand to as high a position as possible so that it could pick up its signal from over the tops of the heads of the congregation. One could hardly have a worse arrangement. Yet here we were

LEARNING WITH TAPE

By Denis Gilbert



The Talking Page is a revolutionary new educational aid. Although its sound source is a 45 rpm disc with some thirty different tracks the system relies heavily on tape recording techniques for its success. The recorded programmes include some brilliant sound effects as well as miniature dramatised features. Together with the equipment they can be used to teach children who either cannot read or who do not speak English

DO you find learning difficult? Some people appear to be able to assimilate facts and knowledge effortlessly—they are the lucky ones. For most of us learning is a task that must be undertaken deliberately and which can only be accomplished by making a conscious mental effort to understand and memorise.

But great changes are taking place in the nation's classrooms. A vast range of mechanical appliances are devoted to making the tasks of both the teacher and the student less painful and more effective. Typical of the ingenuity that goes into the production of new educational aids is an equipment developed by Rank-REC Limited called the "Talking Page."

The Talking Page does not use magnetic recording techniques directly. It comprises a portable battery operated random access phonograph system co-ordinated with illustrations in book form. Resembling a desk top lectern in appearance it enables children to progress at their own pace and with a minimum of guidance. A specially designed and illustrated book is placed on the top of the machine and a 45 rpm disc slots into the side. When the student selects any given page of instruction the appropriate sound recording is automatically picked up by a linear tracking device. When the sound message has been played back the mechanism stops due to the action of a switching relay actuated by a subsonic pulse on the record. The student can select any page at will and can repeat the sound message as many times as is needed for understanding. The whole is battery powered, portable and so designed that it can be used by primary school children with a minimum of preparatory instruction.

The Talking Page was announced in London recently by Rank-REC Limited and a course on music created by Yehudi Menuhin was demonstrated by him. The many applications of this equipment are only too obvious; it will be invaluable for teaching the English language to non-English speaking immigrants and it should

be of enormous benefit to all aspects of primary education.

The needs of adults however are rather different. For them the basic tool often need be no more sophisticated than an ordinary magnetic recorder. On our front cover this month we show a typical classroom scene with a young student using a Truvox tape recorder as a straightforward educational aid. With a pile of reference books open on his desk the student is recording his own tuition tape which builds up as his research progresses. The saving in time and effort is enormous.

Similar methods can be used outside the classroom within one's own home to make learning more pleasant and more effective. It does not require specialised or expensive equipment; any owner of an ordinary tape recorder has at his disposal an invaluable teaching aid which will be just as useful for helping the younger members of the family to get through their O and A levels as it will be to their parents to learn sufficient of a foreign language to increase their enjoyment of a Continental holiday.

The simplest application is in the memorising of facts. Those facts might be a vocabulary in a foreign language, a string of historical facts and dates or the synopsis of a "set book" specified for an English examination. Whatever the origin of the information, sound recording can make an enormous difference to your ability to memorise.

The method of use is simplicity itself. The relevant facts are read out and recorded on tape. Learning is accomplished by playing the tape back over and over and over again. Every spare moment of the day is utilised; one can play back the tape

whilst dressing in the mornings—if the family will put up with it the tape can be played back during mealtimes—and that last half hour before going to bed is an obvious time for a final listening session of the day. It is important that the student himself does the actual recording and it is also preferable that he should include all the normal extraneous sounds such as page rustling, coughing, traffic noise, even interruptions. The last thing in the world we want is for this kind of work is a perfect studio type production.

By adopting this free-and-easy happy-go-lucky recording technique it will be found that not only is the task of recording made much easier but, believe it or not, such a tuition tape is very much easier to memorise. One makes use of what is known as "association of ideas." When thinking back to individual pieces of information the extraneous sounds recorded on the tape will help to serve as signposts or guides in the memory. For instance, when trying to remember a particular phrase or definition that has been recorded and played back many times the student is assisted by recalling the way in which the original recordings sounded; he might remember that at that particular point on the tape there was a loud noise from something dropping in the room next door and from that point on he will begin to hear the sound of his own voice repeating the desired information.

Portable battery operated cassette equipment is probably the most useful for this kind of work. Because of its extreme convenience it can be used for playback during all kinds of odd moments of the day that would otherwise be wasted; a

Please turn to page 169

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DO you have a sense of history? Do you feel strangely moved when confronted by the evidence of events long since passed? When looking at any of our many ancient monuments I always get a funny feeling in the pit of my stomach—almost a sensation of intruding on the privacy of past owners. In the same way I can never walk along the track of an old Roman road without feeling conscious of the presence of the marching legions. But then that is what history is all about.

One can so easily find oneself bemused by this sense of time past that time present loses its importance. But what happens today will be regarded as history tomorrow, and tomorrow's citizens will depend upon the citizens of today for their knowledge of what we now regard as the familiar customs of contemporary life. We live in a period of rapid change; perhaps future generations will refer to our own little historical slot as "the change explosion." Not only have we all changed dramatically in the things we do and the ways in which we think but we have also changed our manners of speech.

Having recently watched a series of BBC television programmes dealing with life in the fifties I am astounded by the differences in attitude and approach of the broadcasters of that day as compared to the 1969 "models". The children's programmes for instance—so prim and proper — perhaps today's youngsters would say "prissy" if that is a word they use nowadays. Everything is dated, everything is old-fashioned; in other words everything is different.

Some people are concerned about the rapidity of this change. It is one thing to suggest, as I have done in the past, that a worthwhile occupation for Tape Recording Clubs would be to collect a comprehensive library of local dialects before they die out completely. But this is only the obvious beginning of such a project. We are all of us changing the inflections of our voices. A stranger might perhaps be forgiven for imagining that a Liverpudlian drawl is the accepted standard of the English language. We all know this has come about through the popularity of the Beatles and other groups originating from that area, and we accept as normal what is in fact a most remarkable phenomenon.

Quite apart from intonation and accent we are changing in the way in which we say things. Take the family doctor, for instance; he no longer speaks in quite the same way as the G.P. of a few years ago. Some people are sufficiently concerned about these changes going on in front of our eyes that they are bothering to do something about it. We, as recording enthusiasts, can help to preserve an

CROSS TALK

By Audios

important aspect of what life is really like for ordinary everyday people in our own day and age. All too quickly this material will acquire the added value of historical validity and people will be fascinated to hear what the world really sounded like in the late 1960's.

There can surely be no better, no easier and no more worthwhile project for our many recording clubs. The material is literally on the doorstep and is ignored only because of failure to appreciate its importance. The nucleus of the effort to produce as complete as possible a sound picture of life in our time is centred on the Institute of Recorded Sound. In a recent statement the Secretary, Mr. Patrick Saul, said that the Institute is now in need of recordings of urban speech from all parts of Britain. This includes specimens of true cockney and other local speech forms from our great cities. What about it?

"**A**LL work and no play makes Jack a dull boy." So says the proverb and so says Sanyo. As part of a sales promotion exercise dealers and wholesalers were offered as an incentive the opportunity to join a trip sponsored by Sanyo to the German city of Hamburg. A Britannia aircraft was chartered and more than 100 guests enjoyed this firm's generous hospitality for three days in March.

It was with as much surprise as gratitude that I found myself to be included on this excursion. The orders of the day referred to "no talking shop," and to the best of our ability we all refrained from mentioning business—that in itself makes a real holiday for a crowd of dedicated audio enthusiasts. So we just sat ourselves back and allowed ourselves to be entertained.

That same entertainment was offered on the broadest possible front. At one moment we were being driven by coach around the perimeter of the Alster and the next we were being whisked in the lift up the tower of St. Michael's Church to enjoy a panoramic view of the city, the docks and a hint of the green country beyond.

A truly beautiful city is Hamburg, well worth a visit at any time of the year. The streets are broad and clean with excellent well-stocked stores and there is a general

impression of both a thriving community and resilient economy. And at night the population enjoys itself in the beer halls and clubs without the conscious effort that seems to be necessary in similar establishments in the U.K.

My three days in Hamburg convinced me that I must return and spend more time there as soon as the opportunity presents itself. There are said to be many camping sites within easy reach of the city and so a holiday in that part of Germany need not be expensive. So my original thought for an unusual holiday is to spend it in and around Hamburg.

THE prospect of a hundred or more commercial radio stations in Great Britain frightens me to death. After much talk we have finally got our handful of local BBC stations and they appear to be as successful as one could expect, working as they do under very restricted conditions. But now the Conservatives have said that if—or when—they are returned to power they will take steps to establish a vast network of commercial transmitters to replace the existing small numbers of local BBC stations.

If you imagine this argument to be about broadcasting then you are quite wrong. Like so many discussions it is really revolving around the central topic of money. It all boils down to the simple question of how much money should be spent on services of this kind and where the money should come from? We are told that because the commercial station will derive its revenue from the advertiser we as the public will not be called upon to foot the bill.

To my mind that is a superb example of double talking. The money to pay for the advertising comes from one source only—the consumer. Whether finance is obtained from licences or taxes or whether it represents a fraction of a penny in the price of a packet of detergent makes not the slightest difference. You and I are the people who pay. We must be—there is no other place for the money to come from.

The irritation of advertising commercials on ITV is bad enough, but to endure the same repetitious jangling inanities on sound radio is just too horrible. Let us have our hundred local stations by all means. Let us then make up our minds that we have to pay for them, put our hands in our pockets and fork out cheerfully. But please, please don't let us have to endure the unspeakable banalities of advertising on sound radio. At least that is my opinion and if you agree with me please write to the Conservative Central Office and jolly well tell them so.

HAVE you noticed the current vogue for injecting a little more life and real humanity into commercial recordings? A disc just released includes asides from the performers to the control room and ends with a fade-out on the words "You've got to be kidding".

I should like to see this principle extended to the classical repertoire. Imagine the inclusion of a full scale altercation between conductor and instrumentalists at the conclusion of the Tchaikovsky 1812, preferably ending with the cannon firing broadside into the strings as the cathedral bells sound a joyful message of musical anarchy. Unfortunately I rather doubt if it will ever happen!

PROJECT ALPHA

By CYRIL CLOUTS

In our previous article we concerned ourselves with aspects of sound related to the structure of a sound spectrum, that is, with the array of harmonics and their relative intensities which constitute a sound and determine its quality or timbre. I should point out here that with each aspect of sound investigated there are complexities which are not dealt with. For instance, the partials (harmonics plus fundamental) of a spectrum are not as simple in their structure as was depicted in the previous article. Each partial is in fact a more complex phenomenon. A further complexity is the relationship which exists between the properties of sound and the part played by the structure of the ear in registering and perceiving sound. To deal with these factors is, I think, unnecessary to our present purpose. A development of basic principles will suffice to clarify the points I wish to make.

Acoustic analysis shows that sounds occur and are perceived according to the manner in which they begin (the attack), maintain their presence (the steady state) and decay. Reference to the sound spectrum has been, in effect, a reference to the steady state which asserts its harmonic proportions after the initial impulse. The attack and decay characteristics of a sound give it what has been called its individual shape and, as such, are primary agents in the determination of timbre. They derive, as does the spectrum, from the particular construction of a sound source and the manner of producing the sound. Specially associated with the mode of attack—less critical in the decay—are transient sounds which were briefly mentioned in the last article. The harmonics of a spectrum are periodic phenomena and multiples of the fundamental.

Transients are non-periodic or non-harmonic partials which occur as components of the initial impulse and do not occur as multiples of the fundamental. At the instant of producing a sound from a trumpet, for instance, a set of high

frequency components occur which include such non-harmonic partials. A sound's initial impulse therefore has a spectrum acoustically related to noise. It can be said, too, that non-critical transients will occur in the steady state of, for instance, a blown sound as a result of the mechanism of sound production. A trumpet will produce minor transients as a function of the small changes of air pressure which occur in the holding of a sound.

Time and Perception

In dealing with the nature of the initial impulse, another factor is introduced which is central to what this article will be concerned with: time as a factor of perception. Sounds, by their nature, require time in which to form themselves. That is, a vibrating system requires time in which to proceed from its inert state to its state of optimum vibration. The perception of sound is related to this growth factor which varies with each particular sound source. A measurement of pitch perception has shown that low pitches require a longer time to identify them than higher ones, and that the order of time required varies between about 50 and 14 milliseconds respectively. Similarly, the timbre of a sound will require a perception time for its recognition. This has also been found to be a fraction of a second: a clarinet requires about 60 milliseconds to reach its growth state, the flute about one-fifth of a second. It is clear that these growth times refer to the minimum time required for the identification of a sound or certain aspects of it. However, this article is concerned with another order of sound perception altogether. To illustrate this, it is useful to begin with a description of the clearly perceptible dynamic nature of the spectrum produced by the decay characteristics of a plucked string.

In the last article I introduced the components of a sound spectrum by referring to the mode of vibration of a stretched string. It was stated that when

one listens carefully to a freely vibrating string it is possible to pick out the lower-numbered partials, particularly the odd-numbered ones, three, five and seven. Numbers two and four are more difficult to hear as they are higher octaves of the fundamental and resonate in close sympathy with it. (A heavy, relatively long string should be used to experiment on, such as the low E string of a guitar. A strong attack near the bridge will be more effective to begin with than a light one.) As the spectrum asserts itself the third partial, one octave and a fifth above the fundamental, can be heard, followed by the fifth partial two octaves and a third above the fundamental. As the sound decays, the seventh partial, approximately two octaves and a minor seventh above the first, may be more distinctly heard. In addition it must be remembered that if an actual guitar string were to be plucked a host of other resonances would be set up in the other strings and the consequent complexity of harmonics is almost too frightening to contemplate. Such a circumstance—which is obviously one of the most common musically—must increase the actual perception-time required to fully comprehend the total sound pattern.

What I want to emphasise here is the necessary condition for comprehending a spectrum in this way. This is that the string must be allowed its full vibration until it comes to rest; it must be given time for the components of the spectrum to assert and reveal themselves and for the ear to scan the spectrum and sense the types of relationship which exist between the lower and higher partials. As this demonstrates, the time required for this order of perception is far longer than the fraction of a second required to register a sound's quality and distinguish it from others. I want to further demonstrate this fact and to show that the perception time I have in mind suggests the possibility of composing a piece of "music"—a "sound system," perhaps—whose basis is the revelation of

quantities as well as qualities within a spectrum or combination of spectra.

Most music that is commonly played consists almost exclusively of short or relatively short sounds which change pitch constantly. What is mainly perceived are the shapes of musical phrases accompanied by one or more instrument qualities. In

which a sustained spectrum or sequence of spectra can last for minutes or tens of minutes or even more.

In the first article I pointed to the current possibility of regarding music as an aspect of motion open to investigation. In an investigation of this kind aspects of music reveal themselves. I am

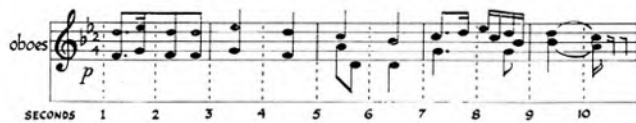


Fig. 1. In this quotation from the Penguin edition of Brahms' Variations on a Theme of Haydn we show the rate of change of pitch against an actual time scale

Fig. 1, part of the opening of Brahms's Variations on a Theme of Haydn, each dotted division represents a unit of duration of about one second. It will be seen that the complete phrase consists largely of two-note chords, or diads. At least one diad occurs within each unit of duration and the diad in each unit is different from the one in the preceding unit. The tonality of the Variations is B flat. The sequence of diads describes a musical motion within this key. It can be said that each diad represents a spectrum within the B flat tonality and that a change of diad signifies a change of spectrum.

Consider the first four units of a duration. They contain six diads. The first, third, fourth and sixth sound one spectrum, diads two and five another. The fact that each unit of duration contains at least one spectrum and that the two spectra alternate with each unit means that no spectrum sounds for longer than one second. This means that, although the ear is given ample time to register and distinguish each spectrum as an event, the sounds are cut off before one has had sufficient time to perceive the qualities within any one spectrum.

Timbre and Oriental Comparisons

The question can be asked: what reason is there for dwelling on the perception of aspects of timbre in this way? The beginning of an answer can also be framed as a question: is it not strange that a major component of timbre, such as the spectrum, is in most music not given sufficient sounding space? The dynamics of a spectrum are the body of a sound. To extend the metaphor: by increasing the length of a spectrum one allows the body of a sound to breathe.

Time and perception of sound are functions of each other. It is therefore possible to think in terms of using this relationship so that the idea of a perception-time becomes a part of the process of listening. We can extend this relationship and set up a sounding system in

suggesting a way of both composing and listening which reveals what would otherwise be hidden aspects of sound.

One type of "music" of this kind might contain no attack after the initial impulse. It can assume the form of a steady sound stream which will be heard to change continually along its length. Since timbre identification is related to the characteristic attacks of instruments, there is the possibility that when such positive growth patterns are removed ambiguity of timbre will result. This is a quality in its own right. However, all forms of change within the properties of sound, such as amplitude change, tend to re-assert the identities of individual timbres. A sound stream might, therefore, contain both ambiguity and identifiable timbre components at various stages of its duration. These facts relate to the use of instruments as sound sources. In the case of building such a sound stream with sine tones, there will be no similar ambiguity as a main characteristic of a sine tone is its uniform quality which makes it readily identifiable under a great variety of conditions.

The type of perception I have been discussing has always been present in the music of India and China. In India, for instance, long drones are commonly used. The tambura is an Indian stringed instrument which emits a drone whose spectrum is rich in partials. A singer locates the intervals which he sings by comparing them and contrasting them with the lower partials of the tambura's spectrum. This requires an ear finely adjusted to their relationships. Joseph Needham, in Vol. IV of *Science and Civilisation in China*, describes how the technique of playing the ancient Chinese lute consisted mainly of producing different timbres at the same pitch. A primary feature of Japanese Buddhist chant is the use of long vocal tones. Practices of this kind are indicative of a response to sustained sounds and, therefore, to the components of timbre.

In terms of what I have said about the comprehension of timbre components, it is possible to make a model of a spectrum and invent sound transformations which will produce change in its dynamic nature.

A model of a sound stream

Following from this, Fig. 2 presents a simplified diagram, in terms of time versus frequency, which shows part of the extent of perception time which I think is relevant to the comprehension of such a spectrum. The diagram depicts five long sounds as horizontal stripes, together with their frequencies in Hertz. These represent a fundamental, G, and its first four harmonics as shown in Fig. 2 last month. The duration of each frequency extends along the full length of the time axis through the dotted verticals. The fact that the stripes are open-ended represents a further duration of each frequency. The dotted verticals each define units of duration of 10 seconds. The sound sources are shown as instruments but they can be also thought of as a combination of sine tones. In the case of instruments, remembering their complexity, each sound would constitute a spectrum and the whole would technically be a combination of spectra. Were each sound to be a sine tone, they would together form a single spectrum with G as the fundamental. For the purpose of the diagram they will be referred to as a spectrum. The varied markings along the frequency stripes represent possible changes of property within each component of the spectrum. A white segment represents a soft, flat, vibrato sound; a segment with diagonal hatching represents a gradual increase of amplitude to medium loud and a return to soft; a black segment presents a slow, medium loud vibrato and a dotted segment a soft, faster vibrato.

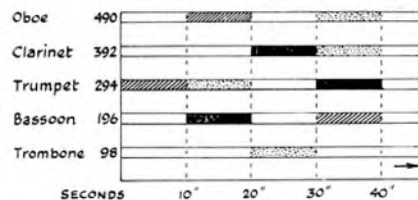


Fig. 2. Time versus frequency—a simplified diagram

The diagram can be seen as representing the dynamics of a spectrum. The changes of amplitude which occur in each component present a model of a spectrum's relative intensities. The frequency at 294 Hz, with its gradual increase of amplitude, can be said to represent a type of a growth pattern. The varied vibrato segments depict a version of the presence of beats between frequencies; the model as a whole may be

Please turn to page 171



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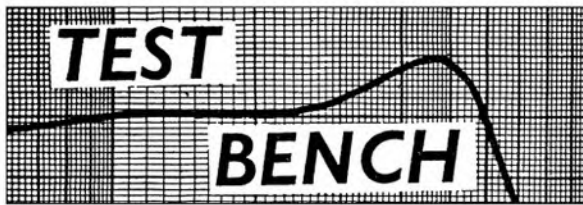
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EMI AFONIC TAPE

INVESTIGATED BY
R. HIRST AND D. KILLICK

FOR our Test Bench Review this month we have elected to investigate the properties of a new recording tape. Marketed by EMI Tape Limited under the trade name Afonic it was also featured in an editorial in last month's issue when we discussed something of the thinking behind its evolution. But now we look at the tape itself in terms of practical performance, and that presents some very difficult problems.

In our opinion it is illogical that so much attention should be devoted in the specialist press to analysing equipment performance and yet so little notice is given to the recording medium itself—magnetic tape. To correct this imbalance we have in the past published a number of reviews of different brands of tape and this evaluation could be regarded as an extension of that series.

The basic problem in assessing tape performance lies in the fact that the end product—recorded audio quality—is a function of both the tape itself and the individual items of equipment used to produce the recording. From the reader's point of view the chief value of any review lies in its truthful indication of how the product discussed might be expected to perform if he were to acquire it. It follows that since tape performance will vary in relation to the recording device there can be no absolute assessment of the value of any given tape that will hold good under a wide range of diverse recording conditions.

The situation would be greatly simplified if there were to be agreement on a standard specification for a standard recording tape and—much more improbable—a specification for a standard magnetic recording device. By its very nature the latter is obviously impossible but some measure of progress has been made towards the former.

There is not yet an agreed British Standard, but it is at present possible to refer to a DIN standard and to a standard recording tape (number 110211) and to compare the performance of the tape under investigation against these norms. The result of such comparisons is an interesting set of figures but we are concerned as to their validity under conditions of practical use on domestic equipment.

The fact that a tape performs better or worse than a standard tape does not

MANUFACTURER'S SPECIFICATION

EMI Afonic Long-Play Tape compared with the DIN Reference Tape 110211 at a Tape Speed of 3½ ips using ½ Track (1 mm) Ferrite Heads Record Gap 2 microns 10 mm Radius. Replay Gap 2 microns 10 mm Radius.

	DIN Reference Tape Batch 110211	Typical EMI Afonic Long-Play Tape
Sensitivity 333 Hz.....	0 dB	0 dB
Sensitivity 1 KHz.....	0 dB	-0.25 dB
Sensitivity 6.3 KHz ...	0 dB	-1.5 dB
Sensitivity 10 KHz ...	0 dB	-1.5 dB
5% MRL at 333 Hz, Ref. 1	+3.75 dB	+3.75 dB
10 KHz Saturation, Ref. 1	-6.5 dB	-6 dB
Reference level to bias noise, Ref. 1	-44 dB, Ref. 2	-48 dB, Ref. 2
Reference level to bias noise, Ref. 1	-53 dB, Ref. 3	-56.5 dB, Ref. 3
Reference level to bulk erase noise, Ref. 1 ...	-49 dB, Ref. 2	-52.5 dB, Ref. 2
Reference level to bulk erase noise, Ref. 1 ...	-56.5 dB, Ref. 3	-60 dB, Ref. 3
Signal to Print after Storage for 24 hours at 20°C, Ref. 4	-53 dB	-57 dB

The above results were obtained using a constant value of bias current, typical of that used by the majority of manufacturers of non-professional tape recorders (i.e. that value of bias current indicated on the Bias/Distortion, Bias/Sensitivity curves of the DIN Reference tape Batch 110211).

All noise measurements were made using a replay amplifier equalised to the 90 microsecond and 3180 microsecond characteristic (in accordance with IEC Publication 94, Edition 3).

Ref. 1.—Relative to an RMS flux of 25 mMx/mm tape width at a frequency of 333 Hz.

Ref. 2.—Weighted, using a filter and quasi peak measuring instrument in accordance with DIN 45405.

Ref. 3.—Weighted in accordance with IEC 123A, British Standard 3489 1962 (A curve), ASA Standard S1—4—1961 (A curve) and DIN 5045 using a measuring instrument with the same dynamic characteristics as a Standard Volume Indicator. (British Standard 3489—1962 and ASA Standard C16—5—1961.)

Ref. 4.—Signal-to-print measurements were made using a 1 KHz tone at a tape speed of 15 ips, recorded to a level at which 3% Third Harmonic Distortion is generated.

Distributed by: E.M.I. Tape Ltd., Hayes, Middx. Price: Available in a number of spool sizes and tape thicknesses including standard play, long play, double play and triple play. Typical is the cost of a 7 in. spool of long play tape 1800 ft. costing 51s. 2d. including purchase tax.

E.M.I. Afonic Long-Play Tape compared with DIN Reference Tape 110211 at a Tape Speed of 7.5 ips, using Full Track Ferrite Heads, Record Gap 6-7 microns 50 mm Radius. Replay Gap 3-4 microns 50 mm Radius.

	DIN Reference Tape Batch 110211	Typical EMI Afonic Long-Play Tape
Sensitivity 1 KHz.....	0 dB	-0.25 dB
Sensitivity 4 KHz.....	0 dB	+0.25 dB
Sensitivity 10 KHz ...	0 dB	0 dB
Sensitivity 15 KHz ...	0 dB	0 dB
Optimum bias ratio at 1 KHz	1.0	1.077
1 dB overbias ratio at 1 KHz	1.0	1.122
3% MRL at 1 KHz, Ref. 1	+2.5 dB	+3.5 dB
10 KHz Saturation, Ref. 1 (1 dB overbias at 1 KHz)	-4 dB	-2.5 dB
Signal to DC Noise in accordance with DIN 45519.....	-43 dB	-51.5 dB
Reference level to bias noise, Ref. 1	-54 dB, Ref. 2	-56.5 dB, Ref. 2
Reference level to bias noise, Ref. 1	-64 dB, Ref. 3	-65.75 dB, Ref. 3
Reference level to bulk erase noise, Ref. 1 ...	-58.75 dB, Ref. 2	-61 dB, Ref. 2
Reference level to bulk erase noise, Ref. 1 ...	-67.5 dB, Ref. 3	-68.75 dB, Ref. 3
Signal-to-Print after storage for 24 hours at 20°C, Ref. 4	-53 dB	-57 dB

The above results were obtained using recommended bias for each tape under test.

All noise measurements were made using a replay amplifier equalised to the 70 microsecond characteristic (in accordance with IEC publication 94, Edition 3).

Ref. 1.—Relative to an RMS flux of 32 mMx/mm tape width at a frequency of 1 KHz.

Ref. 2.—Weighted, using a filter and quasi peak measuring instrument in accordance with DIN 45405.

Ref. 3.—Weighted in accordance with IEC 123 A, British Standard 3489—1962 (A curve), ASA Standard S1—4—1961 (A curve) and DIN 5045 using a measuring instrument with the same dynamic characteristics as a Standard Volume Indicator. (British Standard 3489—1962 and ASA Standard C16—5—1961.)

Ref. 4.—Signal-to-Print measurements were made using a 1 KHz tone at a tape speed of 15 ips, recorded to a level at which 3% Third Harmonic Distortion is generated.

necessarily indicate that the same differences would always be obtained in the consumer's home using his own equipment. This would only occur if we had standardisation of recording equipment and that, as we have already said, is improbable just as it is also undesirable.

In fact there has been continuous development of both recording equipment and magnetic tape and for a period of some five years the advantages of using a high coercivity recording medium have become only too obvious. As a result a number of domestic recording tapes can be described as "high coercivity" and many domestic machines produced during the last five years have been designed to apply the necessary increased level of

bias. This is an excellent state of affairs from the point of view of owners of "modern" equipment. It is, however, suggested that owners of older machines—around five years or more—would be well advised to have their equipment checked by a reputable service agent to have the bias value adjusted if necessary. It must be pointed out however that an elderly machine with worn heads is likely to give better over-all quality on a high coercivity tape—although of course the correct procedure is to replace the worn heads and have the bias readjusted.

Our own technical approach is to conduct a series of investigations, measurements and comparisons using our own hybrid test-bed fitted with heads which

it is hoped will approximate the type of heads generally in use on domestic machines. This is followed by explanatory notes to assist in relating laboratory figures to conditions of practical use. Before setting out on this task we were only too well aware of the fact that tape manufacture today is a highly sophisticated art and differences between good tapes are likely to be no more than marginal. This calls for critical control and measuring techniques.

These measurements are only meaningful if the tests are carried out under certain stated conditions, and so we first set out the details of our own procedure:

1. The measurements were carried out at a tape speed of $7\frac{1}{2}$ ips.
2. The tape was overbiased for a fall in maximum output of 1 dB at 1 kHz.
3. The measuring replay amplifier was equalised to a 70 microsecond curve at $7\frac{1}{2}$ ips.
4. In all cases the recorded levels have been referred to a sine wave of 1 kHz recorded to a level that will produce 3 per cent total harmonic distortion on replay.

For comparison purposes duplicate tests have been carried out on a sample of standard recording tape, Batch No. 110211, and the two sets of figures form the basis of this review. This standard tape has been chosen because not only is it manufactured to the most stringent specification but it is also readily available to the public. It is therefore possible for private individuals to carry out investigations using their own equipment to assess the differences between any given tape and the standard.

Output level for 3 per cent total harmonic distortion

The recording was made at $7\frac{1}{2}$ ips at a level which produced 3 per cent total harmonic distortion at 1 kHz. Both the standard tape and Afonic tape produced very similar outputs.

Overload characteristics at 1 kHz.

The recording level was increased so that the output from the tape contained 5 per cent total harmonic distortion. At $7\frac{1}{2}$ ips Afonic tape produced 1.5 dB more output than the reference tape.

Signal to noise ratio

The recording was made at $7\frac{1}{2}$ ips at a frequency of 1 kHz to produce 3 per cent total harmonic distortion on replay. The input signal was then removed and the tape was allowed to continue in the record mode for sufficient time to allow a measurement to be made. When the signal output level was compared with the resultant noise Afonic tape produced a signal to noise ratio 3.2 dB better than that achieved with the reference tape.

Since, as we have previously demonstrated, the tape under test gave 1 dB more output than the standard tape under these conditions it could be said that the improvement in signal to noise is made up of an actual 2 dB reduction in noise plus 1 dB gain in output to give an effective advantage of approximately 3 dB.

Output at various frequencies

For these tests we used 1 kHz as the reference frequency and recorded tones at a level of 20 dB below that required to give 3 per cent total harmonic distortion at that frequency. Working at $7\frac{1}{2}$ ips it was found that at 10 kHz the output from Afonic tape was 0.5 dB better than that from the reference tape. At 15 kHz Afonic tape improved even more, giving 1 dB extra output. At 300 Hz the outputs from both tapes were so similar as to be immeasurably different.

Erase characteristics

We limited this investigation to a purely arbitrary comparison between the two tapes as recorded and erased on the same machine. A signal of 1 kHz was recorded at $7\frac{1}{2}$ ips to a depth that resulted in 5 per cent total harmonic distortion on replay. The input signal was then removed and the tone erased. The resultant output from the Afonic tape was

found to be 2.2 dB less than the signal still present on the reference tape. We do not suggest that this is a definitive test but it does indicate that the two tapes have very similar erase characteristics.

Bias sensitivity

All measurements so far described have been based on a recording speed of $7\frac{1}{2}$ ips and a bias value calculated to give a 1 dB reduction of output below maximum. In our comparisons it was necessary to adjust the bias for the two different kinds of tape to achieve an optimum for each. It was found that Afonic tape requires 9 per cent more bias current than the standard tape to produce an identical 1 dB reduction in output. As a matter of interest it was also noted that if both tapes were inadvertently subjected to a similar increase of bias over optimum then the Afonic tape tended to preserve its high frequency response measurably better than the reference tape. It could therefore be said that when the bias current on a machine is set to too high a value then considerably wider discrepancies will be tolerated by Afonic. This could be of some advantage since it will enable the tape to give a good performance over a wider range of different kinds of equipment.

At this point we concluded our technical investigation but we do feel that some explanation is necessary to relate what has been said to the practical requirements of domestic users. Several times in this review we have referred to an optimum bias level which is arrived at by recording a 1 kHz tone as the bias current is being increased. The output from the replay amplifier is measured and it is found that as the bias current increases so does the output. At one particular point maximum output is achieved and thereafter it begins to fall. The optimum level of bias current is that required to produce a decrease of 1 dB in output below maximum. To prevent any misunderstanding we must emphasise the fact that this procedure is correct when working at tape speeds of 15 and $7\frac{1}{2}$ ips *but it would be quite wrong for slower speeds*. Optimum bias for $3\frac{3}{4}$ ips and less is regarded as the value which will give maximum output. A well-designed tape recorder using two speeds should provide both a change of equalisation and a change of bias value when switching from $7\frac{1}{2}$ to $3\frac{3}{4}$ ips, unless facilities are provided for manual adjustment.

There are certain fundamental differences between professional or semi-professional machines running at relatively high speeds and lower-cost domestic equipment which often uses both slow speeds and narrow tracks. To obtain a wide frequency response under these conditions domestic tape recorders often use

TEST BENCH REVIEW OF SONY TC 355 PUBLISHED MARCH 1969

In compiling our Test Bench Reviews of equipment we are always conscious of the heavy weight of responsibility we carry, both in respect of our obligations to our readers and also to the manufacturers of the products under investigation. The purpose of a review is to sincerely indicate to the reader just what the relative advantages or disadvantages and performance standards of the equipment under discussion might be expected to be.

In the case of the review of the Sony TC 355 we published a response curve showing an unusually steep rise. These figures were carefully prepared and checked and were sincerely believed to be accurate in respect of the particular machine under review. We were careful to clearly state, page 97, that "this effect could be peculiar to the review model" and we also added that we would be pleased to publish the manufacturers' comments in due course. Our findings have now been queried by Sony (U.K.) Limited who equally sincerely believe that such results are not representative of the performance that might be expected from their general stock of this model.

If this is so then our review has quite unwittingly not given the reader a fair idea of what he might expect if he were to purchase this machine—neither was it fair to the manufacturer. We have accordingly offered to recheck current stock samples taken at random and to publish our new findings. Any such subsequent investigation will be treated in the same manner as our usual reviews and the results will be reported with strictest impartiality.

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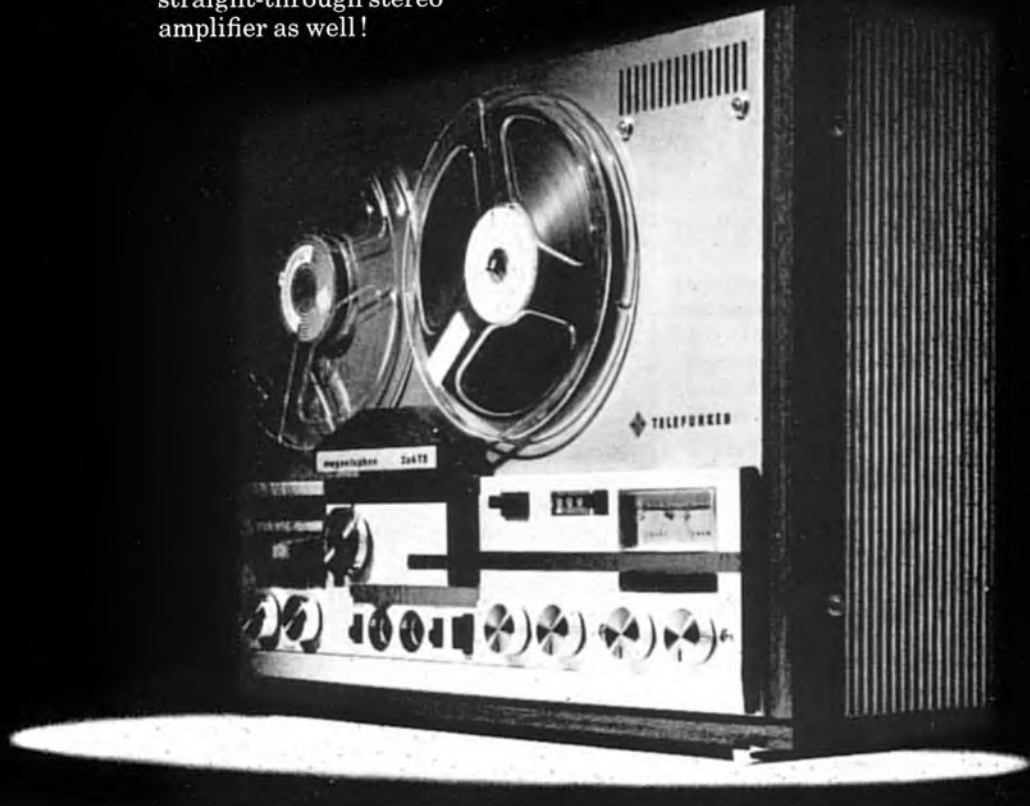
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FIRST STEPS IN STEREO

from page 157

under practical conditions having to do something which we knew only too well was wrong. But then that is what so often happens when theory gives way to practice.

Our cable runs had barely been completed when the service started. There had been no time to properly check circuits or set levels. The ship was launched and under way and we could do nothing about it.

Hardly surprising that things went wrong. To our horror it was found that the two microphones at the altar were both being fed into the same channel, so we had to wait discreetly for a suitable point in the programme when we could drop the level of these two microphones, unplug, replug and then restore the levels again.

We realised we should have allowed a great deal more time for the setting up process. In the old days when working mono our monitoring system was quite simple. Now we had a separate external amplifier plus a pair of speakers and double the connections to look after. This monitoring system must be properly in action right at the beginning of the setting up process so that each individual microphone can be carefully checked to ensure that it is not only working but that it is properly connected to its appropriate channel. Most of our troubles on this session were due to lack of time—time that is essential to properly install one's equipment.

Like the proverbial curate's egg our results were good only in part. Much of the final recording was hopeless, but we were immediately struck by the difference between the stereo recording and its mono counterpart. By switching the external amplifier into mono replay and mixing the output from both left-hand and right-hand channels we were able to get a direct comparison between the stereo recording and a reduction to its monophonic equivalent. Even when the stereo was not good it was still better than the mono version. The small sections of stereo that were really good had us enthusiastically imagining the prospect of still better things to come.

At the end of the evening we left the church to load our equipment into the car, only to find that whilst we had been busily recording the outside world had experienced the heaviest snowfall of the winter. In front of us was the prospect of an unpleasant and treacherous journey home. We did get stuck, but not until we were within some 200 yards of our destination, so we ended the day collecting a spade and digging the car out of a snowdrift. This was not an occasion we shall either of us forget, but it was worth every moment of it.

TEST BENCH

from page 166

head gaps as short as 2 microns and there is rarely provision for the user to adjust the bias level to optimum to suit different kinds of tape. This value is pre-set by the manufacturer and the user depends entirely on the accuracy of his testing and the strictness of his specification.

It is obviously impossible for us to simulate the total variation that might be encountered across the entire breadth of the retail market. What we have done is to attempt to indicate the kind of results that might be expected from a properly designed domestic tape recorder. When purchasing low cost equipment of dubious origin the prospective customer always stands the risk of finding—amongst other things—that his machine has not been properly adjusted to give a good performance on modern tape. It is another case of the cheapest being the dearest in the long run.

For user tests we recorded Afonic tape using a good quality $\frac{1}{4}$ -track stereo mains machine and compared results to other identical recordings made on various other brands of tape. Amongst the comparative test tapes was a sample of what is popularly known as "white box"—that is, cheap tape lacking any brand name. The Afonic tape showed quite a dramatic improvement in both noise and output over this white box sample. Against other branded tapes from reputable manufacturers the subjective advantages of Afonic were not easy to assess aurally since results were not dissimilar to those obtained from other low-noise high output tapes. This confirms the laboratory investigation which demonstrates that only tiny differences were measured. Nevertheless small gains in quality can be significant and we strongly recommend the use of a recording medium that will enable the user's equipment to operate at the peak of efficiency.

We should mention that the print-through and drop-out factors were so unobtrusive on the Afonic tape that we almost forgot to mention them. Which speaks volumes!

Finally a word must be said about one small mystery surrounding Afonic tape. Although this trade name is used by the manufacturer in his literature and advertisements he has not for some strange reason seen fit to either print it on the box or put it on the label. Odd, isn't it? So if you are looking for Afonic tape do not expect to find it described as such in the shop. E.M.I. Tape Limited state that all their current production is now Afonic and a simple check is to examine the colour of the tape itself. This should be black. If it is brown it is not Afonic. It is understood that a redesigned pack will shortly be on the market and we hope that this will bear the trade name that

E.M.I. themselves have seen fit to use. It will save a great deal of unnecessary confusion.

In conclusion we can say that Afonic recording tape is an excellent product that will stand comparison with any other equally sophisticated recording medium. It has been claimed to be "best in the world" in many respects. Whilst we feel that such sweeping statements are both unnecessary and invidious we would endorse the fact that it can proudly stand in a place of its own amongst the best.

LEARNING WITH TAPE

from page 158

train journey can be a valuable learning session instead of a complete waste of time. But any ordinary standard mains machine is ideal for home use. Another variation of the principle of learning by tape is to use one of the so-called "sleep learning" methods. There has been a certain amount of misunderstanding about what sleep learning is capable of doing. It must be clearly stated that no known method of learning removes from the student the obligation to devote a certain amount of regular and concentrated mental effort to the subject. Sleep learning techniques are primarily intended to reinforce conscious effort, and they do not claim to replace it.

The demand for education has never been so great as it is today. Neither has the old proverb about never being too old to learn been more true. Soon we shall have the first radio and television transmissions from the new Open University, an institution that will offer degree courses for any who care to take them. Never have there been such opportunities for the man in the street to improve his knowledge and his qualifications. And just as the Talking Page will help five-year-olds to overcome their difficulties so ordinary tape recording equipment can help you to learn your own chosen subjects more speedily, more efficiently and less painfully. So when learning don't just think of pens and exercise books but make use of that most versatile of all educational aids, the ordinary tape recorder.

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NATURE NOTES FOR MAY

BY RICHARD MARGOSCHIS

LAST May I had a microphone secured to a tree root which had been exposed some four or five feet inside the entrance to a badger's "set"; I left it there for several nights. At dusk I sat watching the entrance and monitoring the microphone, fully expecting to have audible warning of "Brock's" approach. Imagine my surprise when I saw him carefully put his head above ground level having climbed up a steep incline and passed right under the microphone without making a sound.

The badger is a nocturnal animal and although he can be so quiet when just coming to the surface his activities above ground can be far from silent. He can often be heard scraping around among leaves and plants in his search for food, all the time sniffing.

He frequently changes his bedding, bringing the old out of the set to be replaced with fresh. When this is going on he will scrape dead leaves and grass together in his front paws and roll them along the ground for a considerable distance, producing a noise rather like somebody sweeping with a hard broom.

He relies to a great extent upon his nose for safety; if he smells you he will be gone! You have to be very careful of wind direction when taking up station to watch. Always sit down-wind from where you expect him to appear; on very still nights a small piece of tissue paper dropped from the upstretched arm will indicate the slightest air movement.

He is not a particularly vociferous animal, there is often a certain amount of grunting and sniffing, and frequently a sort of rather pleasant chuckle. By now the young cubs will be above ground and there is a good chance of finding a family at play; this can be very exciting and noisy. Fights among adults can also be very noisy, and weird screams have been described though I have never been fortunate enough to hear such noises.

When placing microphones near the set care must be taken to leave plenty of time for your scent to disperse before the badger arrives. From this point of view a microphone hanging above ground level is an advantage, with leads, preferably off the ground, running to a suitable observation post. Alternatively a reflector can be placed in a strategic position aimed to cover the entrance and tracks leading from it.

If you work with microphones at a distance do be sure to have one in your hand also, and ready to plug in. I once had a badger cub sniffing in my pocket and both my microphones were 20 yards away.

Talking of "aiming" reflectors, how do you get on now that the trees are in leaf and you cannot see the bird you hear? The parabolic is directional and must be correctly aimed to get full advantage of its gain.

The most common method is to use a sighting hole cut in the centre of the dish so that a sight can be taken along the line of the microphone, but this is useless if you cannot see your subject. The alternative is to listen, from a monitor point in the amplifier, to the signal being fed from the microphone. The reflector is visually aimed in the general direction of the sound and then moved around until the strongest signal is heard; it is then correctly aligned on to the sound source.

Monitoring can be by means of a small ear-piece or a set of headphones. The earpiece is lighter, less bulky and generally easier to handle than a headset but some practice is necessary in using it successfully. When it is in use your one ear is listening only to sounds from the direction in which the reflector is aimed, whilst the "open" ear is listening to sounds from all directions. This has the effect of destroying the directional capabilities of your natural hearing so that if the earpiece is in your left ear you will, at first, think that the subject is more to the right than it really is, making the initial visual aiming difficult. However, the earpiece can easily be removed and replaced as desired.

On a good set of headphones you should hear only the sound picked up by the microphone and they will give you a better conception of the signal and background noise. They are, perhaps, more essential when A/B monitoring is available.

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PROJECT ALPHA

from page 163

seen as one interpretation of the overall amplitude and frequency modulation of a spectrum. The white segments represent the characteristics of a more uniform steady state.

Experiment in Synthesis

What has been said in connection with Fig. 2 suggests how, using the sine wave feature of a Heathkit generator and the sound-on-sound feature of a Telefunken Magnetophon 250, sine tones can be used to set up a sound stream consisting of a single spectrum or spectrum sequence in which each component is made to exhibit the types of transformation which I have mentioned. This equipment which is being used as a basis for these articles includes two primary features which can be used as the basis for setting up such a system. These are the level control in association with the level indication meter and the capacity of the sound-on-sound feature for achieving beats between recorded frequencies.

Beats are related to the phenomenon of interference. Interference occurs when, for instance, two frequencies combine under conditions in which the resultant distribution of sound occurs in such a way that, at specific points, they neutralise each other, resulting in an alternation of sound and silence. When two sounds of nearly the same frequency are combined, the relative displacements of the faster and slower vibrations cause the increase and decrease of air pressure produced by each to agree at certain points, and at others to be in opposition when a pressure increase of one wave coincides with a decrease in the other. When the pressure functions agree, a sound louder than either frequency occurs; when they oppose each other sound level is reduced. The result of this interference is, first, a process of addition and subtraction of the two frequencies. They add together to give a close resultant frequency. Secondly, the amplitude of the new frequency varies. The curve which can be drawn to connect the peaks of these amplitude variations is termed an envelope. This envelope itself induces another new frequency and this is called the beat frequency. It occurs as a series of fluctuations of amplitude at a rate equal to the difference between the two original frequencies. When two frequencies of 200 and 250 Hz are combined, they will fluctuate at a rate equal to their difference, i.e. 50 times a second. In this way the beat rate can be controlled.

When synthesising a simple spectrum it is useful to begin by combining three or four harmonics above a fundamental. This can be done in accordance with the intensity proportions associated with an electronic waveform such as a square

wave. In this case, unlike the irregular intensity progression of an instrumental sound, the partials exhibit a regular progression: the amplitude of each partial is inversely proportional to the partial's number in the spectrum. The intensity of the second partial, therefore, will be one half that of the fundamental, etc., etc. When adding one partial to another the level indicator on the recorder should be set at the intensity relevant to the partial to be added and should register as little motion as possible, ideally none. The result of the combination should be a smooth sound.

Using a spectrum of this kind, a spectrum model with the properties of its components varied, as depicted in Fig. 2, can be synthesised. One can introduce into the synthesis the types and degree of change desired for each component by making use of varied beat frequencies and a variety of amplitude change. Actual tests should be made to determine what rates of amplitude change correspond with a particular rate of motion of the level indicator. In a simple experiment, if a total duration of 40 seconds is chosen for a spectrum, this can be divided into equal divisions, as in Fig. 2, and a method followed of changing a different component within each successive division. Another possibility would be to withhold one component from the initial stage and introduce it at a later point. When a model has been completed, the full length can be modulated by beat frequencies or amplitude. It can also be faded out and the components of a new spectrum introduced through the gradual decrease and fade of the first one. Next month we will deal with uses of rhythm.

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REVIEWS

ROGER MILLER. A Tender Look at Love.
Mercury CMP7018. 54s. 6d. including purchase tax.

It's strange how one associates voices with colours. There can be no more colourful voice than Roger Miller's; and that colour is a deep, dark brown. The "relaxed" style of singing is becoming increasingly popular but I can think of no one who is able to convey so perfectly a sense of luxurious indolence.

As Roger Miller saunters carelessly through his programme the listener is affected by the feeling of genuine well-being. It really is wonderful how this supreme master of the fine art of laziness can induce a grudging envy in we work-a-day mortals. For this delightful stroll through the attractive fields of inactivity he has chosen: *Tolivar, By the time I get to Phoenix, What'd I give, My elusive dreams, Less of me, The twelfth of never, Little green apples, Gentle on my mind, Honey, With pen in hand and Dear heart.*

At first I was a little suspicious of recorded quality but soon decided that the unusual vocal sound is entirely due to the character of the singer's voice. It does have a fascinating quality as well as a fascinating style. If Roy Miller himself had been writing this review I am quite sure that he would have stopped at this point and left on his door a cryptic notice simply saying "Gone fishing." Anyone got any worms to spare?

RAVEL. Boléro, Ma Mère l'Oye and La Valse. The London Symphony Orchestra conducted by Pierre Monteux. Philips CPC0060. 54s. 6d. including purchase tax.

This excellent addition to the Philips classical catalogue gives us three evergreen favourites from the light classical repertoire. It gives us also two of the most dramatic and daring compositions to be placed before the public.

At least that is what *Boléro* and *La Valse* were when they were written in the 1920's. Today our musical tastes are somewhat more "sophisticated" and Ravel no longer either shocks or surprises. Tactfully they have been arranged on this album with the idyllic tranquility of *The Mother Goose Suite* in between. A collection of charming fairytales it perfectly sets off the frenzied desperation of the other two works.

For sheer listening pleasure this album offers very good value for money. My only criticism is of a slightly obtrusive hiss in the opening quiet passages of *Boléro*. Apart from this recording is excellent with *The London Symphony Orchestra* giving a polished performance.

BARBRA STREISAND. Simply Streisand.
CBS 40-63151. 54s. 6d. including purchase tax.

The sleeve notes contain nothing more than a short, direct message from Richard Rodgers. I will quote him verbatim: "Nobody," he says, "is talented enough to get laughs, to bring tears, to sing with the depth

of a fine cello or the lilt of a climbing bird. Nobody, that is, except Barbra. She makes our musical world a much happier place than it was before."

Whilst I agree wholeheartedly that Streisand has all these desirable attributes one could dispute her uniqueness. Nevertheless the fact that one or two others might have an equal claim to such accomplishments does not in any way detract from her very fine performance. She can, occasionally, produce what to my ear are extremely ugly vowel sounds—but then she's only human and we can't have everything.

The album comprises: *My funny Valentine, The nearness of you, All the things you are, Make the man love me, Lover mine, More than you know, I'll know, When Sunny gets blue, The boy next door and Stout-hearted men.*

Certainly my world is a happier place for her visit, thanks to a good recording. An old-fashioned elocution teacher could work miracles with our Barbra, but I somehow doubt if she will descend far enough from Richard Rodgers's pinnacle to take my advice. Pity, because in all other respects she's high up on my list of "Wanted Women".

7½ ips STEREO

Equipment used for review tapes: Amplifiers—Quad valved and Wharfedale transistorised. Loudspeakers—Celestion and Jordan-Watts. Tape Recorders—Akai 3000 D and Tandberg 64X.

TIJUANA PARTY. The Borderlanders.
Coronet CSL 7410, 7½ ips, ¼-track Stereo. 57s. 5d. including purchase tax. Also available 3¾ ips, ½-track mono, 41s. including purchase tax.

When assessing the quality of this tape we have to bear in mind its relatively low cost, and also the fact that it features in a "free offer" that is now being widely advertised. For these reasons I approached the album with a certain suspicion, but after listening carefully I am happy to be able to report that it does offer some quite good quality.

The only criticism is of the hiss level, which tends to be obtrusive until tempered by a little top cut at the main amplifier. Probably it would not be noticed when using less clinical speaker equipment. Apart from that quality is really surprisingly good—plenty of clean sound and presence which is essential for music of this character nowadays.

Numbers offered include: *A taste of honey, Third man theme, The lonely bull, Whipped cream, La cucarracha, Border town, Tijuana express, El relicario, Tijuana taxi, Mexican hat dance, Spanish flea, What now my love, Zorba the Greek, Carta blanca, Quit hornin' in and La Golondrina.*

It doesn't pretend to be pretentious—just a collection of good homely fun presented in an unsophisticated way. As such it is successful and can be recommended—quite a bargain at the price, in fact, but don't forget to knock that top down a bit.

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An unusual feature of the amplifier is the return of the "presence" control, which by boosting mid-range treble and bass frequencies creates an overall impression of closeness to the performance; when operated in conjunction with the treble control it performs the function of a switchable scratch filter. As will be seen from the illustration

push-button controls are very sensibly placed on the upper horizontal surface so that the pressure of the finger is downwards. Connections are deliberately restricted to make for ease of use, the three inputs provided being simply for tuner, tape and pick-up. The latter is suitable for crystal or ceramic cartridges only.



A Stereo Radio Tuner, A747, is complementary to the amplifier. This unit covers long and medium wavebands as well as VHF and incorporates a built-in stereo decoder plus a stereo beacon. AFC is provided on the VHF band and a tuning meter is also incorporated. The AM aerial is built-in and automatic stereo/mono switching is provided.

Both the above items may be purchased as a combined stereo tuner amplifier under the reference A758.

A matching Record Player, A749, is fitted with a three-speed single-play Garrard 3500 turntable with an optional auto-change facility. The single stylus pick-up is integral with the tone arm and the high compliance cartridge is said to be suitable for mono and stereo records.

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To complete the range of equipment three models of loudspeakers are offered together with a specially-designed trolley on which all the items may be mounted to form an attractive and useful housing. Recommended retail prices of the individual items are as follows: Stereo Amplifier A746, £32 11s.; Stereo Tuner A747, £34 3s. 10d.; Stereo Tuner/Amplifier A758, £71 11s. 10d.; Record Player A749, £28 17s.; Sound System Trolley A762, £16 18s. 6d. Three models of loudspeaker enclosures range from £34 4s. 4d. to £60 18s. per pair. All prices are inclusive of purchase tax.

Rank Bush Murphy Limited, Power Road, Chiswick, London, W.4.

MANUFACTURERS' ANNOUNCEMENTS

During the period from March to June this year five of the major marketing and service sections of Rank Audio Visual Limited will be moving into new premises on the Great West Road, Brentford, Middlesex. Amongst those changing their homes will be Pullin Photographic, distributors of Akai tape recorders, who are at present in offices at Aintree Road, Perivale and also the service departments now accommodated at Shepherds Bush, London, W.12. It is intended that by bringing the various marketing sections together under a single roof the efficiency of the company's London area operations will be increased whilst at the same time administration costs will be reduced. Some 700 employees will be working in the new premises which apart from offices will also contain a new canteen, coffee lounge and shop where staff will be able to buy household groceries and confectionery.

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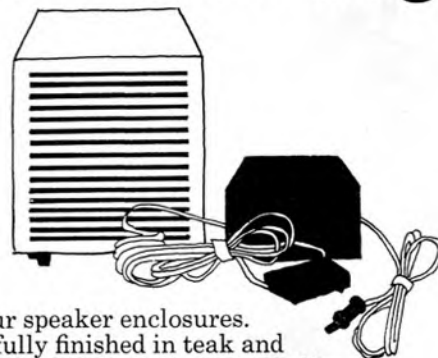


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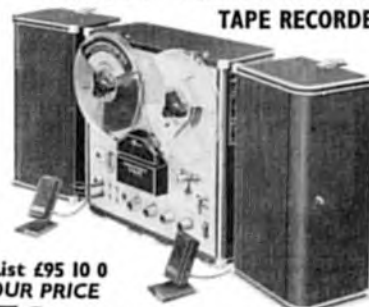
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