



HI-FI **for** **Pleasure**

**A GUIDE TO
EQUIPMENT**

by

Burnett James

Hearing it all

The arrival of the long-playing record has swept the gramophone back into favour. Sales of 'real' music—symphonies, concertos and chamber music—have soared to such heights as to embarrass the manufacturers of records.

But what of reproduction? Most record buyers are playing their expensive discs at a level which is both unsatisfactory and ruinous. Mr. Burnett James, who is a well-known record reviewer, here tackles this sensitive problem.

In writing this handbook he has had the enthusiastic help and advice of many experts. As a result, the preliminary investment of the few shillings which his book costs will provide the reader with the best advice on record reproduction, and may easily save him pounds.

In plain, and sometimes trenchant, language Mr. Burnett James addresses himself to the musical rather than to the technical ear. He examines the problems of recording. He defines 'high fidelity' and expounds the elementary facts of reproducing from disc. He surveys the components of a 'hi-fi' system and explains that assembly and matching is so simple as to be nearly foolproof.

Nor does our author scruple to name names and to recommend specific products. Vague advice being useless in this matter he will tell you what, in his opinion, are the best components and their prices, thus permitting the listener to relate his ambition to his financial resources. He concludes with an examination of the prospects of tape reproduction, and adds a glossary of such terms as 'wow' and 'flutter'.

FOREWORD BY
SIR COMPTON
MACKENZIE

HI-FI For Pleasure

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by

BURNETT JAMES

With

24 Illustrations



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Foreword

by Sir Compton Mackenzie

I HAVE recently finished compiling 'My Record of Music' which will relate my adventures with the gramophone during the last thirty-two years. I was anxious to perform this task before contemporary developments of what I am tempted to call the greatest boon that mechanical ingenuity has given to mankind should have made the gramophone and its music of a generation ago seem so prehistoric that my book would sound more like archaeology than gramophony.

After reading *Hi-Fi for Pleasure* I am more sharply aware than ever of the gulf between an old-fashioned discophile like myself and Mr Burnett James. Yet I have read his book with an interest by which, to be frank, I was completely surprised. Lacking a mechanical mind, I expected to be bored: instead, I was continuously entertained. I am not qualified to endorse Mr Burnett James's exposition as a fellow expert, but I can testify with enthusiasm to the pleasure he has managed to convey in *Hi-Fi for Pleasure*.

I have tried the book out on a middle-aged convert to the gramophone, and that middle-aged convert will not be happy until he can brag of the new instrument he proposes to acquire under the inspiration of Mr Burnett James. I have no doubt that this will be the gratifying effect of the book on the many who I hope will read *Hi-Fi for Pleasure*.

Compton Mackenzie

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Acknowledgments

I WISH to express my most grateful thanks to many individuals and companies for the willing help and co-operation they have given me in the preparation of this book. Without their help I should have been hamstrung and remained tongue-tied. Maybe some of them will wish I had. I have to confess that I have not always taken the excellent advice given to me unreservedly to heart; that I have at times run wilfully counter to various attempts to keep me on the path of sense and sanity; and that I have picked everybody's brains unashamedly and made my own use of the information gained thereby. I hope, though, that my basic intentions will to some extent vindicate me in the eyes of those who have put themselves out to help me. I suppose I ought really to have given them, one and all, the cautionary warning—"Anything you say will be taken down and may be used in evidence."

My thanks are due in particular to the following:

Mr. H. J. Leak and Mr. Hawkins of H. J. Leak & Co. Ltd. for help and information about their products and intentions.

Mr. P. J. Walker of the Acoustical Manufacturing Co. Ltd. of Huntingdon for the same reason.

Also for the same reason, Mr. H. B. Davey of E.M.G. Handmade Gramophones, Ltd.

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I owe a special debt of gratitude to Collaro Ltd. and the Rogers Developments Co. Ltd. for kindly agreeing to my requests for the loan of products made by them for

detailed test and examination in my own home and under my own listening conditions.

I am also deeply indebted to Mr. N. C. Mordaunt of Tannoy Ltd. for bringing to my home a whole car-load of Tannoy equipment and for free and uninhibited information and advice on all subjects relating to "hi-fi" reproduction.

To Mr. G. H. Russell and the staff of the Gramophone Exchange Ltd., of Shaftesbury Avenue, I am indebted for their kindness in allowing me to use their premises for the purposes of hearing a wide range of equipment and for giving me freely of their great experience in meeting public demand for the best equipment over many years.

My thanks to the British Standards Institution for their great kindness and courtesy in allowing me to see a preliminary draft of the document B.S. 1928 as it refers to gramophone records in its revised and extended form, and especially the information it gives on the new proposed international agreed standard for recording characteristics.

I am grateful, too, to those recording companies who gave lucid and helpful answers to my request for information about their records and their recording characteristics. Also to those who did not reply: their silence has often been eloquent!

Preface

MY PUBLISHER and I have designed this short book as an introduction—no more—to the nowadays universally popular hobby or pastime of “high-fidelity” reproduction. We are both “hi-fi” enthusiasts, but not, I hope, fanatics—he, with undue modesty, I think, says he likes playing the gramophone but knows nothing about it: I am supposed both to like it and to know how it works. The following pages are intended, therefore, as a guide to the business of modern record reproduction which will neither scare the technically uninitiated away from the whole business nor send the engineer into paroxysms of ribald laughter. I have tried to avoid technicalities as far as possible in the discussion of what is, after all, a highly technical process. For the technician there are many profound and erudite publications to help him on his way to happiness and prosperity: for the non-technical music-lover there are, so far as I know, a good deal fewer that try to give plain answers to plain questions. I hope the present volume may do something to meet this need.

The world of making and reproducing gramophone records is an exceptionally busy one at the present time. Never before has the consumption of gramophone records reached such exalted proportions; and never has the search for high-class reproduction occupied so many minds or threatened to bankrupt so many households. The miracle of modern applied science has woken us all up to the pleasant but undisputed fact that we can, day by day and in our own homes, enjoy reproduced music of an astonishing variety and quality. We have but to know how to set about it in order to make the best of our good fortune.

We have, of course, to put our ears to school occasionally, as well as our minds. I doubt if the general public yet appreciates to the full the tremendous advances made in the science of sound reproduction since the war. And the illusion persists that anything very advanced must be also very expensive and very complicated. Of course no scientific

instrument—and after all the modern gramophone is that—is either a plaything for half-wits or very cheap. But I do assure everyone who cares to know about it that a “high-fidelity” gramophone is neither beyond the skill of any reasonable person to operate nor so expensive as to be only within the reach of that now almost extinct species the bloated and indolent rich. I have tried to make that point at various stages of my text: if I have succeeded in doing so then I shall have fulfilled at least part of my purpose.

We want ever improving standards of reproduction: we are getting it to a quite remarkable extent. But we are nowhere near the ultimate yet—I doubt if we ever shall be. Certainly the experts don’t agree. One likes one thing, one likes another; and it’s all very reasonable. All the same, there are a few basic facts that ought to be known if we are going to be able to form any sort of logical judgment at all. After that there is only about one other thing I need say in this my advertisement or argument. Having once got the first principles straight and intelligible, go out and hear for yourself. Don’t take anything on trust. The choice of a gramophone to live and be happy with is as personal and subjective a matter as buying one’s ties or books. One man’s joy is the next man’s headache. I hereby give due and fair warning that I accept no responsibility whatever for anyone’s disappointment if they buy first and listen second in respect of any piece of apparatus discussed or praised by me. I am concerned only to signpost the road: everyone must select his inn for himself.

I should explain, before irate companies start throwing things at me, that the various individual components discussed in Chapter II and elsewhere are merely taken as standards and *representative* of the best of their kind. There is no suggestion that they are the only good pieces of equipment available. Therefore, no manufacturer whose products are not mentioned or discussed in detail need feel himself slighted. I am, as I have sought to make clear in the text, not concerned to compile a catalogue. If an unmentioned product lives up to the standard set by the best in its class and price group, it deserves the same praise and patronage as any other—and I hope it will get it.

I am afraid that in spite of my best intentions to the contrary one or two pages in this book may still perplex the uninstructed reader. If so, I am sorry about it; I have done what I can, but my subject makes certain basic demands and at times requires exposition or development in terms not at once comprehensible to the lay mind. But I don't think the difficulty will persist beyond a page or two. Perhaps I can best conclude this brief Preface with the sentence with which Neville Cardus once ended the Introduction to one of his incomparable cricket books: "And if my schoolboy sometimes thinks that I use some rather long words I hope he'll be patient, because I think he will know the meaning of them all when he is as old as the parson."

I

First Principles

A FEW YEARS AGO I came into possession, by routes roundabout and expensive, of a large, sleek and beautiful motor-car of astonishing potentiality. After some preliminary burrowing in pockets and holes where various bits and pieces may usually be located, I discovered a handsomely bound and produced "Instruction Manual". Being one of those curious people who habitually do unpredictable things like reading Introductions to books, and taking at least a token notice of educational literature relating to the assorted pieces of machinery that, from time to time, come my way, I proceeded to peruse the handbook with some thoroughness; and there, on page one—or as near page one as made no matter—occurred the sentence, "Before attempting to start the engine ensure that there is a supply of petrol in the tank". Just that, plain and, I suspect, admonitory. Evidently in the matter of mechanical knowledge and the like the manufacturers were intent on leaving nothing to chance where their customers were concerned. No doubt the instruction was in many cases superfluous; no doubt the habit of trying to run internal combustion engines on hot air and hopefulness is not universal. None the less, to this day I am not quite convinced that the error, if error there was, lay entirely on the side of unjustified pessimism.

I am moved to begin a book not at all concerned with motoring with this little anecdote because I suspect that it carries some sort of moral for the operation and daily use of all manner of modern mechanical appliances. The moral appears to be—begin at the beginning and work upwards; or, in other words, take a firm grasp of first principles. And that is what, in as few words as I can manage, I propose to do in a book confidently advertised as a "guide" to "high-fidelity" gramophone reproduction.

I do not imagine that the average discophile—or whatever

today he chooses to call himself—stands in great need of the warning, “Before attempting to use the gramophone first see that the current is switched on”. But I do think that some initial guidance on the basic principles of record reproduction will not be altogether out of place as a preliminary clearing of the ground, or preparation for more detailed and exhaustive enquiry. I suspect that a certain confusion of mind and discomfort of body—and therefore a certain decrease in the enjoyment of music—is currently caused by the complexity of language and the general air of esoteric mystery which too frequently surrounds the business of playing the gramophone—a complexity and mystery that is generated largely in the minds of fanatics who can’t or won’t admit that their pet occupation is easily within the acquired ingenuity of almost anyone not hopelessly mutton-headed from birth. High-fidelity reproduction is rapidly acquiring a jargon and a hocus-pocus of its own that can readily frighten away the honest mortal in search of uninhibited musical enjoyment. I want, therefore, to lay the twin bogeys of impenetrable complexity and exorbitant expense at the outset.

If we agree to regard the gramophone, whatever its outer form or ultimate performance, as a machine for providing music in one’s home, we shall at least be starting on the right track. How it achieves that desirable result will, I hope, become clear as this book progresses. What for the moment matters is that the end in view is and always must be the music and not the technicalities. A good gramophone ought to be self-effacing; it shouldn’t call attention to itself, manufacture noises of its own, or be allowed to become a public or private nuisance by standing between the listener and his unfettered pleasure in music. However deep and absorbed one’s interest in electronics may be the only justification for the existence of the gramophone at all is the degree of faithfulness with which it can reproduce musical sound. The gramophone is the servant of the musical imagination, and nothing is more of an obstacle to free working of that imagination than an obsession with technics. For those whose sole pleasure lies in chasing the ultimate in high frequencies and the possession of the latest

ingenious gadget there is always the pure tone frequency test record and the oscillograph. These, and not musical recordings and scores, will no doubt suffice for the day's regular aural and visual repast.

I am reminded of the parallel case of photography. When in 1925 Oscar Barnack invented the small precision camera (the Leica) using 35-millimetre ciné-film, a fresh era of photography opened. The introduction of a new instrument enabled the camera, more or less for the first time, in the words of Helmut Gernsheim, "to record the new, the immediate, the varied life of our time". But Gernsheim significantly goes on to say, "To many the miniature camera became a new means of expression, to countless others it tended to become a temptation and danger". Indeed, many photographers became, and have remained, so entirely taken up with technique—with filters, and lens-hoods and view-finders and varying emulsions—that it remained a perpetual wonder how they ever got round to making a picture at all. The photographic world knows this addiction or obsession as the disease of "gadgetitis" and rightly recognizes it as substantially lethal to the artistic potentialities of the photographic medium. It is fundamentally the danger of regarding the machine as more important than the men behind the machine.

Much the same thing happened in the early days of radio, when the fanatics became so intent on locating some remote, and usually quite uninteresting, station, that it was next to impossible to sit down and enjoy any broadcast programme at all. Nowadays the radio maniac has largely disappeared—at least from the normally sane household—but his place is to some extent being taken by the "hi-fi" fiend who is so mesmerized by knobs and appendages, by graphs and response curves, that he prefers any day a magnificent recording of totally unmagnificent music to a fine performance of great music in which a few slight technical deficiencies can, on minute scrutiny, be discovered. No one denies that the ideal is the great performance of great music resplendently recorded; but so long as technical perfection is not our daily portion we have to put first things first and choose musical splendour above

all else. Which is, of course, only to say again that the gramophone must be the honest but self-effacing servant of musical inspiration.

The parallel with photography is not strictly accurate, largely because it is not entirely necessary to be equipped with the latest camera in order to take good pictures, whereas it is, broadly speaking, essential to make use of a recent, but not necessarily the most expensive, gramophone in order to reproduce recorded music with true or high fidelity. Nevertheless, a fundamental and basically similar principle is involved—the principle of ends and means. They should never be confused, whether we are musicians or photographers.

What, then, is “high-fidelity”, and is it musically-speaking absolutely necessary? I am aware that of the two questions the first cannot be answered confidently by one man for every other; and that the second is not so much a legitimate question as question-begging. All the same, they have to be put down, simply and plainly for all to see and cogitate upon, if any sort of reasonable coherence is to be brought into the argument at all.

Perhaps the most vital necessity at the present time is that of making some satisfactory definition of the term “high-fidelity” itself. Nowadays every manufacturer who produces an electric gramophone is moved, either from choice or necessity, to advertise it blatantly as “high-fidelity”, however modest its specification. In fact, so wild and exorbitant are the techniques of modern advertising that the term “high-fidelity” is in imminent danger of losing all sense and meaning. Unless steps are taken to curb the exuberance of publicity agents the whole business of “high-fidelity” will be reduced to absurdity. If the term “high-fidelity” is to remain in current circulation at all, it had better mean something and that something ought to be, if not scientifically precise, then at least capable of a broad preliminary definition. There are countless little boxes and inexpensive components on the market today, many of them admirable in their way and often excellent value for money, but they are not “high-fidelity”, and if their sponsors will persist in misusing that term, they

will get no honourable mention from me. Nor will those who talk blandly about "absolute fidelity". However the sales talk may run, there is no such thing as "absolute fidelity" and the fact had better be realized now. Those who cannot be dissuaded from chattering about the "absolute" in gramophone reproduction are guilty of deliberate duplicity and are the living enemies of true technical advancement. Not one of the honest and illustrious designers and makers of reproducing equipment or gramophone records who have so willingly helped and advised me with the preparation of this book has a good word to say for idle gossip—for it is no more than that—about "absolute fidelity". They are perfectly aware of existing limitations—their own no less than other peoples. I make this point with all the conviction at my command because in the course of this book I shall no doubt bestow enthusiastic praise on certain pieces of apparatus that have especially impressed me; but I want to make it clear that the quest is, and must always be, for "higher fidelity". It cannot in the nature of things be for "absolute fidelity".

The main difficulty about trying to define what precisely is "high-fidelity" is that it depends even more on how something is done than on what is done. I am convinced that what is true in theory is also true in practice, whether in electronics, or anything else. It is the problem of translating theory into practice that appears in the last analysis to invalidate the former. The principles may be as sound as a bell; but the application of those principles is another thing altogether. That is why a specification on paper and the final product do not always see eye to eye. It is probably the basic problem of all scientific processes.

If, therefore, we say that a gramophone truly and indisputably "hi-fi" should have a frequency response substantially linear from 30–16,000 cps., we cannot necessarily assume that every instrument with such a specification will automatically sound the same, or even that each will make a pleasant sound to our own ears. This is particularly true of the loudspeaker end of the chain. I shall describe in the following chapter several different

types of loudspeaker which, although all deserve to be called “high-fidelity”, do not sound in the least alike in one’s living-room. Personal choice plays an immense part in the selection of a reproducer, and anything I may say both here and hereafter must of necessity be coloured by my own taste and preference.

As far as the main amplifier is concerned the differences are far less audible; but here again the systems of tone control employed by the various manufacturers are by no means the same, nor can one necessarily be described as absolutely superior to another. It is simply a question of different ways of coping with the same basic problems—each listener must decide for himself who best deserves the favour of his hard-earned money. About all that can be said without fear of dispute is that, as far as amplifiers are concerned, any product of a manufacturer of repute can be relied on to do its job properly and to live up to the claims made for it. There is so much good equipment about today that anyone who attempted to foist off something primitively designed and wired on the chewed string and sealing-wax principle would only be assuring his own progress to the bankruptcy court by the shortest distance between two points. From this aspect at any rate the ordinary, non-technically minded music lover need not fear that he will be taken in by any manufacturer with a reputation to hold.

In view of all this, then, no one but a pedant or a bigot is likely to start laying down the law in all directions. The type of reader who wants the “Buy this; do not buy that” sort of guidance will have to seek elsewhere for illumination. For my part I am, as I say, concerned to elucidate principles and to sift the vast amount of reproducing equipment now offered to a bewildered public by a form of grouping under more or less comprehensible categories. For this reason I have no wish to compile a catalogue or award marks like a pontifical examiner. I am acting on the assumption that the record lover knows that he wants the best reproducer he can afford, but isn’t too sure how to get the best of the limited funds at his disposal.

The modern gramophone can most easily be understood

if it is first broken down to its elements. Let us summarize the process of record-making and reproduction from beginning to end. An original "live" performance takes place—in a studio, concert hall, or theatre—in the presence of recording engineers who have previously, and with some forethought, placed their microphones in what may be called strategic positions, and then "take down", as it were, all subsequent musical sounds, nowadays on magnetic tape. The tape is then processed at the factory and disc matrices prepared from it by a complicated process which needn't be gone into here. From these matrices, also by a process of some complexity, discs are then pressed and offered for public sale. This is an outrageous piece of simplification, but I am here concerned with, primarily, reproduction, so I must dwell lightly on the other end of the business*.

Having got our disc it now remains to play it in such a way that everything the recordist, with much patience and persistence, has captured in the grooves will emerge undistorted from the loudspeaker. That is our aim.

The record is placed on a turntable which will revolve steadily at the right speed, and the pick-up point is lowered onto the first groove. The passage of the point over the groove will cause it to vibrate and so generate an electronic signal in the pick-up movement. This signal is then passed to the amplifier, via the tone control unit or pre-amplifier, and the amplifier will, having amplified it to the required extent, transmit it to the loudspeaker which in its turn will transform an electronic signal into audible sound waves. If we are lucky—and, sometimes, clever—the sound that comes out of the loudspeaker will be exactly what was captured in the record grooves. And furthermore, if the recording engineer was also lucky and exceptionally skilful, the sound delivered by the loudspeaker will be a faithful transcript of what was heard in the studio, concert hall, or theatre. It is what happens to the sound between the original performance and the final result that comes out

* No; a sense of shame and the demands of justice make even me blush here. I give, therefore, in Appendix A the E.M.I. analysis of the complete recording process.

of our own loudspeaker which constitutes the whole problem of “high-fidelity” reproduction.

Of course, the record buyer has no control over the recording engineer’s part of the process: he has to take the record as he finds it. His own part of the operation begins when he puts his record on the turntable. Before we go more thoroughly into that, we may pause for a moment to consider the implications of the foregoing paragraph.

Firstly, all that is required for high-class record reproduction is a pick-up and motor unit, an amplifier with a pre-amplifier or tone-control unit, and a loudspeaker. Simply that and nothing more. There is an idea abroad that in order to enter what is loosely called the “hi-fi” field a gramophone must be immensely complicated, terrifyingly expensive, and made up of so many gadgets and appendages that the ordinary mortal can’t hope to operate it properly at all. But in fact, the only difference between an ordinary standard gramophone and a “hi-fi” gramophone lies in the capability of the three main sections of the chain. There is no earthly need for a horrid complexity of bits and pieces—three units alone are all that will be needed to send oneself and one’s friends into wild eruptions of delight. No doubt the more advanced gramophone will have a more flexible and comprehensive system of tone control and equalization; but even here it all works according to well-known and strictly logical laws. One has but to read and to act on the perfectly clear and simple information gained thereby. In the next chapter I shall attempt to define and describe in some detail the proper function of the various components: for the moment I am anxious only to reduce them quantitatively to manageable proportions, and to insist that *any* gramophone, however humble or illustrious, works upon the same fundamental principles. Indeed, ever since the day when Edison astonishingly obtained a recognizable sound from a point passing over a modulated groove the basic principles have hardly altered at all—it is only the application of those principles and the constant refinement of detail that has advanced, almost miraculously. Even the invention of electrical recording and reproduction only meant that a mechanical

process had been superseded by an electronic process. The principle of impressing sound waves on a solid substance and turning them back to their original form by means of setting up complementary vibrations in a piece of reproducing apparatus remained. All our gains are simply in the nature of refinements of technique and an ever-increasing knowledge of the exact problems involved. The LP record itself is far more evolution than revolution—it is in reality little more than a “78” smoothed out and extended in scope and efficiency.

The search for true “high-fidelity” depends on the close co-operation of musician, recording engineer, and the designer and manufacturer of the reproducer. In a world generally thought to be bristling with competition it is often surprising—as well as salutary—to remember that we have arrived at the present state not through continual bitter warfare but from co-operation of quite remarkable order. We are still far from complete standardization; but without such agreement and consultation as does exist—and has always existed in the record industry—it would be quite impossible to play, broadly speaking, all sorts and makes of records on all sorts and makes of gramophones. In the present period of busy research and production there are persistent efforts going on all the time to achieve agreement on standards and definition in all departments. The future prosperity of the whole industry depends on it.

We may perhaps arrive nearest to a satisfactory definition of “high-fidelity” in a gramophone by stating that the degree of fidelity in reproduction depends on the extent to which it is possible to reproduce from the loudspeaker everything that the engineers have caught in the original recording. Only on a very limited scale can any gramophone compensate for errors in recording—it can lessen faults, but it cannot reasonably be expected to add virtues. Thus the gramophone is dependent for its final performance on the records that are “fed” into it. I make this elementary observation because it is still too common to find people vicariously criticizing the performance of a reproducer without giving sufficient thought to the character, quality,

and general condition of the record which happens to be on the turntable. No gramophone is a miracle-worker; no recording company is infallible. The two have to work always in conjunction. No doubt a really good and flexible gramophone should be able to cope with bad or old-fashioned recording; nevertheless, the best results are only to be expected from a combination of the best records and the best reproducer.

It was Friedrich von Schelling who called architecture "frozen music"; and in much the same way the grooves on a record might be called "frozen" or crystallized sound waves.* Ideally these waves imprinted on the record ought to be the exact counterpart of the original sound-source. In practice, however, the problem is a good deal more complex. In spite of the tremendous advances of recent years we have still reluctantly to admit that the recording of all the frequencies is not necessarily synonymous with the faithful recording of all the music. This is probably because into the sound of a musical performance as it reaches the listener's ears there enter such indefinable things as "atmosphere", the acoustic warmth and the colour of the hall or studio, and the sense, in one's own room, of the living presence of music as a vital activity of the human mind and spirit. A theoretically perfect recording may well emerge from the loudspeaker as little more than a clever analytical graph of sound wave formations rather than as a direct manifestation of genius and imagination. It is all very depressing, no doubt, but it happens to be true and an essential part of the compromise that must lie behind all processes of musical reproduction.

As I have already said, "absolute fidelity" is not ours to find—all we can really hope for, viewing the complete process from beginning to end, is the creation of a convincing illusion of reality. Or, in the words of two leading companies concerned with the production of records and equipment: "The creation, in the listener's normal surroundings, of the ILLUSION of the actual performance as it would have been heard under the most favourable conditions" (E.M.I.); and: "The criterion, as always, is

* In form, of course, not in actual dimensions.

that the reproduced sound shall be the closest approach to the original" (Acoustical Manufacturing Company). Those two sentences, though not identically phrased, mean very much the same thing. They can be allowed to stand as complementary definitions of the aims and ideals of those concerned to give us true "high-fidelity".

I think that at this point a little clarification of the various types of sound sources and their potentialities in respect of "hi-fi" reproduction may not be out of place. For music, of course, is not just one thing, the same in scope and physical dimensions under all conditions and circumstances; and the degree of fidelity obtainable on record depends much on the nature of the original. Chamber music, for example, being designed in the first place as a natural inhabitant of private rooms, can generally be relied on to sound more natural, more at ease, and more in proportion under average conditions of domestic reproduction, than vast orchestral eruptions or opera grand and imposing, which normally require conditions of some spaciousness and splendour to make their full effect. It is, of course, true that by cunning manipulation of microphones and deliberate recession on the part of the recording engineers, an *illusion* of grandeur and spaciousness can be created on the record, as many a fine operatic, choral, or orchestral recording bears eloquent witness. But it is always very much of an illusion, almost a form of sleight-of-hand, for the prospect of having to endure a symphony orchestra or a Wagnerian music-drama cast in one's own home is not one to be endured for long. A string quartet, on the other hand, might easily find a welcome "in the flesh" in our homes, and therefore on records it does not, or should not, make such severe demands on our powers of imaginative identification.

Broadly speaking, it may be assumed as axiomatic that the more readily a musical form or combination will fit "live" into conditions of domestic listening, the more easily will it be accommodated with true "high-fidelity" on records; and the farther away from domestic habitation is the original the more comprehensive will the illusion and the imaginative effort needed to create it have to be. With

the best modern recording techniques and reproducers it is now very nearly possible to approach "absolute" fidelity with perhaps one or two musical sources. The solo human voice, solo woodwind, and, to a lesser extent, solo strings, can occasionally be made to sound as though they really are in our own rooms. But since the loudspeaker represents a single point source, and since any combination of musical instruments or voices, however small, is multi-sourced, the problem of perfect diffusion and absolutely realistic balance is almost beyond the scope of engineering to conquer. I will go as far as to concede that a solo voice or solo instrument, unaccompanied, does come just within the potential bounds of "absolute" fidelity. But beyond this neither I nor anyone else who knows his business will go. In every other case a convincing illusion is all that we can logically hope for, and every effort to improve the general height of fidelity must be directed towards making the illusion more convincing. One cannot, after all, hope to reduce the *Annunciation* of Titian to the size of a postage stamp without expecting to lose something of detail and broad effect in the process, however penetrating one's lens and however exemplary one's technique.

It may well be asked, then, if an illusion is all we can reasonably hope for, why should we go on chasing, at a heavy cost in time, brain-work, and hard cash, ever higher flights of fidelity? Why, in fact, should we not be content with our standard radiograms which make a generally pleasing noise without trying to catch every detail and the whole gamut of frequencies, when in any case we have to ask our imaginations to supply the ultimate reality? The question is, even to-day, asked often enough to make the answering of it worthwhile. Or, to put it another way, isn't a humble gramophone, well-designed within its inevitable limitations, and modest in price, sufficient to let us enjoy recorded music without bothering too much about the higher complexities?

In plain non-technical language, such a question may be answered quite simply and adequately. We need as high a fidelity as we can get for the ample reason that the closer we can approach to the original sound the more

convincing will the illusion of reality be. Much goes on in a complex musical score, and the more we hear of it the more readily shall we be able to convince ourselves of the living presence of music and its illustrious performers in our own rooms. It is sometimes remarked, without due consideration for the weight of words, that "high-fidelity" reproduction is an acquired taste: often enough people hearing "hi-fi" for the first time shy like a colt at an exploding steam-roller. It is, of course, the presence of fully recorded frequencies at both ends of the scale, but especially at the top, coupled with the quite unfamiliar clarity and separation in the individual instruments, that causes most of the trouble. I have actually heard it said that one doesn't want to "hear all the instruments" normally, as though composers habitually wrote inner parts for their own private amusement or to use up surplus music paper, and coloured their scores magically just to give employment to out-of-work triangle players. But I do solemnly assure these curious folk that if a composer wrote a part for a certain instrument he intended it to be heard. It may have been thoughtless of him, but there is nothing we can do about it now.

Unfortunately, it is not the taste for good reproduction that has to be acquired, but the taste for bad reproduction that has to be erased, obliterated, or otherwise removed. Conditioned by years of inevitably poor reproduction the ears of many, and especially of those who seldom visit the concert hall, have come, perhaps unawares, to regard the old woolly radiogram "tone" as normal and virtuous. When they come up against "high fidelity" they are rather like the man who has feasted all his life on tinned salmon and so come to regard it as natural that when he is confronted with fresh salmon he begins to suspect the drains and starts complaining darkly that it smells of fish. "High-fidelity" reproduction is not the first subject in which many of us have to unlearn the lessons of our youth before we can come to wisdom and understanding; but it is, in the present context, one of the most important.

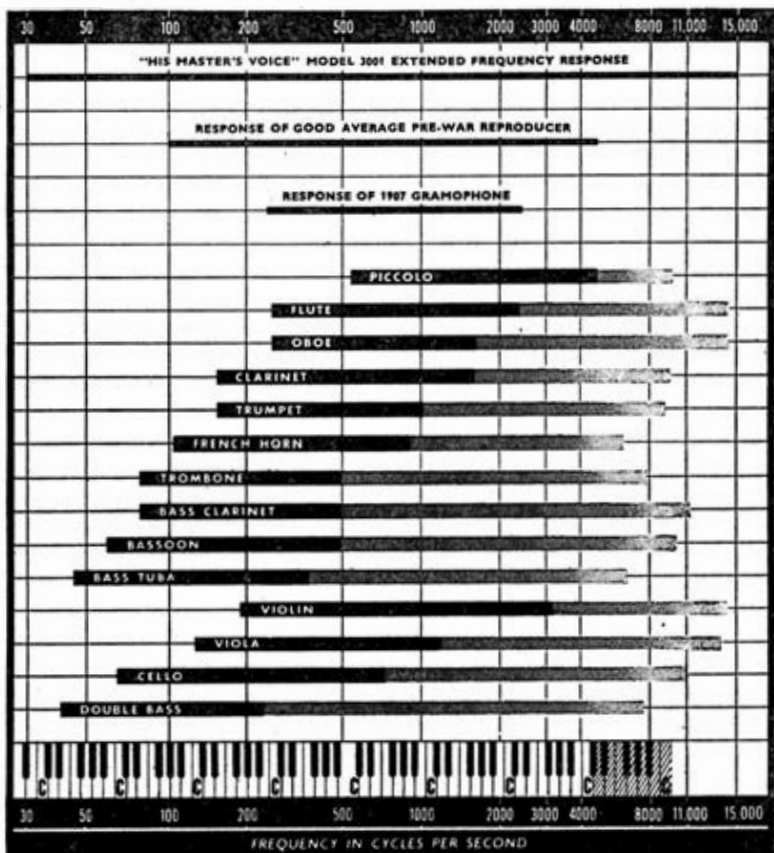
Having given, I hope, a reasonably clear and comprehensible answer to the question "What is the use of 'hi-

fi'?", I propose now to examine the problem in more technical detail, and to make some brief attempt to show what it is in the phenomenon we know as musical sounds that makes the pursuit of "high-fidelity" worth all the fuss and bother.

A great many words might be written about the constitution of musical sound waves—fundamentals, harmonics, transients, and all the rest of it—and a decently lucid exposition achieved. But a far shorter and clearer way to the same end is the use of a chart showing the range of the fundamentals, and the associated harmonics or overtones, of all the principal orchestral instruments. There are many such charts about, but the one which follows is the most comprehensive I have yet come across, especially since it also shows the response of three different types of gramophone—early, middle and "hi-fi". I am indebted to the Record Division of E.M.I. for permission to include it.

It will be seen that the fundamental tones of the instruments of the orchestra, taken collectively, cover a range from something below 50 cps. to something over 4,000 cps. Obviously then, a gramophone that does not extend efficiently to around 40 cps. at the bottom end, and above 4,000 cps. at the top will not even reproduce the fundamentals of the extreme tones. In other words, one loses some of the actual notes. A good many modern composers make copious use of the extremes of the instrumental ranges, particularly in the bass. Sibelius, for example, shows a persistent affection for deep sounds of strings and woodwind (actually the lowest fundamental of all is that of the double-bassoon, at approximately 33 cps., not included in the chart); and neither Wagner, Tchaikowsky, nor Richard Strauss, to mention only three obvious examples, can be trusted not to explore the farthest depths of the orchestra. I am deliberately limiting the discussion to the orchestra—what happens with the pedals of the organ must be clear enough to anyone with ears to hear.

Now let us look at the middle of the three lines devoted to reproducer response—the one marked "Frequency response of good average pre-war reproducer". At the top end all the fundamentals are just about squeezed in; but in the bass, so



This chart shows the frequency compass of the chief instruments of the orchestra. The grey portions indicate the harmonic, or overtone ranges.

often and so wrongly thought to be the strong point in the old radiograms, a dreadful state of affairs is revealed. Remember that the chart was prepared by E.M.I. who, as one of the largest makers of commercial reproducers since the invention of the gramophone, ought to know what they are talking about. What do we find at the bottom end of the pre-war gramophone? A lower limit around 100 cps. and in consequence the loss of half the double-bass, almost as much of the bass tuba, a nasty lump of the cello and bassoon, and the lowest notes of the trombone and bass clarinet. All this is gone, cut off, lost without trace. How is it then that the old machines achieved a reputation for good bass reproduction?

The answer to that question lies in the generation of harmonic resonance, usually in the cabinet, at around 100 cps. The old "carpet-bag" bass so beloved of radiogram addicts is no real bass at all, as can be easily proved by listening not for a tuneless thump, the sort of thing that hits you violently in the stomach, but for pitch and separation in the extreme bass. The simplest test is with a good record of dance music. A plucked double-bass ought to have noticeable delicacy and precision of pitch: it shouldn't bang aimlessly and tunelessly, swamping every other sound in the surrounding countryside. If there is no clearly defined musical pitch in the extreme bass, then it may be safely assumed that the reproduction in that region is spurious. It is not the note you hear at all, but the deliberately pre-emphasized second or third harmonics. In other words it is distortion of the worst sort. It is not even pleasant to the musical ear, although public demand for ugly, resonant bass caused manufacturers to design cabinets, not as to-day, so that they damp out noisy resonances, but actually to emphasize them. So much for "carpet-bag" bass: it still exists, but it should be ruthlessly sought out and demolished wherever it rears its nasty head.

It is the absence of banging, over-resonant bass that leads many people to assert with some forcibility that the best "hi-fi" reproducers are deficient at the bottom end. But just listen in the concert hall and see what happens when the lower reaches of the double-basses are called into service.

I am convinced that good bass response is the foundation of first-class reproduction: it is extremely hard to achieve—all the way down, that is—but without it the whole sound of reproduced music is coloured, distorted, and made thoroughly indigestible.

At the top end of the scale the position is slightly different. As we can see, the fundamentals are more or less adequately accommodated. It is in the realm of harmonic and transient response that the upper weakness principally lies. A musical note is not a "pure" tone, in the sense that it is one sound and one sound only. Its pitch is determined by the fundamental—the actual note sounded; but the quality or timbre is determined by the nature of the harmonics, overtones, or partials. The reason why the note C, for example, when played by a violin, a flute, and an oboe, although identical in pitch, is not the same in tone quality is because the overtones or harmonics of the three instruments are totally different. The violin has strong over-tones, the flute comparatively weak overtones, so that it approaches nearer to "pure" tone; and the oboe, being a reed instrument, has probably the strongest overtones of all. On the relative strength and proportion of the overtones depends entirely the characteristic "tone quality" of any musical instrument.

It follows, therefore, that unless the harmonic structure of the various instrumental tones remains unimpaired in reproduction the resulting sound will be drab, colourless, and altogether uninteresting. The life, vitality, and chromatic luminosity of instrumental music lies in the harmonics, and they, every bit as much as the fundamentals, must be accurately reproduced if the sound that comes off the record through the loudspeaker is to approach tonal realism. The musical ear is, or should be, no less sensitive to texture than to pitch and tonality, although one might not always think so to judge from the sort of gramophonic noises many folk who fancy themselves musically gifted not only tolerate, but actually prefer, from their pet reproducer. Tinned fish again!

Frequency response pure and simple is not, however, the whole answer to tonal faithfulness in reproduction. There

is another phenomenon about harmonics and overtones that vitally affects the fidelity of reproduced sound, and that, put plainly, is the fact that harmonic structure varies with volume. If the same note is played twice on, say, a violin, first softly and then loudly, the relation of the harmonics or overtones, and therefore the quality of tone, changes. The increase in volume strengthens the overtones in relation to the fundamental; or, to put it another way, the difference between *pianissimo* and *fortissimo* in a musical instrument, especially one strong in overtones, is a qualitative as well as a quantitative difference. If, therefore, a soft note is electronically amplified to sound like a loud note it suffers audible distortion in the process—a phenomenon which leads directly to the conclusion that a proper and imaginative use of the volume control is one of the most important of all factors in the aesthetic problem of playing the gramophone. Most people tend to play chamber music too loudly and orchestral music too softly. Some thoughtful attention ought always to be paid to the setting of the volume control in the search for naturalness and true fidelity of reproduction. In a most valuable little booklet, *The Pursuit of High Fidelity*, issued by E.M.I., there occurs a poignant little phrase to the effect that too high a volume level will “tend to bring the *fortes* into the threshold of pain”. The point is that even if one’s loudspeaker produces an absolutely smooth response from the top to the bottom of the musical range—something that can certainly not be taken for granted—a deafening uproar of the sort caused by excessive amplification in relation to one’s own listening conditions will appreciably accentuate harmonic distortion. The overall volume level and dynamic range accommodated on the record can only be calculated in the abstract, so to speak. That is, it cannot take into account either the characteristics of a particular reproducer or the natural resonances and general dimensions of a particular room. Adjustments to compensate for these two conditions or phenomena have to be made on the spot by the listener himself. In any case it is not yet possible to reproduce on records the full dynamic range of a symphony orchestra as it is heard in the more spacious surroundings

of concert hall or opera house. Although the dynamic range of modern recordings has expanded enormously in recent years, some compression is still necessary in order to reduce the orchestra to manageable proportions in normal domestic conditions. What one has basically to do is so to adjust one's reproducer that the resultant sound will create as nearly as possible the illusion of reality in one's own room.

In order to arrive at the right volume setting for any particular record it is not necessary to make learned and complicated calculations: the experienced and attentive listener will soon learn to "feel" the right compensation of volume and balance required to make reproduced music sound natural and realistic in his own home and with the equipment at his disposal. Recording engineers usually take some pains to ensure that with domestic listening conditions in mind the reproduced sound will have a reasonably accurate perspective. The sense of spaciousness so admirably achieved in modern orchestral recordings is largely the result of clever microphone placing by the engineers. One's living-room is not the concert hall, and never will or can be, so that a certain "recession" is required in orchestral, operatic, and choral recordings, if one is not to suffer the uncomfortable sensation of somebody blasting a trombone venomously down the back of one's neck.

Spaciousness and perspective are in the first place illusions that have to be created by the recording engineer; but the listener or manipulator of the gramophone has to play his own part too: he has to ensure by intelligent adjustment of the controls that the second half of the process—that of actually playing the record under individual and unique listening conditions—complements the first part, that of making a realistic recording. There is sometimes a tendency among recording engineers to push the high frequencies too far forward—to go for artificial brilliance rather than homogeneity of sound. But a really faithful recording achieves balance and perspective in all its parts, top, middle, and bottom. On the other hand, high frequencies make a more violent impact on the human

ear, especially at close quarters, than low frequencies; also they are more spectacular, and the temptation to regard them as the be-all and end-all of “hi-fi” is a persistent menace that has to be guarded against. As I say, “high-fidelity” recording and reproduction implies the realistic balance of all sounds in the complete musical range, both harmonics and fundamentals. But the natural desire to show off at either end of the chain ought to be severely resisted.

So far I have said nothing about transients. Put in its simplest terms, transients are a form of “shock waves”—they are usually produced by hitting something hard, and unlike harmonics they are not dependent on pitch. The violent “attacking” of a note or chord by any instrument or combination of instruments sets up initial transients; but perhaps the best and most familiar examples of transients occur in the percussion or “kitchen department” of the orchestra. Take cymbal crashes for example. Cymbals are not tuned—that is, they have no pitch, they go their own way regardless of key or harmony. When two cymbals are clashed together they produce violent transients and set up overtones that go high up into the supersonic range. Because they are not tuned these sounds do not affect the tonal or harmonic logic of the music; but they do affect the colour and vitality—otherwise they wouldn’t be put there at all—and the ability of a reproducer to catch these random sounds is one of the qualities that give life and colour to the reproduced sound. After all, a cymbal crash ought not to sound like somebody kicking over a tin object in the night—it ought always to sound like two bits of brass struck together to set up extensive and exciting vibrations. The realistic reproduction of these sounds, essential to the lively and vital sound of orchestral music, depends on the ability of the reproducer to catch the highest and most elusive frequencies. The piano, too, because it depends on the percussive effect of a hammer hitting a tensed wire, produces strong transients. An analysis of the sound produced by a note struck forcibly on a piano reveals strong initial transient formation gradually fading—that is why the piano, unlike string or wind instruments,

cannot sustain its tone at the same intensity over any prolonged period. Again, therefore, realistic reproduction of the piano depends on the efficient transient response of the reproducer.

To return for a moment to the phenomenon of harmonics, it is often forgotten that a great deal of music, particularly of modern music, depends on the deliberate use of natural resonance and natural harmonics. Manuel de Falla, for example, based his highly personal and individual system of harmony and tonality on the use of natural harmonics as the "real" notes of harmony; of using the harmonic of a fundamental as in its turn the fundamental, and of changing the harmonic function of a note in the chord to produce a new harmonic structure. This is not a book on music theory, so I am content to state this merely as fact and not to delve more deeply into it. But the point I wish to make is simply this: if a reproducer cannot accurately give us the full range of harmonics it not only destroys the colour and vitality of instrumental music; it also makes a non-sense of the inner logic of music like Falla's, and a good deal else besides, which depends to a great extent on natural harmonics. The pursuit of "high-fidelity" is, therefore, not merely the technician's fad, but something of very real *musical* importance. I underline the word "musical" because there still circulates an idea that music and "hi-fi" do not add up to the same thing. I admit that there are times when they don't; but that is largely either because "hi-fi" is abused for the purpose of showing off, or because technique is not infallible and our best-laid schemes and stratagems sometimes go awry.

I think I have now said enough to make it clear why we ought to seek "high-fidelity" reproduction—and, of course, "high-fidelity" recording—with some determination; but not, I beg you, with long-faced solemnity or ungenial fanaticism. It is, and always must be, the music which counts first and last. But by a process of simple deduction, music, being the art of sound combination, must inevitably be most enjoyable when it sounds most natural and most faithful to the original. Facts and figures, though, don't tell us the whole story or give us the key to great musical

enjoyment. A Kreisler, primitively recorded, can still give us more pleasure and a deeper imaginative experience than a lesser player resplendently recorded but short in imaginative wind. The only thing we can really do to make our life richer and more splendid is to do our best to see that however marvellous or however poor a recording of great music, wonderfully played, may be, we can at least reproduce it as well as it humanly can be reproduced. That, and that only, is the one justification known to me for the constant pursuit of "high-fidelity". It is a pretty good justification.

Of course the modern gramophone is a scientific instrument of some complexity, and a little skill is required to operate it properly. But we needn't make a bogey out of it. Like the miniature camera which, when it first appeared, was thought to be horribly obstinate and complicated, but soon became easily, almost thoughtlessly, manipulated by thousands the world over, the modern "hi-fi" gramophone is rapidly taking its place as normal and comprehensible in homes whose occupants are not technically instructed beyond the ordinary. No doubt some application is necessary to operate it so that it will give its best. I venture to err once more on the side of repetition, because the days when one could simply throw a record onto the turntable and let it take its chance are definitely gone, and no doubt the arrival of a "hi-fi" gramophone in the house will cause some lifting of the eyebrows until pride of new possession and the sight of knobs and complicated-looking pieces of wire have been reduced to reasonable proportions. None the less, no one should be dissuaded from taking the plunge of installing the sort of apparatus that will make full sense out of the most modern records, and give a new lease of life to old ones, just because a little basic technique has to be acquired. As I say, it is all simple enough if one starts from the beginning. The modern "high-fidelity" gramophone may pose its own problems of both manipulation and appreciation, accustomed as most of us are to primitive sounds extracted from only too simple machines; all the same, as Hazlitt said of allegory, we needn't be afraid of it—it won't bite us.

II

Components

I HAVE EXPLAINED that the modern electric gramophone can be most easily understood if it is broken down to primary elements—the amplifier, the pick-up and motor unit, and the loudspeaker, in that order. For those, and they will no doubt be the majority, who want also to obtain high-quality reception of broadcast programmes with the same equipment that they habitually use for the playing of records, a fourth unit must be added in the form of a radio tuner or feeder. There is no known reason to seek for additional equipment.

In selecting the components of a “high-fidelity” reproducer, some preliminary thought should be given to the choice of separate items in relation to the whole. It isn’t everyone who can afford the very best that current techniques can devise in all departments, and in order to get the best for one’s money a sensible planning of one’s campaign will pay handsomely. For example, if one has not more than, say £100 available, there’s no point in buying an expensive loudspeaker and being therefore obliged to economize on the pick-up and amplifier. The efficient working of the reproducer depends on the quality of all its parts: no one component can be expected to make up for a deficiency in another. Each has its own vital and essential part to play, and enduring satisfaction will not be the portion of anyone who does not first sit down with paper, pencil (and bank-book) before rushing off enthusiastically to the nearest dealer’s premises.

One has initially to decide how much one can afford to spend at once, either in cash or on the “never-never” if need be, and whether that sum is to be final or only a beginning. The lowest limit for which one can reasonably expect to buy a reproducer properly deserving the name of “hi-fi” is about £70; the upper limit may be taken as being somewhere in

the region of £250. Add another £20–30 for a high-class radio feeder. Within these limits there is an infinite variation of type and method dependent on personal taste and preference.

Perhaps the most difficult decision to make is whether you can envisage the day when your prosperity can reasonably be expected to render some additional expenditure possible in the future. In other words, is the purchase most likely to be outright, once-for-all, or in the nature of a long-term operation? Everyone must make that decision for himself; but, having made it, he should plan accordingly. He will, I think, be best helped by a simple and straightforward explanation of the scope and aptitude of the various individual bits of apparatus now offered in immense profusion by enthusiastic and, for the most part, hard-working designers and producers.

So, let us begin at the beginning and try to build logically and with proper foresight.

Amplifiers and Pre-amplifiers

An amplifier is a device for amplifying (i.e. making larger) electronic signals that are fed into it. It does not amplify “sound” as such. Whether the original signal (voltage variation) is induced by a gramophone pick-up, a radio receiver, a microphone, or by any other means, does not matter: the function of the amplifier remains the same. It is on the performance of the amplifier that the quality and strength of the signal passed to the loudspeaker entirely depends. It will therefore be appreciated that without a high-class amplifier the performance of the best record, the best pick-up, or the best loudspeaker yet devised by human skill and application will be rendered void. The amplifier has truly been called the heart of the reproducer; and if the heart is not sound the rest of the body electronic might as well give up the struggle from the outset. That is why I have deliberately put the amplifier first, and why the first principle in selecting a reproducer ought to be—buy the best amplifier you can afford.

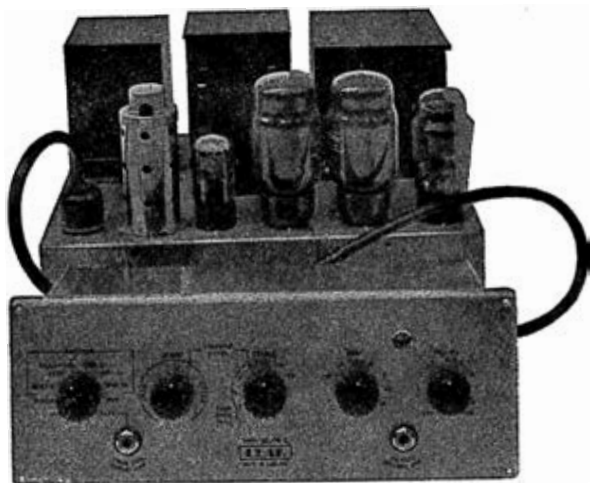
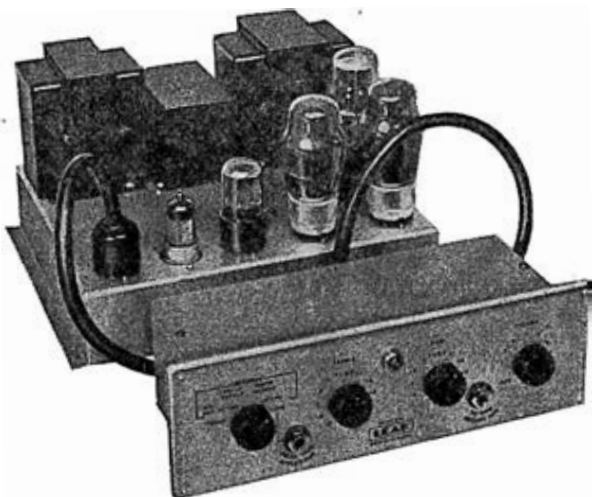
Fortunately, nearly all the problems of amplifier design

are today known and understood. There is no longer much mystery about amplifiers; any competent engineer can produce one if he takes the trouble; every manufacturer known to me admits it freely. There are different ways of producing the desired result, no doubt; but of all the links in the chain the main amplifier is nowadays the most reliable, the most comprehensively understood, and the least in need of further technical development. All amplifiers made and designed by reputable manufacturers can be relied on to give satisfactory results in respect of their specifications.* The pre-amplifier or tone control unit is another matter, and will be dealt with in a moment.

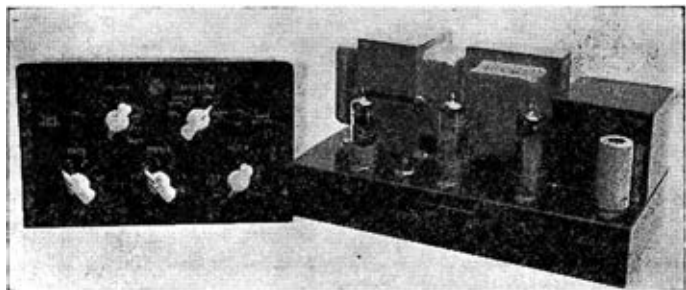
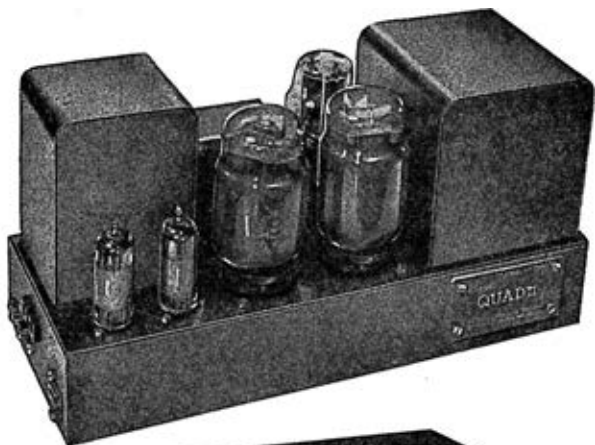
I do not, therefore, propose to give details of amplifier circuits. Such information is obtainable, free of charge, from most manufacturers for those with the technical knowledge to make anything useful of it. And in any case, for the average music-lover intent only on getting the best out of his records it is the end not the means which matter most.

Apart from initial cost, then, the choice of an amplifier will depend on the nature and flexibility of the tone controls, and the power-handling capacity. The three factors are, of course, closely related. By and large, the cheaper the basic cost of the amplifier the less flexible will it be of control and the lower its maximum output, although the actual performance within those limitations may not suffer at all. For example, the Leak TL/10, the Rogers RD Junior and the Armstrong A10, rated at 10 watts output, are almost indistinguishable from the big brothers in basic performance—that is, the reductions are not audible—until one puts them under the most severe strain of, say, having to cope with the pedals of an organ at high volume and on the most advanced type of loudspeaker; and then the difference is only perceptible to the most sensitive ears. Also the tone-control systems on these inexpensive amplifiers are, although not as

* Which does not, of course, mean that between various makes there is no difference in respect of workmanship, attention to detail, exact fitness for the job in hand, etc. The highest reputations have only been made by a combination of basic skill and supplementary refinement.



ABOVE. *Leak TL/10.* BELOW. *Leak TL/12 Varislope II*

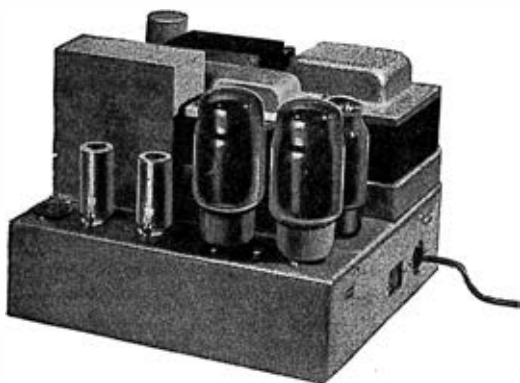


TOP AND CENTRE. *Acoustical Quad II*. BOTTOM. *Rogers RD Junior*.

comprehensive as those on the 12-watt equivalents, extremely clever compromises, giving results that can only be bettered at a considerable increase in initial outlay. Indeed, the Rogers manages also to incorporate a simplified but very efficient filter as well as independent bass and treble controls. For those who cannot contemplate the purchase of the ultimate in modern equipment an amplifier of the TL/10 or RD Junior type can be confidently recommended as the foundation stone of a genuine “hi-fi” system. When one pays extra money for a particular component one usually gets something for it; and, by the same law or principle, when one pays less one usually has to give something up. (I mean, of course, not a pound or two, but a substantial difference in the region of £15 or so.) But much will depend on one’s overall requirement. If, to take the most expensive item of the lot, one has ambitions in the direction of a loudspeaker of the type and quality of the Acoustical Corner Ribbon, the Tannoy Autograph, the Klipschorn, or the Davey DCR 60, then obviously to ensure the best possible results one ought to go for the best possible amplifier—say the Acoustical QUAD II, the Leak TL/12, the Tannoy, or the Rogers RD Senior*.

I am aware that certain manufacturers now advertise that their less expensive amplifiers give results not audibly different from the more costly ones. This is on the whole a perfectly reasonable piece of propaganda, since it is true enough under most conditions of normal listening, and also because it does much to convince those not unduly wealthy that “high-fidelity” can still be within their reasonable and logical ambition. All the same, I remain convinced that in order to make the utmost of the potentialities of the top-class, expensive loud-speakers the first essential is the acquisition of one of the amplifiers in the higher price range, with their exceptional facilities for tone control and their greater power-handling capacity. But for those who cannot, and probably never will be able to, afford £100 or more for a loudspeaker alone, a good 10-watt amplifier will give them all their hearts desire. Indeed, the introduction of the

* Both the Tannoy and the Rogers Senior are based on the well-known Williamson circuit.



ABOVE. *Tannoy De Luxe Pre-amplifier*

BELOW. *Tannoy "Hi-fi" Amplifier*

lower-priced high-performance amplifier has done much to carry "high-fidelity" reproduction into the popular arena where dwells the majority of the world's toiling millions who have their dreams but who prefer to remain on friendly terms with their bank managers. From this point of view, if from no other, designers like Leak and Rogers deserve our heartfelt thanks for bringing

quality of design and workmanship and low prices nearer together than, a few years ago, would have seemed possible.

The pre-amplifier or tone-control unit has, as its name suggests, basically two main functions—to provide an initial stage of amplification to the signal, and to add the correct amount of equalization for recording characteristics, balance, inherent distortion, and the like. In other words, it sorts out the primary signal, corrects it, and then passes it to the main power amplifier in the right form for transmission to the loudspeaker. The main amplifier provides nothing at all in the way of compensation or equalization: its sole job is to amplify whatever signal it receives to the required degree and with absolute accuracy. It is because of the degree of amplification required that the capability of the amplifier is so important to the quality of reproduction. It has to amplify or magnify complex signals by a large multiple without either adding anything or allowing anything to escape in the process. If it is guilty of sins either of omission or commission it produces from the loudspeaker audible and distressing distortion.

The pre-amplifier is, however, in reality only one stage of the complete process of amplification. To-day it is usually constructed and mounted separately for two reasons—firstly for convenience, and secondly, so that it can be easily changed or replaced when new techniques or new types of signal source become available. Those who have followed developments during the past few years will have noticed how, for example, Mr. Leak has more than once changed his pre-amplifier without being obliged to alter the basic design of his exceptional TL/12 power amplifier circuit. Owners of old TL/12s can to-day add new Vari-slope IIs without an expenditure in the region of £45. So, for convenience and as a safeguard for the future, always select an amplifier with an independent pre-amp.

Whereas there are not many audible differences between one good amplifier and another there are many differences in principle, and therefore in the details of results, between the various pre-amplifiers. As like as not, once the price-range of one's prospective purchase of an amplifier has been

determined, it will be the pre-amp. that will determine the final choice in favour of one make or another. For it is the pre-amp. with its determination of control and equalization that gives the user his ability to get the sound he most wants out of his reproducer. The more flexible it is the better; but there are different ways of achieving flexibility, and there is no full agreement on which method is indisputably the best.

If, as I find to be generally conceded, Mr. H. J. Leak with his original Point One TL/12 set the standard both in design and workmanship for the modern audio-amplifier for domestic use, then it is equally conceded that it was Mr. P. J. Walker, head of the Acoustical Manufacturing Co., who pioneered real flexibility of tone-control. Although progress rapid and often astonishing has been made in many directions, it was Leak and Walker who set the standards by which all other products were, and in many ways still are, judged.

Broadly speaking, what is required in a properly designed tone-control unit (often and for obvious reasons known as the "fiddle-box") is (a) a selector switch giving input channels for radio, microphone and tape and pick-up with at least four equalized play-back characteristics for different sorts of records; (b) independent bass control; (c) independent treble control; (d) a filter giving both variable point and variable rate of cut-off; and (e) an accurately graded and sensitive volume control, preferably logarithmic. It might be easily argued that the volume control is the most important of all for intelligent playing of the gramophone. It is also the one least thoughtfully designed by some manufacturers, and the one most abused by the general run of gramophone users.

The input channels for radio and microphone do not need much comment from me, especially since this book is devoted principally to the reproduction of records. There is not much difficulty about them; nor are they the cause of general argument. The pick-up input, though, is another matter. Nowadays most manufacturers provide built-in facilities for matching the most widely-used types and makes of pick-up; others, like Acoustical, use small plug-in

units for the same purpose. Whatever pick-up is selected, it should be properly matched, and the designer of the amplifier will usually give information on this point in his instruction booklet—which please read! But the most important facility provided by the input selector switch is, or should be, the availability of the correct play-back characteristics for different records. I have attempted to give in Appendix B some helpful information on recording characteristics which until recently has been a thorny, not to say wilfully obstinate, problem. But now that a standard has been internationally agreed, or nearly agreed, the time is perhaps not far off when it will be possible to play all new records on one known and generally accepted curve, and the need for prolonged search for the right setting will have vanished, we hope for ever. There remains, however, the question of many records made during the last five years or so on LP and the many grand old 78s which few of us will willingly relinquish—records which accepted no one general characteristic but which can be relied on to remain in current circulation for many years yet to come. In order to cope satisfactorily with these various and frequently excellent records of yesterday and the day before a basic minimum of curves will be essential. I think it is fair to say that this minimum ought to run something like this—British LP (E.M.I. and Decca); AES; NARTB (NAB); RIAA-New Orthophonic (the recently agreed International Standard); and Standard 78 (admittedly a compromise, always). It is, of course, possible to extend and sub-divide the list almost indefinitely; but for practical purposes that should be taken as the least that can be relied on to give top-class results on associated equipment of the highest quality. For more detailed information of recording characteristics in general I refer the reader to the appropriate Appendix.

To deal with this problem various systems are or can be devised. The QUAD II has an ingenious system of press-buttons which can be used either singly or in combination to give almost every known curve, sixteen in all with the full permutations. Leak uses a wide range of straight-switched positions in the Varislope II; while the Tannoy

pre-amplifier not only sorts out LP characteristics, but a whole crop of 78 curves also. The cheaper amplifiers usually rely on a basic compromise which serves its purpose but has not the flexibility of the more expensive ones. As I say, when you pay more for an amplifier you generally get something for it.

The bass and treble controls present no great problems. They must be independent of each other and of volume, and they should give reasonably intelligent curves. Ideally, step-switches are preferable to continuously variable carbon tracks, since the former give precise and properly calibrated slopes of boost and attenuation, and cannot vary with prolonged use. As a general rule bass and treble control should be used with moderation, mostly to give musical balance in the conditions of listening, and just occasionally to compensate for defects in recording. They should not, however, be used excessively to correct failings in the pick-up or loudspeaker. An engorged hump in the bass caused by a too enthusiastic use of the bass boost is always ugly and unnatural; while excessive treble boost invariably lacerates the eardrums because distortion increases with frequency, and the screeching top induced by accumulated distortion due to treble boost is worse than no top at all, or none to speak of. A slight bass boost to compensate for the weakness of the low frequencies under domestic conditions and a little treble attenuation to remove recorded or reproduced harshness are normally all that will be required.

Filters are in a slightly different position, in that since they are there to remove distortion they are meant to be used as liberally as necessary. Generally speaking, the sharp slopes should be reserved for 78s where excessive surface noise and inherent limitation of HF response requires drastic correction on very wide-range equipment. The ideal setting is always the one which experience shows to be the point where a balance is struck between the maximum recorded music and the minimum distortion. On LPs it is often better to reduce HF distortion with the treble control than with a fierce setting of the filters, because the latter tends to produce the unpleasant effect known as "transient

ringing” which often sounds as though someone has sat on and squashed the higher harmonics. The effect is often more disagreeable than the original distortion; but a gentle roll-off from between 10–7 K/cs can in many cases make a bad record not good, but at least endurable. As a rule, though, if an LP is so bad that it demands the steepest rate of filtering—don’t buy it in the first place as it will never be any use. With 78s it is a different matter—filter as hard as necessary, but no more.

There exist differing views on the design and scope of filter circuits. The QUAD and many others use fully independent filters—dependent that is of the treble control; Leak, however, prefers a variable rate of slope and cut-off combined with the treble attenuator. Both systems have their advantages and disadvantages. Independent filters give more flexibility; while the “varislope” system seems to reduce the risk of uncomfortable “transient ringing”. The reader may be left to make his own choice.

But whatever system is preferred, don’t abuse it, Controls are put there to rectify deficiencies, not for idle fingers to play with. The QUAD II has a useful device whereby at the turn of a switch all controls can be returned to “level” so that one can in an instant see exactly the difference between tone and filter correction and no correction. It is surprising how often one finds that all one’s solemn twiddlings have gone into labour and produced hardly a mouse of improvement. Which is not, of course, to say that comprehensive controls are valueless and unnecessary—only that they should be used reasonably and not regarded as gadgets which, when sufficiently played with, will turn every miserable goose into a snow-white swan. A bad record is a bad record, and although it may not be always quite beyond redemption, especially if the music or the performance happen to be unusually rewarding, it has in the end to be accepted for what it is. Flexible tone controls are refinements, and the more flexible they are the more they can do; but they can’t logically be expected to turn black into white. It is because recording technique is not infallible, and because the greatest performances of the greatest music sometimes come to us bristling with technical

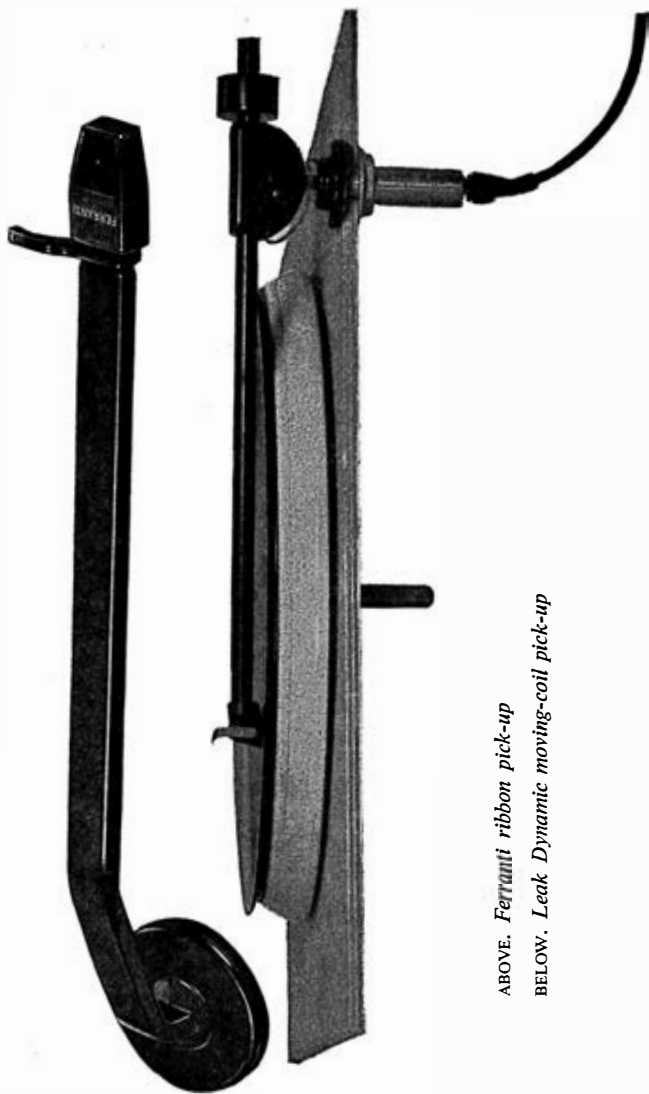
faults, that we have to do what we can to put matters to rights; and here the more expensive amplifiers will give us their rewards. But we ought always to remember that the more "correcting" we have to do the farther we become removed from the illusion of musical reality. We have to do it, but we aren't bound to make a virtue of it.

About the use and abuse of the volume control I have already spoken. All I need add is that the control itself should be smooth and free in operation and accurately calibrated. Again it is the Acoustical QUAD which seems to set the standard. The QUAD volume control is a large die-cast knob the weight of which acts almost like a flywheel, so that it turns with extreme smoothness and minute variations are easily achieved. Also it is so calibrated as to give 5 db variation per division. A case can be made out for a step-switch volume control; but in practice so many steps would be required to give the necessary degree of control that the more sensible method is a continuously variable track with a logarithmic rate of increase and decrease.

I have seen it argued that the pick-up, because it comes into first and most direct contact with the record, ought to receive primary attention when one is selecting a reproducer. The argument is fallacious. I have also seen it advocated that the loudspeaker, because it actually delivers the goods, or the sound, ought to come first and the rest be built round it. Wrong again. Begin with the amplifier. After all, it is the heart of the reproducer: it deserves pride of place, for if it fails us we are doomed from the start. The pick-up we can replace later, if need be; also the loudspeaker, even more easily. I repeat, buy the best amplifier you can reasonably afford. It does not need to be the most expensive, but it must be good. I have tried to indicate the lines along which you should proceed.

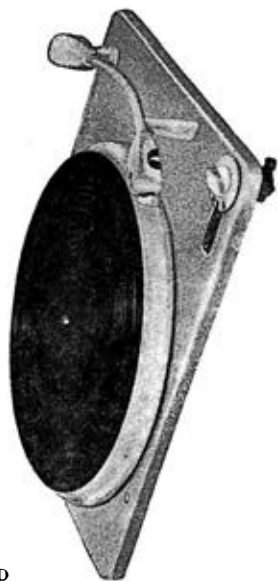
Pick-ups and Motors

Having got our amplifier and its associated control unit, we must now look for something to feed into it; we can leave what it is going to feed until later. Since we are



ABOVE. *Ferranti ribbon pick-up*

BELOW. *Leak Dynamic moving-coil pick-up*



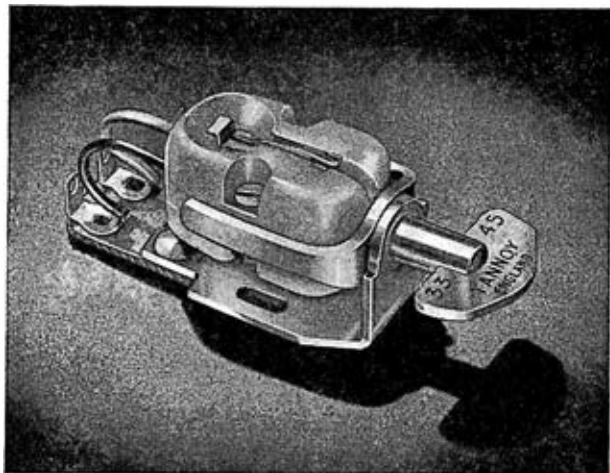
*Collaro Studio Crystal pick-ups: on
TOP, 2010 unit, and RIGHT, AC3/554*

concerned here primarily with the reproduction of records we shall need for the feeding of our new amplifier a pick-up mounted on a motor (plus, of course, some records, which don't however concern us for the moment).

A gramophone pick-up is a device for converting the mechanical vibrations of a stylus (needle) into corresponding oscillatory voltages capable of being amplified and subsequently transmitted into the loudspeaker for reproduction in the form of audible sound waves. That is the basic technical definition; and, like much else of its kind, it is well to keep it in mind while examining the various types of pick-up in current use.

But before we go deeper into that difficult problem I want to lay one very large bogey—the automatic changer. In the old days when many 78s were required to accommodate any large scale musical work there was, no doubt, an excellent case to be made out for swift and unaided change by mechanical means. But to-day, with LP firmly established as the proper means for the high-quality reproduction of music, it is useless. Top-class modern pick-ups, light in weight and sensitive to any extraneous influence or pressure, are never happy with bits of mechanism tied to their tails; and LP records dislike comprehensively being ground against one another. Therefore, anyone who wants "high fidelity" reproduction can banish at the outset all thoughts of auto-changers. The wilful exposure of LPs to damage by allowing them to rub bits of grit into each other or by any of the other perils or vicissitudes that must inevitably be their lot on the auto-changer is carrying the sin of indolence altogether too far.

Now let us get back to pick-ups. There are four main systems for designing and causing to work the device we have in mind—ribbon, moving coil, magnetic or moving iron, and crystal. Actually the ribbon pick-up is simply a single-turn moving coil, so perhaps there are really only three systems in general use. They are all good in their respective ways, but some, not unnaturally, are better than others, potentially at least. For a long time the magnetic or moving-iron pick-up was the most widely used—the others had to await later development before they came



Tannoy Variluctance Phono Cartridge

into their own. The modern moving-iron pick-up is, of course, only a refinement, albeit an almost unrecognizable refinement, of the old blunderbusses with which we used to assault our records like so many ambitious cosh-boys before illumination visited us. The Decca moving iron, still doing excellent service in its latest or "H" form, was one of the first and certainly the most popular of the immediate post-war "high-fidelity" pick-ups; the Connoisseur Superlightweight is a further refinement of the same principle, less amenable but slightly superior in performance. The famous range of E.M.I. pick-ups were, and are, also moving irons. I have an idea though, that, well as it served us, the moving-iron pick-up has seen its best days, at least in its conventional form. With the startling advance in the capability of the cheap crystal pick-up and the reduction in price of the basically superior moving coil, the moving iron rather tends to fall between two stools. The man who cannot afford the best can hardly do better

than go for one of the excellent crystal units now on the market; while the man with a little more to spend will find it definitely to his advantage to go for the moving coil. I admit that theoretically the moving iron is still capable of giving splendid results; but whether it can compete with the crystal in price or the moving coil in quality is something on which I, who have tried many and been sorely-tried by many more, have serious doubts. The future of the moving-iron principle probably lies in the “variable reluctance” cartridge such as Tannoy produce, which is not cheap but which is capable of giving top-class results. In this cartridge many outstanding problems have been successfully overcome,* and the short demonstration of Tannoy equipment kindly given to me in my own home by Mr. N. C. Mordaunt of the big folded horn loudspeaker fame, encouraged me sufficiently to make me look twice at my own moving coils. It was certainly the first pick-up based on the moving-iron principle that had made me do so for many a long year.†

I think there is little doubt that modern pick-up design has for the moment reached its peak in the Ferranti Ribbon. The Ferranti is expensive, not perfectly simple to handle and install, and has an extremely low output, for which reason it is not suitable for use with every type and make of amplifier. The QUAD II makes special provision for using the Ferranti pick-up; other amplifiers may complain, so before installing it—or indeed any ribbon pick-up—ensure that you have an amplifier ready to cope with it. As a general rule any pick-up can be used with any good amplifier that has a place in the present discussion: but all ribbons must inevitably have a very small output—they constitute a case on their own and require special attention. On the other hand there is no possible doubt that as long as we have to

* In particular there are no undamped resonances in any part of the range. The top resonance is not, as it usually is, simply shot up into the supersonic region; it is hunted down, located and thoroughly damped.

† Goldring have recently introduced a substantially cheaper “variable reluctance” cartridge. It is less refined than the Tannoy, but is remarkably good value.

suffer pick-ups in any form the Ferranti Ribbon will hold its lead for a long time to come. The great advantage of the Ferranti is that it removes the few drawbacks to the multi-turn moving coil. It appears to have got over the sin (theoretical at least) of fore and aft movement; because it is a ribbon it has negligible mass (the overall figure at the stylus tip is 2.5 milligrammes of which 2 milligrammes are represented by the stylus itself); and it has the enormous advantage in a pick-up of its kind of possessing full vertical compliance without the use of a cantilever mounting. On the other hand it is, besides being expensive, a trifle delicate—it is definitely not the sort of thing to leave lying about for the general use of the household, addicted as some of them may be to ancient records of “honky-tonk”. It must be a positive nightmare to manufacture; anything made with a ribbon invariably is.

I am equally certain that, for general use, robustness of construction, and the highest quality there is no pick-up to surpass the new Leak Dynamic moving coil. The original Leak Dynamic was a magnificent pick-up; but the new one seems to be a noticeable refinement of it. It is lighter in weight—like the Ferranti Ribbon it is hardly likely to scour the surfaces of one's dear-bought records—its response is admirable, and its resonances are well out of the way. Also it has, unlike its predecessor, interchangeable heads, and its price with two diamond heads can by no stretching of the imagination be called exorbitant. It doesn't mind being knocked about, within reason, and it will easily load any amplifier currently available, with of course its proper transformer. As a general-purpose pick-up capable of giving results not less than authentic “high-fidelity” the Leak Dynamic meets every reasonable need. It stands with the Ferranti at the head of the short list of top-class pick-ups.

When it comes to inexpensive pick-ups the choice must inevitably, I think, go to the modern crystal. First round in the development of the crystal pick-up undoubtedly went to Messrs. Cosmocord with their excellent Acos G.P. 20. This has been further developed in recent years with the introduction of what is known as the Hi-g head. The number

of these pick-ups in general circulation is eloquent proof of their fundamental quality and outstanding value. Nevertheless, it is now difficult not to admit that in the same range Messrs. Collaro have gone even one better with their Studio P and Transcription models. Those who heard the public demonstrations at the 1954 Radio Show came away with much food for deep and lasting thought. No one, I think, claims that for performance these crystal pick-ups can stand up to the challenge of a moving coil. But then, it is not really reasonable to expect a pick-up to give a performance exactly comparable to that of one three or four times its price. The best Collaro pick-up—and the Acos too for that matter—is a remarkable instrument that has undoubtedly revolutionized ideas on the subject of cheap pick-ups. No one need hesitate to invest in one unless he proposes to use a loudspeaker costing around £100; and even then he may well spend a lot more money and get a lot less pick-up. Furthermore, the complete Collaro 2010 unit (transcription three-speed motor and transcription pick-up), cannot be bettered at its price anywhere—in the world I am almost tempted to add—and might well be taken as the standard unit at its end of the chain for those who want really high-quality but who can't go over into the near £60 range for motor and pick-up alone. As I stressed at the beginning of this chapter one ought to plan one's purchase of a reproducer from the outset—one ought to select a pick-up with one's eye not altogether removed from the eventual loudspeaker. If purchase is confined to the medium-price range the Collaro unit has not so far as I know—and I have taken some pains to find out—been surpassed. I fancy it won't seriously disappoint anyone, whatever his or her ambitions may be. I might add that for the even poorer man Messrs. Collaro also produce a cheaper but still excellent unit in their AC 3/554. This is a slightly less advanced model of the pick-up and the motor is not a transcription unit; but where price is the determining factor the AC 3/554 will help to fill many a dark hour with lightness.

On the subject of motors I need not say very much. It goes without saying that for the satisfactory reproduction of records, and especially of LPs, the motor must be

accurate in speed and absolutely steady. Also the motor must not transmit rumble—that is, nasty noises as of indigestion, induced mostly by indifferently ground bearings and imprecise manufacture. For a long time the synchronous non-variable speed motor was almost universal: now, I am glad to note, variable speed motors are coming into fashion again. For those who possess the sense of absolute pitch a variable speed motor is a necessity, because one still cannot guarantee that every recording will play the music in the key it says it's in, and nothing is more distressing to the sensitive ear. Some musicians have found it impossible to listen to certain recordings at all, not because of the quality of either performance or recording, but simply because of a minute irregularity of pitch. Electric current is also liable to fluctuate, so that some means of rectification is required even for those who can't readily distinguish eighth- or quarter-tones.

Again the better the pick-up, amplifier, and loudspeaker, the better does the motor need to be, or its shortcomings will be ruthlessly shown up. Try a ribbon pick-up on a motor subject to rumble—if someone doesn't soon offer the poor loud-speaker a spoonful of bicarbonate of soda your household is unimaginative!

Among motors currently available the best are undoubtedly the Garrard and Connoisseur variable three-speed models. Both are admirable, and both cost around £25. The Connoisseur has for long been recognized as the king of modern motors, justifiably so far as I know. The latest model incorporates, besides three beautifully changed and controlled speeds, a possible 2 per cent variation on each separate speed. I am not absolutely convinced that this ideally is enough; but in view of the general engineering standard of the whole I let it pass. The Garrard, too, offers us a unit capable of retaining its silence and accuracy in the best possible company. The Collaro units already mentioned are not variable speed and are not quite on the same exalted level—but then neither are their prices. They, too, have their place and fill it admirably. Others could be mentioned; but as a general principle it should be taken that if finance will run to it a "transcription" (or advanced

quality) motor will always earn its money—at least it won't get in anybody's way.

I must finish this section on the sharp point of the stylus, however uncomfortable it may be. In order to make matters simpler for myself and less tiresome for my readers I propose to reject all points not sapphire (or ruby), tungsten-carbide, or diamond as not germane to a discussion of "high-fidelity" reproduction. I fancy that the addicts of thorn needles will in any case have shut this book up long ago; nor will the old steel prong (hard or soft) find many adherents to-day—especially since it can't be used for LPs. And, furthermore, tungsten-carbide is more potential than actual as a source of commercially produced styli: so we may take it that sapphire and diamond are the only two materials that seriously interest the ordinary record buyer.

The only substantial difference between synthetic sapphire and natural diamond reproducing points is that the latter are many times harder and therefore longer wearing. From the point of view of reproduction there isn't much to choose; but the diamond's unsurpassed longevity is kinder to one's records, and to one's nerves. The days are long past when sapphires were blandly advertised as good for 2,000 records—or even at times 5,000. Nowadays it is generally conceded that a sapphire shouldn't be trusted much above 200 playings, not because it will necessarily be worn out, but because it might be and it will probably do fierce damage before distortion reaches sufficient audible proportions to induce the unwary to undertake replacement. Also, sapphires are susceptible to fracture from untoward shocks or jolts, whereas a diamond requires a hammer of some magnitude and toughness to do it serious hurt. On the other hand it is only fair to point out that a worn diamond does a good deal more damage than a worn sapphire. The advantage is that diamonds can be trusted to remain undamaged for very much longer periods. I am definitely of the opinion that if one can countenance the initial outlay the diamond is easily the best buy. Of course it is much more expensive; but since replacements will be few and far between, I doubt if in the long run, over a period of

years that is, sapphires represent any real economy at all.

Care of the reproducing point is one of the leading factors in the preservation of expensive records, so that regular inspection of diamonds and regular replacement of sapphires is an ever-present necessity. Sapphires do not cost much and should be renewed ideally a little more often than necessary—in other words before they develop “flats”. With diamonds the best procedure—since most folk don’t possess microscopes of their own—is to return them to their makers for inspection and resetting at regular intervals—at least once a year; better still, every six months if they are in constant daily use. The experienced listener can frequently rely on his ear to detect deterioration in a point, whether sapphire or diamond; but the average listener is best advised to make it a rule to have his point examined at reasonable intervals. The process is neither difficult nor costly, and it saves much uneasiness of mind and potential damage to records.

In order to do justice to ~~modern records~~ reproducing points have to be incredibly accurate in size and shape. A little more latitude is permissible for 78s than for LPs. In the case of the former the agreed size is $\cdot0025''$ and the acceptable tolerance $\cdot0005''$; for LPs, however, the correct size is $\cdot001''$ and the variation $+0$ and minus not more than $\cdot0002''$. In other words, a satisfactory reproducing point for LPs must not exceed the specified size at all, and only be smaller by two tenths of a thousandth of an inch. I know of no other industry that regularly works to such a degree of precision while at the same time maintaining mass-production. The position is even more remarkable when one remembers that the production of records—in hundreds of thousands, if not in millions—demands not less a standard of accuracy.

The shape of the point need not detain us for long. Most manufacturers adopt a spherical point as standard for both 78s and LPs. A good case can, however, be made out for the use of an elliptical or oval point to aid tracing on 78 r.p.m. records. So far as I know the Ferranti Ribbon pick-up is the only one to fit an elliptical diamond as standard for 78s only. But Decca have for a long time past made

available an elliptical sapphire as an alternative to the normal spherical point. In the case of an elliptical point the dimensions are .003" x .001" at the point of contact with the groove walls, the larger dimension lying laterally, that is, across the groove. In practice an elliptical point helps the stylus to maintain proper contact with the groove walls under heavy stress and towards the centre of the record; but the rate of wear is considerably increased and there is usually a slight loss in top response. Whether or not a particular individual feels it worth while to experiment with elliptical points—unless he is the fortunate possessor of a Ferranti pick-up when he will get one automatically—is a matter of more or less personal preference. Some advantage can be expected, but it does entail a little trouble and an even more vigilant eye on stylus wear.

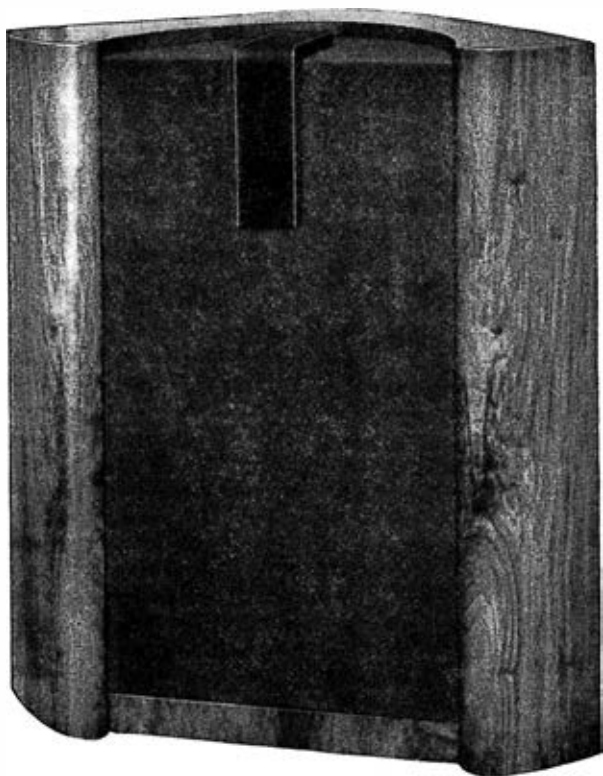
An increasingly popular means of coping with incipient tracing distortion is provided by the so-called "BJ" pick-up arm. This clever little gadget ensures that the stylus moves across the record in a manner identical to the cutter-head—that is, in a straight line instead of the usual arc of the conventional pick-up arm. There is no doubt that the "BJ" arm—named after its inventor, Mr. Peter Burne-Jones—does reduce tracking error to an absolute minimum, if it does not obviate it altogether, and thereby does much to eliminate many of the mechanical faults inherent in the conventional pick-up assembly. At the present time, however, the "BJ" arm is not available in a form that will accept really high-class heads such as the Leak or the Ferranti. A range of low- and medium-priced heads can now be satisfactorily accommodated; but it remains to be seen whether it can be adapted to the best heads, or whether the manufacturers of those heads will countenance their use with it. If so, and if the problems of adaptation can be satisfactorily overcome, it may yet prove to have caused a revolution in pick-up design of far-reaching influence. The "BJ" arm works on the principle of two arms of different lengths so mounted at the base that they carry the head from the outer grooves towards the centre in a perfectly straight line. Theoretically it solves an old problem; practically it has yet to show that it can enter the highest fidelity range

without introducing further complications. I understand that Messrs. Tannoy are experimenting with a modified "BJ" arm for their own variable reluctance cartridge. I confess that I have not yet heard the result; but my information suggests that it is not less than thoroughly encouraging. (I have since heard this "BJ"-Tannoy assembly and the results are admirable).

I can leave the problem of pick-ups on that rather tentative note. It is now necessary to see how we can best turn the oscillatory voltage signals with which we have so far been concerned into audible sound waves for our enjoyment.

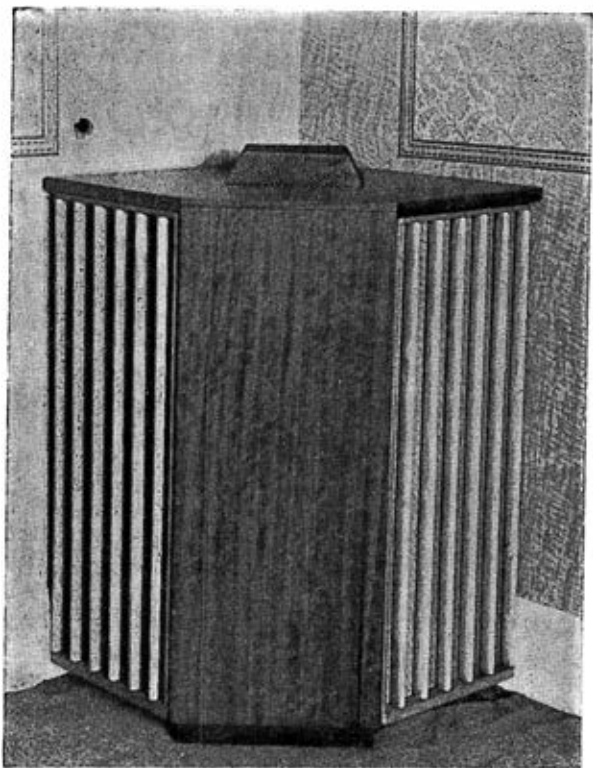
Loudspeakers

The loudspeaker is the last link in the chain; it has also been called, with some justification, the weakest link. But because the loudspeaker actually gives out the sound that we hear in our own room, there is no subject on which opinion varies more wildly or more heatedly. In discussing loudspeakers the maxim about one man's meat is apt. It is possible to prove the superiority of one type of loudspeaker assembly over another by graphs and calculations, and yet to find, no doubt to one's natural annoyance, that the listener comes down heavily on the wrong side of the fence. Someone once observed that every man has a nose with two holes to blow through. On the same principle of observation it can be assumed that every man (or woman) has two ears, each with a hole to hear through. Unfortunately, however, it cannot be assumed that every pair of ears is exactly like another, or that the minds served by those ears will automatically agree on what sounds or combination of sounds are most natural and most nearly approximate to the original. Or, to return to the form of words used in the previous chapter, the creation of an illusion of reality depends as much on one's subjective reactions as on theoretical calculations. No doubt we all ought to like what is theoretically the best; but until loudspeakers attain a state of unassailable perfection we shall most of us go our own ways and become argumen-



Acoustical Corner Ribbon

tative in the process. Good loudspeakers are also extremely expensive. However much we may want the very best that contemporary techniques can devise, most of us have to make do, for financial reasons, with something a little less. All loudspeakers are, like all records, a form of compromise; but because our pockets are not bottomless we



Rogers Junior Corner Horn

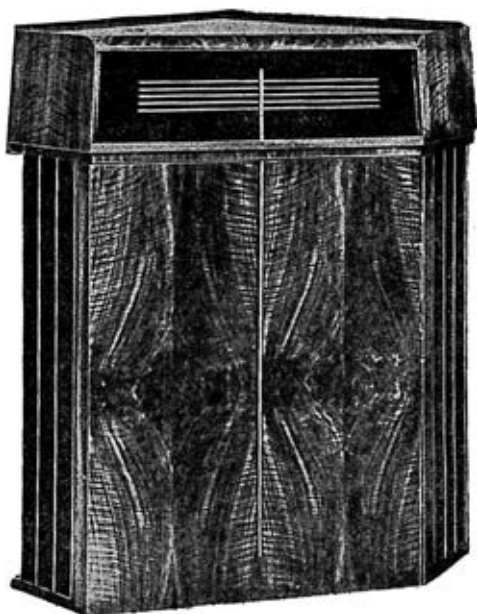
too often have to make do with a compromise of a compromise.

In the course of preparing this book I have deliberately set out to hear as many different loudspeakers as I can find. It has been an illuminating, if not an unconditionally encouraging, experience. It has also revealed to me once

more the fallibility that hedges all mortal endeavour. On at least one occasion I have taken myself off to hear an expensive and ambitious loudspeaker that has been widely praised by those who ought to know; and I have come away stern of face and explosive. The next man after me has, as like as not, been enraptured. I am obliged to issue this warning because more than anywhere else in the selection of a reproducer the choice of a loudspeaker is personal and individual. Nevertheless, I have some experience in the matter, and I hope that here too I may be able to offer some helpful guidance.

I do not intend to go deep into the intricacies of loudspeaker cabinet dimensions, materials, and general design. The amateur carpenter can have a great deal of fun with a loudspeaker or two and a pile of plywood. But for present purposes I am acting on the assumption that the prospective purchaser will be looking for a made-up unit he can buy as a whole, or as near a whole as makes no matter. If anyone wants to go in for building his own loudspeaker enclosure many of the leading manufacturers will supply blue-prints for that purpose, and several excellent books exist that will carry him in detail towards the land of his heart's desire.

Perhaps the first thing to realize about any loudspeaker is that it will be markedly conditioned by the acoustics of the room in which it is used. I need hardly enlarge on this. One or two loudspeaker systems—such as one of the Tannoy range and the Pamphonic "Victor", incorporate a form of "room control" which alters the properties of the unit or units to suit the characteristic of one's listening quarters. This is undoubtedly a most useful and intelligent addition; all the same, most manufacturers rely on the tone controls of the amplifier to match the loudspeaker to the room. All that really concerns us for the moment is the unquestioned fact that the performance of the loudspeaker cannot be assessed—outside the dead-field studio—without taking into account the acoustic properties of its habitation. No doubt a good loudspeaker will always sound good, and a bad one will never altogether conceal its sins; but the shape, the furnishings, and the material of the walls of a



Vitavox Klipschorn

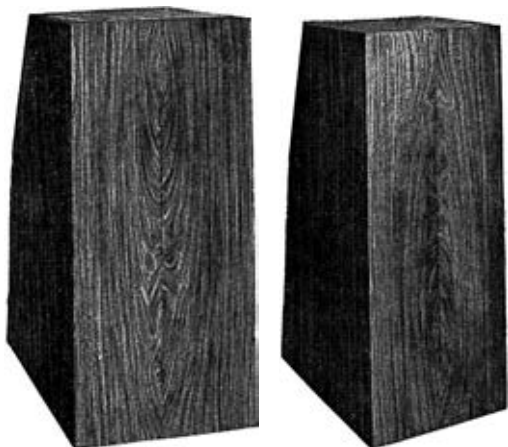
room can produce coloration and alter the internal balance of any loudspeaker. All rooms also normally lived in have resonances of their own and produce standing waves in some position or other, to the detriment of the loudspeakers they house.

From any loudspeaker system we require first and foremost smoothness of response throughout its whole range,

no matter if that range is wide or comparatively limited. A narrow range loudspeaker that is really smooth is much to be preferred to a wide-range unit that is full of humps and bumps of unsuppressed or even spuriously induced resonance. It is, of course, the lack of undamped resonances that is primarily responsible for the smoothness of good loudspeaker response.

A resonance is caused by excessive inflation of certain frequencies due to sympathetic vibrations at selective points in the range. All loudspeaker units have natural resonances in the cone and in big units—12-inch or over—the natural resonance is in the region of 35 cps; in smaller units it is usually around 70–80 cps. In the efficient mounting of loudspeakers, therefore, it is essential to damp out the resonances in order to ensure smooth reproduction from the bottom to the top of the range. I put resonances at the bass end of the scale first with intent because, as I have already tried to explain, the thumping and banging bass of the old radiograms was produced by deliberate emphasis of resonance in the region of 100 cps. It showed us admirably just how ugly uncontrolled resonance can be.

Resonances are not, of course, the only faults that occur in loudspeaker systems; but they are probably the most obviously annoying, and they give rise to a good many other enormities. No loudspeaker approaches within sight of perfection; they all, to a greater or lesser extent, mangle the signals fed into them. This is not a piece of ill-tempered cynicism—it is plain fact. The main sins they commit usually have big names: we needn't be unduly concerned to understand them all now, but a brief classification may be useful. The most prominent faults in loudspeakers, apart from resonances, are harmonic distortion, frequency distortion, and intermodulation distortion. If we feed into a loudspeaker system two or more streams of electrical oscillations of different frequency but identical strength, the output from the loudspeaker ought in theory to be two or more different tones of exactly the same audible strength, and nothing else. However, what usually happens is that, because no loudspeaker leads a completely blame-



*Davey DCR 60 and DCR 61
(Corner Reflectors)*



*12" Tannoy Dual Concentric Loudspeaker
(cut away to show construction)*

less life, we get, to a greater or lesser extent again, multiples of the original frequencies (harmonic distortion), unevenness of strength between the different frequencies (frequency distortion), and certain summation and difference tones (intermodulation distortion). Ideally none of these forms of distortion should be present at all: in practice they nearly always are, however slight, somewhere in the reproduced range. It is the job of the designer of loudspeakers and loudspeaker mountings to reduce these distortions to a minimum. Some years ago the efforts to achieve this were more or less primitive; to-day the best units have succeeded remarkably well.

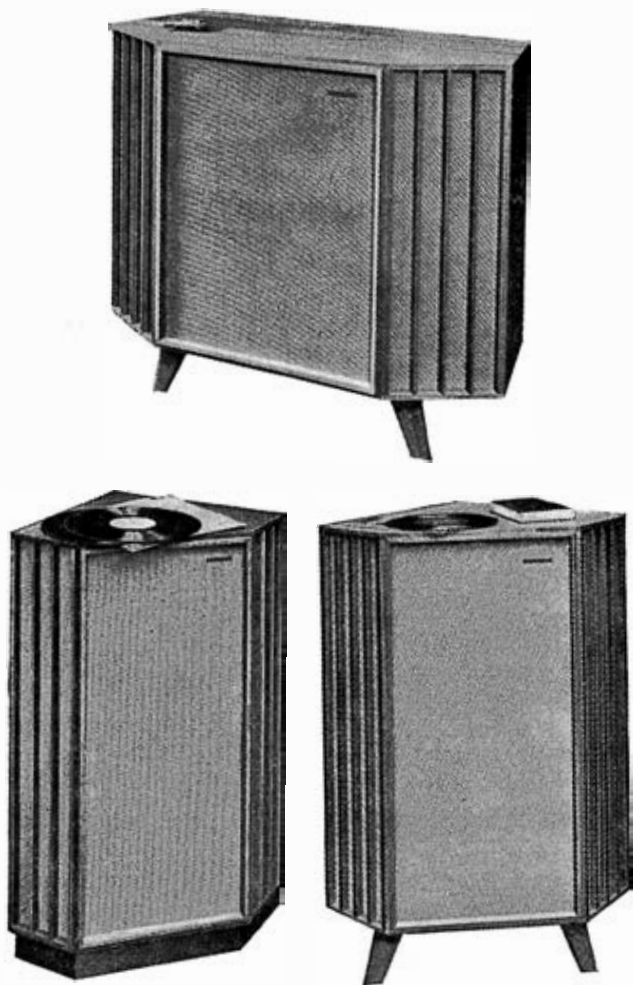
The main audible advantages of freedom from the common forms of distortion, apart of course from an unmistakable if largely indefinable feeling of well-being on the part of the listener, are clarity and separation (the ability to hear every instrument at work clearly and individually), delicacy of reproduction, especially in the soft passages of music, and wide-range response without running into ugly troubles at either end.

I am aware that that is no more than an over-simplified statement of a very complex problem. To begin with, it takes no account of the basic problem of designing and making a cone unit that will behave itself under load. But that and its associated problems are more the concern of the engineer than of the music-lover who wants the result but isn't over-interested in the means of getting it. As I say, this book is directed principally at helping the latter to get what he is after without being obliged to understand all the technical details. If a loudspeaker gives excessive distortion then many of us will swear, but not all of us will care whether the noise that plagues is caused by one form of distortion or another. The question those who are not technicians are entitled to ask is, "Does it work?" and "Is it the best I can get for what I can afford?"

Because different sizes and different types of loudspeaker often work best within comparatively limited frequency bands, most of the more expensive systems use two or more units separated by cross-over networks. In this way the individual units can be used to do the job they have to do

in the range where they are most efficient. Put briefly, the general idea is to use a big unit for the bass and a small unit for the top, since big units are necessary to handle the lowest musical frequencies and little units, whether cone or not, can usually be relied on to make the best job of the upper end. The two units—colloquially known as the “woofer” and the “tweeter”—are separated in range and coupled in action by a cross-over network which cuts the response of one at the frequency chosen for the other to take over. In cheaper loudspeaker systems a single unit can usually be loaded in such a way that it can cover the whole available range by itself.

I confess that unless an advanced type of “tweeter” unit is employed, I see very little point in going for a multi-speaker system at all. The mere taking of two or even three conventional cones, separating them by cross-overs, and wrapping them up in polished plywood, seldom seems to me to justify by results either the trouble involved, small as it is, or the usual cost to the customer. It is only when a specially designed horn-loaded “tweeter” is used that one begins to reap the full benefit of multi-speaker assemblies; otherwise efficient loading of a single unit gives excellent results at a far lower cost. Cheap cross-over networks can also be extremely troublesome because of the difficulty of completely damping out the response of one unit at the point where the other takes over. If there is appreciable hang-over resonance either in the individual units themselves or worse still at the point of cross-over, the audible result is in the nature of mess and muddle. To be more precise, if the cone continues to vibrate at a certain frequency after the signal generating the response at that frequency is cut off, then one has the sensation of hearing two or more sounds simultaneously. The effect is not unlike that produced at a “live” performance in a hall with an excessive reverberation period, when, by a sort of echo effect, the rhythm and clarity of texture of music are obscured by the carrying over of one beat or instrumental sound into the next. The same sort of thing happens if one plays the piano with the sustaining pedal constantly in operation. In loudspeakers clarity and separation are due



THREE TANNOY LOUDSPEAKER ENCLOSURES

ABOVE. *Landsdown*. BELOW LEFT. *Canterbury*. BELOW RIGHT. *York*.
(The *Autograph* is similar in appearance to the *Canterbury*)

in great part to the suppression of all vibrations, either in the cone or the cabinet, at the exact point where the signal itself ceases. In practice it is extremely difficult, some would say theoretically impossible, to prevent these vibrations from continuing through their own momentum for perceptible periods. Modern techniques of loudspeaker and cabinet design, however, have succeeded remarkably well in damping out hang-over, so that with the best units available to-day an admirable degree of clarity is obtainable without making the whole business too costly and too unwieldy.

It is obvious that in a book of this scope I cannot go into minute details of loudspeaker design and mounting; the best way of giving the reader some practical guidance on the choice of a loudspeaker is to use my own experience, gained through many protracted hours of listening to various units, to indicate how various manufacturers have coped with the basic problems, and to give my own personal views.

On the sound principle that in examining any range of products the most satisfactory way of arriving at useful conclusions is to look first for the very best available, I propose to begin at the top end of the scale and to ignore for the moment the circumstance of financial stringency. It is only if we know and understand the best that we can hope to assess the potentialities and capabilities of less ambitious endeavour. Many of us have to make do with the latter; but we ought to set our standards as high as we can. After all, we judge, or we should judge, violin playing by the standards of a Kreisler or a Heifetz, and not by the competent fiddling of the café band.

I have, as I say, pursued loudspeakers with some determination; and I have, I am bold enough to think, been able to reduce the problem to reasonable dimensions. But I must emphasize again that the choice of a loudspeaker is, in our present state of imperfection, a highly personal matter. My own findings may therefore cause loss of temper on the part of some of my readers. All the same, in the three broad price-ranges I have managed to run to earth a number of loudspeakers which should satisfy the majority

of those who know and can appreciate what is this elusive phenomenon we call “high-fidelity”.

If one wants and can afford the highest quality of reproduction obtainable to-day the search for a loudspeaker might be directed first in the direction of the Acoustical Corner Ribbon designed and made by Mr. P. J. Walker at Huntingdon. When it first came out towards the end of 1949 the Corner Ribbon was described by Mr. G. Howard-Sorrell in *The Gramophone* as “one of the most advanced designs so far made available to the public anywhere in the world.” After months of persevering search I am convinced that those words still hold true. The tremendous amount of preliminary work that went into the basic design of the Corner Ribbon, about which the makers have published an admirable booklet, resulted in a unit that for smoothness, naturalness, and fidelity of reproduction has yet to be surpassed, and, with very few exceptions, even approached. It is also especially interesting to the general gramophone user because it will, unlike some of the big horn-loaded units known to me, work quite happily in not over-spacious surroundings. In short, the Corner Ribbon has good manners; it doesn’t knock us over backwards every time we turn the gramophone on. There are known technical reasons for this politeness of manner and bearing; but what most matters is that, like the well-educated man, the Corner Ribbon can make itself at home in all reasonable surroundings. After all, we have to live with a loudspeaker. There are altogether too many loud-mouthed loudspeakers around to-day—they are noisy and aggressive; they try to seduce us on the well-known principle that a ferocious uproar can always sound impressive. I am in the habit when judging a loudspeaker of asking it first to reproduce the softest and most delicate musical sounds—quiet *pianissimo* passages for divided strings; soft cymbal clashes, gentle ticklings of the triangle; rich, warm, romantically glowing chords for horns. I investigate the explosions later on; for if a loudspeaker can’t catch the most delicate and gossamer tones of music, it may be safely assumed that with the big climaxes it will merely provide an accumulation of noise. There is, I am convinced, something which I like to call

“power-to-noise ratio” in the performance of a loudspeaker. I am not quite sure what it is, technically speaking, and it’s almost certainly as a term or description abominably inaccurate: nonetheless, to me at least it indicates the ability of a unit to deliver the genuine power of music rather than a loud noise: it is a qualitative rather than a quantitative factor. It is probably bound up with the ability of the loudspeaker to reproduce harmonic structure accurately and intelligibly, in its most complex and forceful forms. At any rate, I know what I mean even if nobody else does; and it usually begins with a really enchanting reproduction of tones soft, delicate, and colourful.*

Because of its unique “tweeter” unit, the Corner Ribbon habitually catches these shimmering delicacies of music more realistically than any other loudspeaker known to me. It does not need reinforcements Wagnerian and voluptuous in order to make its proper impression, although it can, of course, set the hounds of hell by the hackles when need be. But they are invariably the composer’s hounds and not some sharp-fanged monstrosities bred in its own unsavoury kennels. Of all the loudspeakers I have yet come across, the Corner Ribbon is the most free of obtrusive resonances, the widest in response range without the attendant vice of aggressive frequency distortion; and the most free from horn, cone, and cabinet coloration. In other words, although imperfect, it approaches most nearly to genuine fidelity than any other unit I have so far discovered on my travels. I propose to use it as my standard of reference.

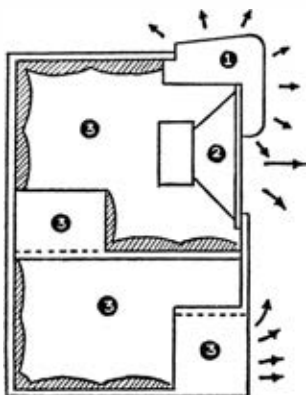
The design of the Corner Ribbon is not complicated: indeed, on paper it looks deceptively simple. But it happens to be one of those cases where extreme refinement and attention to detail has had the effect of making appear innocuous a whole host of problems normally obstinate and refractory beyond the ordinary. The LF unit is a straightforward 12-inch twin-cone loudspeaker working through an acoustic air filter inside the cabinet. In essence the clean, rich bass response is achieved through a modified form of Helmholtz resonator: the secret lies in exceptionally successful damping of unwanted resonances. I have heard

* Much the same is true, of course, of pick-ups.

it objected that the Corner Ribbon is comparatively weak in the bass; but although, as I have said, nothing is yet perfect in our world, I am convinced that the objection arises largely because at no point in the complete response range is any frequency boosted artificially—or accidentally—by resonance.

But the really interesting part of the complete assembly lies in the ribbon "tweeter". It is this that gives that beautiful delicacy of reproduction I have already spoken of. Because a ribbon has negligible mass it is free from most of the vices inherent in conventional cones: it has practically no colouration, and it suffers hardly at all from hang-over. Its response is practically unlimited in the upwards direction; although, because of its frailty, it cannot handle LF amplitudes at high volume. All the same, the Corner Ribbon manages to place its cross-over at 2,000 cps, which is exceptionally low, but which by clever design has been reliably achieved so that the advantages of the ribbon unit cover the widest possible range. The ribbon is horn-loaded at the front so as to give the maximum realistic sound distribution. The extreme HF is directional, as it is at a concert, where in a good hall one could easily shoot the triangle player by ear, so to speak; but owing to the wide dispersal achieved by the multi-directional horn the sense of spaciousness in large-scale musical works is quite remarkable. By further thoughtful design the sound appears to recede to some point behind the cabinet as the original source grows in dimensions. A solo instrument or voice appears to be directly in the front of the cabinet; but the orchestra is made to sound as though it emanates from somewhere behind the unit so that the angle of reception is appreciably widened and the sense of perspective progressively improved. Like all corner assemblies, the Corner Ribbon makes use of the walls of the room above and each side of it as an extension of its own cabinet. The following diagrams show the basic layout and the multi-directional radiation of the ribbon unit.

I have deliberately expended some time and thought over a description of the Corner Ribbon Loudspeaker because, as I say, I have after a good deal of trial and error adopted it as



ABOVE

Top diagram view showing horizontal dispersion

LEFT. *Side view sectional diagram showing arrangement of units and vertical dispersion. (1) Multidirectional Ribbon Unit. (2) Low Frequency Unit. (3) Elements of Acoustic Filter*

ACOUSTICAL CORNER RIBBON

my standard, and because having got a few prejudices of my own about loudspeakers in general off my chest, I can now proceed to review the problem in more detail without having to stop all the time to explain what I, personally, expect from what is after all the machine that translates the intangible into the tangible. There are, I know, many who do not share unreservedly my enthusiasm for the Corner Ribbon; but this is my book and for once in a way I can say what I like without having to be either tactful or uncomfortably heedful of other people's prejudices.

For those who must look in a cheaper category the most hopeful avenue of exploration lies in the admirable range of loudspeakers—either mounted or unmounted—produced by Tannoy. After all, Tannoy produce in the magnificent Guy Fountain *Autograph* unit one of the very few loudspeaker assemblies that can talk to the Corner Ribbon as man to man. I am quite prepared to believe that the man who prefers the Tannoy *Autograph* is not a fool.

The same is true of the Vitavox Klipschorn with its exceptionally powerful horn-loading, regarded by some as the last word in loudspeaker design. They are, however, even more expensive, both of them; and in any case I am not necessarily urging everyone to rush off and buy any particular loudspeaker. I have simply adopted the Corner Ribbon as a standard which can be logically accepted by those in search of the highest fidelity. Beyond that, we all have to make up our own minds, aided of course by the living evidence of our ears.

The great service provided by Tannoy is that they make possible an extremely high standard of reproduction at a wide range of prices. The top quality of Tannoy reproduction is similar to that of the Corner Ribbon. The delicacy and freedom from resonance is there, and the power-handling capacity varies with the particular enclosure selected. In the Tannoy range there are three enclosures, all in the medium-price group, that give what I believe to be easily the best quality of reproduction available for a similar cost anywhere today. The cheapest is the Canterbury which houses a 12-inch dual concentric loudspeaker; it gives a remarkably good account of itself, but a noticeable improvement can be obtained for a few pounds more by mounting the 12-inch unit in the 15-inch enclosure—the York. A little more expensive again is the Landsdown, which is not a corner enclosure but one designed to stand against a flat wall but still to use the walls as a continuation of its own loading. There are several loudspeakers about to-day in the medium-price category—£45–£65—but there are none known to me to surpass the Tannoys.*

The heart of all Tannoy assemblies is one or other of their dual concentric units—either 12-inch or 15-inch. The units are in effect two loudspeakers in one. By a design of fascinating ingenuity the core of the centre pole is bored out to provide a horn for a co-axial “tweeter” mounted inside it. There is a cross-over network within the single unit operating at 1,000 cps. The result is one of the few loudspeaker units which meets all basic requirements in a form compact, efficient, and inexpensive. The frequency range is

* And now also the GRF at £99 15s. 0d.

exceptionally wide, the distribution excellent, and the smoothness of response unexpectedly—to me—impressive. I say “unexpected” to me because quite frankly until Mr. Mordaunt brought one of the Tannoy units down to my home I had thought a ribbon unit essential for really top-class HF response, and also for the smoothness and delicacy I invariably look for. A direct comparison of the Tannoy system with my own ribbon speaker caused me to have unmistakable and immediate second thoughts. I am still not sure that anything can fully supersede the ribbon—at least anything in current use: there are rumours of electrostatic units in the embryo stage which may alter all our ideas on the subject—but I freely admit that the Tannoy concentrically-mounted HF unit made me think it might be so. What is certain is that, taking into consideration the cost factor, Tannoy wins hands down. Ribbons are extremely expensive and extremely tiresome to make and market, though I see that Kelly Acoustics, who have recently marketed a tweeter unit at £12 12s. 0d., seem to think otherwise. Perhaps some new means of achieving really efficient HF response will come along—as I say, it may be electro-statics—but for the moment Tannoy have as good an answer as reason could logically expect.

One great advantage of the Tannoy system is that, by mounting the two units concentrically, an almost ideal positioning of the HF and LF diaphragms in relation to each other is achieved. Nor is dispersion adversely affected as it usually is when two separate units are mounted co-axially. The polar distribution of the dual concentric 12-inch unit is -3db at 10,000 cps over 60 degrees, and for the 15-inch -4db over the same angle at the same frequency. At the time of writing there are, so far as I know, no units of any sort that give better figures and at the same time have a comparable response range. It seems logical, then, for the time being at any rate, to see in the various Tannoy units and enclosures the most satisfactory solution for a moderate cost, of the many and complex problems of loudspeaker design. The fundamental soundness of Tannoy principles is shown beyond all reasonable doubt by the performance of the big *Autograph* assembly which pro-

duces its outstanding results by means of a further development of those same principles.

So far all the loudspeakers we have been discussing work on what may be called the "direct approach" principle. In other words, the actual units are placed in front of the enclosures and the reproduced sound is radiated directly into the room in such a way that, however determinedly problems of dispersion are tackled, there is always a certain directional effect, especially of high frequencies. But there are other ways of mounting loudspeakers, and for many a reversal of the usual methods is the most satisfactory way of coping with the basic problem. What we may call the "indirect" approach is most ably carried out in the various enclosures designed and marketed by Mr. H. B. Davey of E.M.G. The Davey enclosures are designed so that the loudspeaker unit itself faces into a corner and uses the angle of the walls to achieve the widest possible degree of diffusion at all frequencies. The largest and most expensive of the Davey enclosures—the DCR 60—uses a 15-inch Tannoy unit in a high absorption infinite baffle enclosure of solid construction. The effect is certainly most impressive, especially with large orchestral and choral recordings. The bass response really shakes the floor—as it should—and the top, though less immediate than is customary with either the Corner Ribbon or Tannoy's own enclosures, is beautifully clean and clear. With solo instruments and solo voices I am not quite so sure. When Mr. Davey most kindly spent the better part of an afternoon demonstrating his units to me I asked him to play one of my favourite test records of Spanish *flamenco* music, and although the sound was very pure and realistic I had the impression, indefinable in part, that the voice and guitar were in the next café. On the Ribbon or the Tannoys I can easily feel, with this particular record, that I am actually present, almost rubbing shoulders with the spell-bound, utterly absorbed company. The difference was subtle but unmistakable. I happen to prefer the vivid presence of music in my own room; for others the illusion of slight distance lends enchantment to music. I am no more right than they are: it is a purely personal preference. For

those who like their music diffused and a little broader in outline, if less immediately vivid, a loudspeaker designed on the Davey principle will probably satisfy them most. The DCR 60 is an expensive unit, and, like all advanced loudspeaker systems, it needs ideally the highest class of associated equipment to make the best of its admirable power-handling capacity and its extremely clear response and separation. But Mr. Davey also makes the DCR 61 and 62 using 12-inch loudspeakers in basically similar enclosures, but at a considerably lower cost. For the best results the DCR 60 is indispensable; but for the impecunious the smaller units are by no means to be despised. As I say, for those for whom the maximum dispersion or diffusion of sound is the uppermost factor in a loudspeaker the premises occupied by Mr. Davey and his staff will repay intensive exploration.

Even the cheapest of the Tannoy and Davey units are, however, not within the reach of everyone, and no discussion of loudspeakers is even half complete without some tentative survey at least of the possibilities of good reproduction in a lower price range still. When the upper limit for a loudspeaker and enclosure is around the £30 mark the best results are obtained by a single moderate-sized and moderately-priced unit really well mounted. A start should be made on the basic assumption that with the inescapable limitations in mind the loudspeaker itself ought to be a good 8-inch or 10-inch moving-coil unit of the sort designed and made by Messrs. Goodman, Wharfedale, Whiteley and others. There are many such units to be had for a few pounds, and they are mostly excellent. The problem is to mount them economically so that they can give their utmost. Often the manufacturers of the loudspeakers themselves market sound, and not inelegant, enclosures specially designed with the characteristics of their particular units in mind. On the other hand, some firms, like B.K. Partners, specialize in making cabinets to house efficiently all sorts and kinds of loudspeaker units. One should in any case guard against falling for the popular assumption that if one cannot afford the very best one is likely to make the best of a bad world by going for a stan-

dard radiogram. As a broad principle the same results can never be obtained from a commercial radiogram at a comparable cost. I do not say that a radiogram cannot enter the authentic "hi-fi" field—the Decca "Decola" did it after the war; the H.M.V. Model 3001 does it to-day—but the cost is always, and must be, high. The "custom built" reproducer always wins the race for economy plus performance—that is, after all, one of the themes of this book. And the superiority of the individually selected and built gramophone is as marked at the bottom end of the price scale as it is at the top.

Any loudspeaker, cheap or expensive, has to be properly mounted if it is going to do itself and its makers justice. It is because the loudspeakers in commercial radiograms are seldom mounted with much thought or care for acoustics that the independent unit always—repeat always—carries off the rosettes. I am not grinding an axe for proof of the assertion is everywhere to hand.

I have to confess that as a cheap method of mounting cheap loudspeakers I do not think much of the popular habit of using a plain piece of flat wood as a baffle—a sort of cyclops in the drawing-room corner. I have yet to meet simple baffles—even expensively polished ones—which damp out resonances or provide audibly smooth reproduction of the kind regularly associated with "high-fidelity". As in the case of bigger units, a form of air-loading usually pays handsome dividends without necessarily wrecking one's bank balance. One of the best forms of intelligent but economical loading of an 8-inch loudspeaker is provided by the Rogers Junior Horn. This admirable unit houses a standard good-quality 8-inch loudspeaker facing upwards, so that the high frequencies are directed out through a small metal grille in the top, and the back of the cone is coupled to a simple but effective horn using the walls of a corner as reinforcement. It will be observed that the principles are exactly the same as those used for the mounting of big, complex, and expensive assemblies; and, as I have made abundantly clear on more than one occasion, I am in this book concerned in the first place with basic principles. The Rogers Junior Horn at £25 complete will undoubtedly fill

the void—often uncomfortably large—between pocket and ambition for a good many enthusiasts. Of course it won't hold the company spellbound where the Corner Ribbon or the Tannoy *Autograph*, or the Vitavox Klipschorn are the guests of honour; no one in their senses expects it to. Nonetheless, in homes modestly endowed but ambitious it is capable of making friends for itself.

Among other promising developments reported since I began to write, H. J. Leak and E.M.I. have introduced electro-static "tweeter" units of advanced design; and Mr. Walker threatens to supersede the Corner Ribbon with a wondrous machine employing electro-statics throughout the entire range.

I hope the foregoing notes, for they are no more, will help at least some people to solve some of their problems. The selection and purchase of a reproducer is an undertaking not to be dismissed lightly for most folk, denied unlimited cash. Usually a gramophone once bought has to do duty for years to come: expensive mistakes cannot be countenanced. With a little forethought, and attention to basic principles, most blunders and miscalculations can be, if not unreservedly avoided, at least circumvented.

There are, of course, a lot of birds inhabiting the spring air, all chirruping noisily. Some of them have told me wondrous tales of new loudspeakers based on fresh designs not far off; others bring cheerful reports of amplifiers, pick-ups, and, most of all, of top-class FM radio feeders. It is a thoroughly pleasant prospect, but we have plenty to go on with for the moment.

III

Assembly and Installation

A BRIEF NOTE here will suffice. Once the parties have been successfully brought together according to taste and temperament—not forgetting economic suitability—a marriage has to be arranged. Or, to stop being fanciful, the various components discussed in the previous chapter have to be properly coupled and housed in order that they may be comfortably accommodated in the home, and work to the best possible advantage in conjunction one with the other. Nor is this a mysterious, esoteric subject, comprehensible only to technicians and specialists. Indeed, on the technical side there is hardly one problem of assembly that would tax overmuch the ingenuity of anyone who can first read instructions and, having read, insert a plug in the appropriate socket. Everything is plainly marked—one has but to push the right plug into the right hole. No doubt there are some folk who are congenitally incapable of performing even the simplest mechanical operation—they are like my grandfather who throughout his life could never be trusted to change an electric light bulb without suffering either a shock or an explosion, usually both. However, even they, thrown up on the shores of twentieth-century technology, may not find intractable the contemporary gramophone, its operation, and even its assembly.

Perhaps this chapter ought really to be sub-titled, “the gentle art of wifemanship”. The man who buys himself a set of “hi-fi” components is living in ignorance if he imagines that his wife has said her last word once he has persuaded her that he ought to be allowed to raid the family budget catastrophically for that purpose. Imagine a man coming home laden with amplifiers, pick-ups, loudspeakers, and proceeding to litter up the place with all manner of contrivances. Banishment to the garage or the cellar at least would be his portion. Nothing annoys a woman more

than a maze of wire and plugs and incomprehensible bits of apparatus strewn here, there, and everywhere else around preserves generally and logically thought to be hers. Even a man who owns, or imagines he owns, a sanctum or lair of his own has to tackle fierce resistance before he is allowed to indulge his fancy unfettered therein

Of course, the manufacturers of radiograms of normal and accepted dimensions know this perfectly well—that is why they invariably wrap up their goods in nicely polished and expensive cabinets designed almost entirely to catch the female eye. Nevertheless, it is one of the basic laws—unwritten perhaps if not unrecognized—that large sums of money shall not be wasted on veneer, french-polish and fretwork in the building of a high-fidelity gramophone. Funds piped off for extravagant furnishings from the total sum available are always better expended on, say, a more advanced amplifier or a better loudspeaker. The heart and substance of the reproducer should always come first—the rest is for the most part nothing but waste. Fortunately, the solution is not really far to seek. A little ingenuity and an eye for the main requirement will work miracles and disarm a housewife.

The loudspeaker, being housed in its own enclosure, will generally look after itself. It will, if it is decently designed and functionally worth its place, occupy a corner of the room reasonably unobtrusively. Most good loudspeaker units are housed in plain, sturdy enclosures of polished or painted wood. They arrive, so to say, all of a piece, and unless they happen to be exceptionally large, they absorb themselves easily into most general furnishing schemes. They are seldom the real problem.

The trouble usually starts with the housing of the amplifier, the motor and pick-up, and the radio unit. Untidy folk often leave these lying about on tables or on the floor, where, to speak plain truth, they are happy and accessible if not ornamental. All the same, this is not the recommended method of installation in a well-ordered household. It leaves the entrails of the gramophone too ready prey to the enquiring fingers of children, maids, inquisitive uncles, and all other unauthorized persons. Curiosity is a virulent

human failing—and the frequent result of the “bench” type of assembly is sudden damage to the exposed components, usually expensive and complicated.

It is therefore more or less essential to give these working parts some sort of substantial housing of their own. By far the best way out is to use an old radiogram cabinet. Often enough one of these can be found lying around neglected and forgotten in the lumber-room—either one’s own or that of a friend or relative—a handsome enough piece of furniture admirably suited to the purpose. Or a search among the back-rooms of second-hand dealers may not prove unfruitful. There are usually ways and means, provided one knows exactly what one wants. Such a cabinet is undoubtedly the simplest and most effective answer to one’s need. It will require little adaptation, the size will be about right to accommodate the motor board, it will be properly ventilated, and a cut-out for the pre-amplifier or tone-control unit can generally be arranged in the most convenient position. Also a tight-fitting and well-lined lid—still a necessity in spite of vastly improved pick-ups and record surfaces—can be confidently expected. All in all, therefore, the discarded radiogram is as likely a source as any other of satisfactory housing for one’s new and jealously-guarded equipment.

Failing a disused radiogram, it is often possible to find either around the home or in the sale-room some piece of furniture that will, without overtaxing either skill or pocket, lend itself to conversion. That curious what-not bequeathed us by our respected and lamented maiden aunt, which, as like as not, we have for years been wondering what on earth to do with; or that pretty little piece we picked up somewhere just because we happened to like it; a sideboard or something else with cupboards that remains elegant but used only for the the storage of junk—all these may be called into service without either wrecking the piece itself or impairing the efficient functioning of the equipment. As I say, a little thought taken along the right lines will make many rough places smooth. Before I was given, by a friend who had finished with it, a handsome pre-war H.M.V. cabinet, I stored my own equipment in an ordinary

built-in cupboard in the corner of the living-room. It was not ideally convenient, but it served adequately enough. It was certainly preferable to new cabinet work, heavily expensive and subject to purchase tax. At a pinch the main amplifier can be hidden away in all sorts of queer places—even under the bed. Where there's a will there's a way, is an old saying, and a very true one.

Wherever and however the apparatus has to be kept, a satisfactory arrangement can usually be contrived, provided one or two basic rules are observed. In the conversion of other pieces of furniture not normally designed for the purpose, it is wise to see that some form of ventilation is provided. Cool air should always be allowed to circulate freely round the amplifier and the motor. It isn't necessary to contemplate boring huge holes in a pleasant piece of woodwork, nor need the question of air-conditioning be allowed to become a bane. If, for example, the amplifier is kept in a drawer or a small cupboard, open the drawer or cupboard when the amplifier is in use. And, as far as possible, avoid suffocating the motor. Some modern motors run naturally at a high temperature, and nearly all of them function best when they can breathe a little fresh air. It is also advisable to see that the motor and pick-up assembly is in a reasonably convenient position for operation. Nothing is more infuriating than a playing desk situated where one can't properly get at it—and nothing causes quicker damage to valuable records than a pick-up that gets knocked across the grooves, something that is always liable to happen if one has perpetually to plunge one's hand into some dark hole where there is neither adequate light nor sufficient elbow room.

As a general principle, keep the leads from the pick-up to the pre-amp. as short as possible. Again, there is no need to be pedantic about it; but reasonably short leads are always desirable. The makers of high-class amplifiers invariably arrange their equipment in two separate units. And they do so for very good reasons. The main amplifier is often comparatively bulky, but the pre-amp. or tone-control unit is small, compact, and easy to mount almost anywhere. Thus the main amplifier chassis can be con-

cealed away in the bowels of the cabinet—since there is no reason for it to be accessible—while the pre-amp. can be brought up on its multi-core cable to any position convenient for daily operation. This fact alone enormously relieves the problems of accommodating the apparatus in cabinets not specifically designed for it.

The pre-amp. may be mounted either inside or outside the doors or lid of a cabinet: there is no particular preference; mostly it will depend on dimensions and convenience. An external mounting means that the controls can be adjusted without frequent openings of the lid with the consequent danger of jogging and therefore of causing the stylus to jump the grooves causing unpleasant noises and material damage. An internal mounting keeps the knobs away from inquisitive fingers and may often be preferable from the point of view of appearance. On the whole, I am inclined to favour a mounting alongside the motor board, for the sake of neatness and because frequent fiddling with controls is not the best way of enjoying music.

Where a radio tuner is included, it too should be mounted on reasonably short leads, unless a system of remote control is required and available. It must also be placed so that it won't interfere in any way with the pick-up by inducing hum. Some of the modern low-output pick-ups are extremely sensitive to hum, and a little experiment is sometimes needed to see that their transformers are so positioned that no field hum from the motor, the main amplifier, or the tuner is picked up. It should always be remembered that a pick-up is intended to pick up only the sound waves impressed on the record surface: all other and extraneous noises have to be banished. It is mostly a question of positioning—a shift of a few inches will usually do the trick. Modern amplifiers are entirely hum free, so that if there is noticeable hum after complete assembly the cause must be sought in the relative positions of the various components and the leads. For example—a pick-up lead that passes directly underneath the motor is asking for trouble; so is a mains switch too near a transformer or a pick-up head. Small details no doubt, but the sort of things than can cause endless trouble and anxiety if not attended to at the outset.

I have said earlier that the loudspeaker will usually look after itself. I am assuming that one of the standard made-up units is used. About all that is necessary is to ensure that the enclosure is so placed in the room that it has proper freedom to function efficiently—here again a little experiment will show how best to position it—and does not suffer congestion by being hidden behind large pieces of furniture. If a loudspeaker assembly has a bass port near the ground it is obviously beyond all sense or reason to install it behind a large sofa or armchair which will merely absorb the bass frequency waves.* The theme song of any loudspeaker unit might well be “Don’t fence me in”. All impedimenta between the loudspeaker and one’s favourite chair should be kept to a minimum and should never be in the nature of absorbent soft furnishings. If one’s command of the art of “wifemanship” is good a shot at a little rearrangement of the furnishing scheme might be contemplated with some hope of profit.

There is an old country saying that there are more ways of killing a pig than by choking it with butter. There are even more ways of installing high-fidelity reproducing equipment, and loudspeakers in particular. One needn’t, of course, go as far as the man in California who sent his wife away for a fortnight so that he could rebuild one entire end of the house to contain built in to the walls a vast and complicated loudspeaker system; or another American who took over the cellar and then proceeded to bore a vast cavity reaching far out under the garden to accommodate the business end of a colossal horn. These borings and excavations can well be left to those with a taste for performing even the simplest of operations in the grand manner. Nor need it be assumed that essentially better results can be logically expected by these means. As I hope this chapter—indeed, this whole book—makes reasonably clear, the installation of a “hi-fi” gramophone system is

* This is even more true of high-frequencies, since these are more directional, owing to the shorter wavelengths. However, since the H.F. unit, at least in a multi-speaker assembly, is usually placed fairly high in the enclosure it is not so likely to be smothered by pieces of furniture.

neither hideously complex nor impossibly expensive. The gramophone is intended for the home—it should be easily accommodated therein. For the fanatical perpetrator of hugely intricate “sound systems” the Americans have one of their own graphic and descriptive terms. They call him, or her, an “audio-hobbyist”.

As a final word, and perhaps, cautionary note, let me repeat that the object—the whole cause and *raison d'être*—of the gramophone is to provide music in the home as naturally and as realistically reproduced as possible. One's living-room is the right place for it, so that one can pursue a civilized enthusiasm in a civilized way. Shivering in the garage is no proper substitute for the domestic hearth, even though it may mean that bits of apparatus and all manner of extraordinary contraptions can be arranged without thought for appearance. There is no earthly need for it. Modern equipment is sensibly designed for home use; no part of it is so immense or so undecorative that it need suffer banishment from even the best-arranged drawing-room. The moral, therefore, is clear—see that your equipment is decently housed and properly arranged; and then enjoy it in comfort. All the same, don't waste money on expensive and unnecessary cabinet-work. Take thought and look around; and with the money saved—buy a better loudspeaker.

IV

The Care of Records

SO FAR nearly all our attention has been directed towards the problems of record reproduction and the electronic equipment necessary for that purpose. Little or nothing has been said about the records themselves. But since the finest gramophone in the world, either actual or potential, is useless without records made according to the highest standards of contemporary technique, and preserved in good condition over prolonged periods of time, it is as well to pause for a moment to consider the general care and treatment of modern records. In spite of a deal of vigorous propaganda on the subject, I doubt whether the average buyer and enjoyer of gramophone records fully realizes even yet the astonishing difference between a record that has been properly cleaned and cared for as it were from birth, and one that has simply been left to take its chance in the world. If we remember that a groove error of a millionth part of an inch in the shape of a 10,000 cps wave-form can completely ruin the tonal fidelity of a record, it shouldn't overtax imagination to understand what a secretion of dust and foreign matter over the record surface can do by way of rendering void the ministrations of the recording engineer and the designer of amplifiers and loudspeakers. It can therefore be regarded as axiomatic that the highest quality of reproduction depends as much on clean, scratch-free, and unwarped records as on anything else in the whole chain of operations. I am speaking, of course, principally of Long Playing records; but there is still no good reason why 78s should not also be treated with a certain elementary respect and foresight.

The care and protection of gramophone records can conveniently be divided into three separate departments or categories—storage, handling, and cleaning. There is no order of preference: all three aspects require equal attention

if much dissatisfaction and consequent fraying of patience is to be avoided.

Take storage first. Since the light, flexible long playing record came into general circulation the whole problem of record storage has been enormously simplified for those who normally live in domestic conditions limited in space. The problems of storing satisfactorily a dozen or so symphonies, the same number of chamber works, a few complete operas, and some oddments, were in the old 78 days distressing and often brain-disturbing. Nowadays there is scarcely any problem at all: four or five times the amount of music can be easily tucked away in a quarter of the space. But it is even more essential now to ensure that wherever and however they are stored or stacked one's pet records suffer no material hurt to shape or surface. Once an LP has warped even imperceptibly there's not much hope for it. Perhaps it can be boiled down and remoulded as a flower-pot; but home-made flower-pots at 36 shillings a time are expensive. So a little thought expended on finding a satisfactory permanent habitation for all one's records is well worth while.

There are, broadly speaking, two good and reasonable ways of storing records. The first, and probably the most universal and convenient, is to stand them upright in properly constructed shelves. The operative word is “upright”. Record shelves should have rigid divisions not more than four or five inches apart, and each compartment should be kept full enough to ensure that no record leans dizzily to one side, but not so full that furious efforts and diggings with impatient fingers become necessary to extract them. By and large all records should be so stored that they will almost stand by themselves balanced on their bottom edges. Excessive tightness or wobbling looseness should be as far as possible avoided.

The other, and most comprehensively thoughtful method is to store records lying flat with several sheets of newspaper—or better still, blotting-paper—between each. This way is particularly valuable in intemperate climates. Each pile should not be more than six or eight records thick, or deep, and all records should be the same size. On no account should

records be left lying around in haphazard piles of twelve-inch, ten-inch, and seven-inch all mixed together, grating each other's edges. Nor should any record be put down at all, let alone stored, on a surface that is not absolutely flat—plate glass is the ideal—nor should they be parked on the turntable so that the centre spindle can push dents and inprints into the surface, even through the sleeve.

Most records to-day are supplied in cardboard containers or "sleeves" inside which they live in further protective bags or envelopes made of thin tissue. Some impatient folk throw out these inner coverings at once and without hesitation, largely because unless one knows the trick the re-insertion of the record in its tissue into the outer sleeve can be an operation of infinite frustration and annoyance. All the same, to protect those delicate surfaces both coverings ought to be kept in permanent use. We are all, no doubt, familiar with the crumplings and tearing of the fragile envelope that won't for all our coaxing and cajoling slip easily into the sleeve, at least not after the first three or four usages. But there is a method of carrying out this irritating but necessary operation. All that has to be done is to put the record in the envelope, fold the flap over firmly, turn down the top leading corner, and then slide it into the sleeve with the flap either at the bottom or the top, but never so that it trails and so catches and tears on the lip of the sleeve. The turned-down corner gives the proper start; after that insertion should be both smooth and painless. The retention of the thin inner covering prevents the record surface from suffering damage as it passes the hard lip of the cardboard sleeve; it also helps to keep thumbs and finger-nails off the grooves.

In the matter of handling it is essential not to pass over the record surface anything sharp, rough, or greasy—including the afore-mentioned thumbs and finger nails. LP records find enough ways of their own of getting scratched and smeared without careless hands, buttons, cigarette-ends, and tie-pins helping them on their way to self-destruction. I sometimes wish the manufacturers of records wouldn't quite so loudly advertise their excellent products as "unbreakable". True, it may not be easy to

destroy them by fracture or fission—but from the point of view of mutilation of surface they are susceptible beyond the dreams of any of the old 78s. To expect a voracious and not technically-minded public to understand the subtle differences between one sort of damage and another—between, as it were, fracture and abrasion—is stretching optimism altogether too far.

I come lastly to the question of operation, or, as some might aver, the ritual, of cleaning. In the old days it was generally conceded that a good brisk rub with a record cleaning pad did no harm now and again. But those who would never play any record without the determined application of pads and brushes were usually regarded as eccentric, if comparatively harmless. To-day, however, the position is different. Effective cleaning is essential, and certainly no judgment ought ever to be passed on any LP that hasn't had its face washed with a scientifically prepared flannel.

The materials on which modern records are pressed—vinyl and geon plastic—build up a charge of static electricity and in the process become highly adductive to particles of dust, fluff, tobacco ash, and any other substance floating around in the air of the room. The truth of this assertion can be easily verified. Take a piece of fluff off the carpet or one's coat and hold it lightly in the fingers underneath an LP record: it will leap at the surface and stick there with a quite astonishing tenacity. Or leave a record on the turntable all night—in the morning it will look as though someone has emptied the vacuum cleaner over it, even though one's house is normally regarded as clean and tidy. There are other tests—they need not be detailed: the phenomenon is generally accepted and should be acted on.*

Most record companies print a note on their sleeves advising a barely damp cloth as the best cleaning agent. No doubt the method is just about adequate, if one habi-

* Many readers will remember the old school-boy trick of rubbing a fountain pen on one's sleeve and then using it as a magnet to catch little bits of paper. The rubbing generated a charge of static electricity; exactly the same thing happens with an LP record.

tually keeps damp cloths around the house. A far better way is to use one of the special preparations on the market which have been scientifically devised for the purpose of record cleaning. There are several about, and most of them are efficient. Messrs. Rimington van Wyck make both a plastic sponge and a cleaning fluid—Fredorec and Clendisc—both of which are admirable; but perhaps the best cleanser now available is a small piece of impregnated tissue made by E.M.I. and sold under the name of Emitex. The great advantage of Emitex is that there is no fussing with taps, bits of cloth, and bottles. No one wants to go dashing off to the kitchen sink every time a record is played, and bottles tend to get knocked over. Emitex, which can be bought for eighteen pence in a sheet sufficient to treat around 100 LP twelve-inch sides, can be kept in its little plastic bag anywhere handy and can't make a mess or do damage if it gets mislaid. Emitex efficiently takes the static charge out of records, and its effect lasts about six months. The record when treated should either be played through at once *or* left to "cool" for three or four hours.

Whatever preparation is used, there is no possible doubt that proper cleaning of records not only preserves the surfaces and does much to prevent scratches and smudges doing lasting harm, but also improves the quality of reproduction, in some cases almost out of all recognition. I have recently carried out some exhaustive experiments with treated and untreated records, and in no case have I failed to find a general improvement in tone and clarity with the former. I wish to emphasize this point, because the whole difference between a satisfactory and an unsatisfactory pressing can often be accounted for in terms of dirt, grit, and improper deposits.*

I hope I have not frightened anybody by raising unpleasant bogeys and complications in this chapter. But often a large sum of money is locked up in private record libraries, and I have become more and more convinced that full

* The real answer is, of course, as Decca have pointed out to me with some force, the invention or discovery of a basic non-static material for records. Larger wonders than this have been given to us in recent years.

value can only be extracted from prolonged listening to records if some initial attention is paid to their proper care and handling. I don't want to be unduly fussy; certainly I don't want to make the pleasure of record playing seem beyond the endurance of normal patience and philosophy. But we are concerned with a scientific process working in the service of man's genius and imagination, so that a little time and a few shillings a year expended over details cannot by any reckoning be called wasted. I was once a sceptic myself; but the proof of the pudding is in the eating, and the wise and appreciative diner doesn't flout the advice of his cook. At least he doesn't spoil the meal by economizing on the sauce.

V

On Playing Old Records

THE ILLUSION still persists that the modern high-fidelity gramophone, although capable of giving splendid results with the best and most up-to-date recordings, is on the whole an unsatisfactory piece of apparatus when it comes to coping with old and sometimes worn, or primitively-made, records. It is an illusion fostered in some very illustrious quarters, and its continued circulation does nothing to help the general quest for higher standards and a more encouraging approach to the problem of record reproduction in general. No one in their senses supposes that the invention of new bits of machinery renders valueless the whole output of the recording industry prior to the day before yesterday; and although it may be regrettable, it is undeniably true that many of the greatest executant artists of the present century did not arrange to live their lives and grace the world with their artistry during the past decade or so, when recording technique came to the threshold of its contemporary luminosity, extended frequencies, astonishing dynamic range, tonal truth, and the rest. A catholic taste in music and a liberal approach to the use of the gramophone as a servant of that taste means inevitably that one's reproducer must be able to handle all sorts and kinds of records, even those which to-day appear primitive and almost pre-experimental from the point of view of recording technique. And I mean, of course, not only those records made since the introduction of electrical recording round about 1925, but also those old acoustical discs which enshrine in their rough and irregular grooves the priceless legacy of an age that has gone, especially when it comes to singers and singing.

I make this point because under the modern eruption of technical advancement there is a tendency for the avid pursuer of "hi-fi" reproduction to reject out of hand all

records that don't revolve at speeds tantalizingly slow and possess surfaces smooth and glossy and ready to co-operate with the stylus point without the need for complicated means of persuasion. Many collectors have already thrown out their 78 r.p.m. libraries *in toto*; no doubt many more will do so in the future. But, if we are to be honest about it, such an attitude is more that of the fanatic than of the musician. In the wise and moderate words of the compilers of *The Record Guide*, still true after more than five years of hectic recording progress: "Some fifty years of musical history is locked up in these normal speed records; and the last twenty of these fifty years (from about 1930 to 1950) is represented, for the most part, by recordings of a high technical level. It would be grossly Philistine to jettison these frequently splendid artistic achievements merely because a more convenient or technically preferable replacement exists or can be expected to appear. Music is more than a matter of high frequencies and the latest recording technique; it is a matter of individual, and therefore irreplaceable interpretations." Exactly: and since many of these "irreplaceable interpretations" were endisc'd before the days of LP, it follows that the intelligent user of the gramophone will not scrap them wholesale for the sake of a mess of revolutions and an endless tintinabulation of high frequencies.

It is true that many of the older recordings are being issued in LP transfers: none the less, however carefully the job is done and the selection made, it is beyond the bounds of logic and reason to expect that every pre-war recording by the great ones of yesteryear will eventually turn up shining and luminous in the latest technical format. In order to make the best of the gramophone's biggest blessing—the freedom of individual selection both of music and of performer—a passport to the kingdom of the 78s will always remain essential. Only when mechanics take precedence over music shall we be able to sit back complacently on a pile of undiluted LPs. I am not being merely obstinate and "reactionary"; I am simply arguing the musician's case. It behoves us all, therefore, to see that our gramophones are fit to cope with the treasures of the past, as well as to bear

full and lasting witness to the high quality of the best records of to-day and to-morrow.

To those who grew up and formed the habit of record buying in the years before LP came galloping over the plains like a lithe young thoroughbred much of the above will no doubt seem like a wilful labouring of the obvious: to them I apologize. But there is a newly-grown generation of record buyers, the largest and most avid yet known, who knew not what hidden beauties were roughly concealed in those myriad shellac grooves; what imperishable treasures of singing and playing and conducting would be lost for all time but for the old records. They are naturally absorbed with new wonders and the modern techniques that have opened to them ever more glowing ways to the enchanted gardens of music. There are also many collectors of vocal records from the so-called Golden Age who have no intention of abandoning their pleasure and their hobby in the face of the presumptuous newcomer; and rightly so. Some guidance on how to deal with old treasures on new machines may therefore help to clear up many a misunderstanding which tends to hamper enjoyment and cause an unnecessary frowning of the brow.

I propose, therefore, to start from the assumption, based on personal experience, that the modern "hi-fi" gramophone, far from making a general hash of ancient but honourable discs, can in fact, and with little difficulty, be made to draw from them musical sounds of a beauty and faithfulness hitherto unsuspected. I am aware that this assertion goes flat against one vociferous school of thought and criticism. None the less, I have frequently proved to my own satisfaction, and will prove to anyone else who cares to listen to me, that it is indeed so. The modern advances in design of amplifiers, pick-ups and loudspeakers, far from knocking permanently on the head all pre-1939 recordings, have actually done a good deal to reinstate them in the eyes of those who seek pleasure and refreshment of spirit from recorded sound.

Frankly, so far as the average recording from 1930 onwards is concerned, there is very little problem at all to-day. Most designers of modern amplifiers incorporate

in their tone-control circuits an efficient filter and flexible independent bass and treble controls. And with these used separately or in conjunction, nearly all electrical records of whatever date can be satisfactorily played on any equipment, no matter how extended its response range. For the most part the filter working by itself is sufficient: just occasionally a piece of bad balance or an internal distortion below the range of the filter needs to be adjusted by the treble attenuator. If after that the record still won't co-operate, then the cause is almost certainly in some irregularity in the groove sizes. This is another problem altogether, and is probably the crucial one when it comes to dealing with records of the pre-electric era.

I repeatedly play pre-war recordings of all types on a gramophone designed on the lines indicated as the best available in my previous chapters; and in no case have I failed to notice an actual improvement in the quality of sound as compared with the results obtainable from a gramophone of the same vintage as the record. The absence of resonances in modern loudspeakers, and the far greater sensitivity of modern pick-ups enables us for the first time to hear all that really was contained in those old grooves. It is often an illuminating experience.

When it comes to the satisfactory reproduction of very old records—and by that I mean principally vocal records of the pre-electric age—the problem is a little more difficult, almost entirely because in those days groove sizes had not been standardized, and the tendency of the sapphire or diamond stylus point to fight an unequal battle with a wildly irregular groove produces distortion most discomforting.

Let us examine this question of groove sizes for a moment, for it has not yet received its due attention from those who regularly deliver themselves of opinions on matters gramphonic.

In 1936, the root groove radius of all E.M.I. records was $\cdot0025''$, and of Decca $\cdot002''$. Subsequently both companies reduced their radius to $\cdot0015''$. This, of course, applies only to 78 r.p.m. records: all LPs have a root radius of $\cdot00025''$. In effect this means that most pre-war records have a root

radius of $\cdot002''$ to $\cdot0025''$, and a stylus point radius of $\cdot0025''$ became accepted as standard, and is still so to-day, although some makers produce a slighter, finer point. It will thus be seen that if the point radius is the same as the groove radius—i.e. $\cdot0025''$ —the point will ride almost on the bottom of the groove, but will still be held firmly by the walls. Ideally, the point should ride a little way up the walls for the best results, since the sound waves are impressed not on the bottom of the groove but on the walls. If the point presses heavily on the root of the groove, distortion will immediately begin to assume alarming and often unmanageable proportions. And it is precisely here that we begin to understand the problem of very old records, where the groove radius was not standard and was in fact frequently a good deal larger than $\cdot0025''$. The result is quite obvious, though highly uncomfortable for all concerned: it means nothing less than that the point of the stylus tends to skate about the bottom of the groove, producing a violent increase in surface noise and, by failing to make proper and continual contact with the walls, and therefore with the sound-wave formations impressed thereon, distortion in reproduction. It is because the problem of groove sizes is still not properly understood by the average user of advanced gramophones that the difficulty of playing some of these old records is regarded as almost too severe to be worth bothering with. For a groove size which is substantially out in relation to the reproducing point cannot be corrected by the tone controls, since the fault is mechanical and not electronic. It is also the reason why some old records play perfectly well while others of the same vintage and in apparently the same condition are not so much difficult as impossible.

In the old days this problem did not arise because the old soft steel needles quickly adapted themselves to any reasonable groove size by a simple process of wearing down of the point. With fibre or thorn needles, of course, it was even simpler, because their points wear down even more quickly. It was when the permanent point, sapphire or diamond, came into general use that the trouble really started. A permanent point retains its original shape until it begins

to wear out altogether: in other words once a sapphire has developed a “flat” it has to be rejected and replaced or it will merely chew up the grooves and spit out the bits. There is thus no direct solution to the problem of a non-standard groove size meeting a standard permanent point. Evasive action has to be taken if large numbers of these old discs are to be played on a modern gramophone.

Fortunately for the man who is wise enough to build up his own reproducer from independent components the solution is not far to seek. It is true that some manufacturers produce a sapphire with a larger radius—usually .003”—but this is not the real answer, largely because both the shape and the size of the grooves may vary, and only a comparatively soft point—steel or thorn—can cope satisfactorily with the problem. I have myself experimented with the .003” point in its own head produced by the makers of the Connoisseur magnetic pick-up, and, while a decent improvement on many sorts of records can be confidently expected, the retention of a point with a permanent size and shape goes only half-way towards meeting the basic requirement.

The only real answer for the man who wants to play large quantities of old records is to incorporate in his reproducer a second pick-up. There is no difficulty and less mystery about this. All that is required is a variable speed 78 r.p.m. motor fitted with a modern light-weight pick-up that will accept miniature steel or thorn needles. The whole appendage can be assembled and mounted for a few pounds, or even less if some burrowing in the stocks of second-hand dealers is undertaken. Often an old playing-desk can be picked up for next to nothing, and two or three pounds will buy the right pick-up—say the E.M.I. No. 12. It is also possible to buy more expensive pick-ups—such as those made by EMG or Expert—which are specially designed for thorn needles: the choice can conveniently be left to the needs of the individual user. But whatever precise piece of equipment is selected, the procedure for installing remains the same. The motor and pick-up can either be mounted in the main cabinet alongside the normal unit and connected to the pre-amp. by means of a

simple two-pole change-over switch; or it can be left as a separate self-contained unit in its own box and then connected up in the same way, except that now, for the sake of convenience, the lead from the change-over switch should be fitted with a small plug to accept the leads from the pick-up on the secondary player. In either case the operation should not greatly tax the ingenuity of anyone capable of operating a gramophone at all. In both cases, of course, the change-over switch operates between the two pick-ups. Thus at the turn of a switch either pick-up can be used at will, and so long as they are both properly equalized the user will be in the happy position of being able to play the latest LP and his favourite old Caruso or Scotti with equal, if not complacent, satisfaction.

I have described what I believe to be the answer to the problem of playing very old records because I have more than once encountered exactly this difficulty, and also because the collection of old vocal records seems to be a flourishing pastime. I wish to emphasize that the solution is both easy and cheap: I also wish to deliver a counterblast against those who cannot or will not cease their agitated vocalism on the subject of the modern gramophone's alleged limitations. The moral is simple: if you want to play a lot of old records, avoid hard permanent points. Nothing is more distressing, for the point, the record, and for the listener, than a groove and a stylus that are not properly equal and opposite. There is a good deal of luck about the whole business: many old records—really old ones I mean—are perfectly happy with the standard .0025" point and a modern amplifier with a comprehensive tone-control unit. But some won't come right at all until a different point altogether is substituted. As I say, no one need go grey overnight if results show that a second pick-up is required.

Before the war records were made with a theoretical cut-off at 6,000 cps. However, it is a mistake to think that all pre-war records should be played with the filter set rigidly at 6 k/cs. sharp. Often records don't listen to theory, and provided the surface noise is not excessive a little extra can be given of life and vitality by opening the filter out to 8 or even 9 k/cs. One's own ear rather than theory should

be the final guide, and to assume out of hand that no record can be extended in response at either end of its theoretical cut-off is emphatically not the best way to perpetuate one's musical enjoyment. A little flexibility of mind as well as of equipment is needed to get the best out of any gramophone worth its salt.

Before I conclude I think I ought to say a word on the subject of “fibred” records purchased second-hand. For my own part I have always found these to be on the whole the most devilish of all records to reproduce happily. There is no doubt that fibre or thorn needles do inflict very little obvious physical damage on the record grooves: they do not cut or tear as steel often will, especially in clumsy pick-ups; and if their frequency response is suspect, that is not always too serious where old records are concerned. Unfortunately, however, they leave a deposit on the grooves, tiny particles of themselves rubbed away in the course of much protracted friction, and this deposit causes a sharp increase in surface noise when it comes into contact with sapphire or diamond. It is a sad paradox that thorn needles, rightly prized for their low surface noise, utterly wreck the surface for subsequent use with other points. And since the increase of hiss, scratch, and general steam-kettle effect, is well within the musical range, it cannot be eliminated except by eliminating also much of the music. Again the moral is simple. Records exuberantly advertised as “fibred” should only be bought if it is intended to continue using fibre needles. That way complete satisfaction is assured. But the user of a diamond who buys a set—“fibred” and therefore blameless—will as like as not be provoked to torrents of blasphemy by a surface intrusion that no filter will remove or treble control attenuate.

I hope the sellers of second-hand records will not think I am aiming unkind shafts at them. They perform an excellent service; and their goods are no doubt beyond reproach. It is simply that fibre and diamond (or sapphire), like whisky and champagne, just don't mix. I fancy that much of the slander directed at the high-fidelity gramophone in connection with old records may well arise from just

this trouble. My point is that the "hi-fi" gramophone will play, and play better than anything else, any record that hasn't been previously mutilated and which has grooves of a size within the accepted limits of tolerance. To expect anything else is merely error and vanity. But, as I have, I hope, made clear beyond the possibility of any incomprehension, there is a simple remedy at hand for anyone who is permanently addicted to fibres, old masters, or, indeed, any other form of gramphonic antiquarianism.

VI

The Record Reviewer

AS THE FLOOD of new recordings increases month by month, so does the task of record reviewing and criticism become more and more important for the buyer of records, especially for those who do not live in or around London and cannot, therefore, spend hours without number hearing for themselves how Nixa's *Don Giovanni* compares with H.M.V.'s; or how Decca's *Meistersinger* fares alongside Columbia's; not to mention which of the half-dozen or more versions of a Beethoven or a Brahms symphony turns out best under various conductors and various recording engineers. Never has reliable guidance been more essential; for with LP records at not much under two pounds a time a bad buy is expensive, and nothing is more likely to induce sullen ill-temper in those who habitually live blameless and unflurried domestic lives than a sudden loss of hard cash, and disappointment into the bargain. The record critic is, as I say, becoming an increasingly formidable figure in the land—a V.I.P. almost. Therefore it seems fitting that a book devoted to the reproduction of gramophone records should make a gesture at least on the side of elucidating something of the reviewer's problems and also of the basic requirements needed for efficient criticism if the critic is to serve faithfully the public interest—I almost wrote the public safety.

I confess that I approach this subject in some trepidation: I am a reviewer myself, and dog, they say, does not bite dog. None the less, our particular kennel is full of hungry beasts, if not thirsting for blood, then at least permanently on the lookout for trouble; and if I occasionally give one or two of my colleagues a playful nip here and there, I hope at least that I shan't be accused of making a meal of anyone. Taken all round critics aren't really the spiteful, bad-tempered, brooding lot they are

popularly thought to be. The idea that the critic is one who sits sternly aloof aiming barbed shafts at poor mortals who come before them is not necessarily true. All the same a healthy current of criticism demands and postulates a certain minimum of variegated argument among the critics themselves. If opinion were unanimous there wouldn't be much need for critics at all. It is the private crossing of swords as well as the public oratory that makes the task of criticism worth while for everyone, and not least for its own practitioners.

In order to review and criticize records efficiently it is first necessary to have a gramophone. I make this somewhat elementary observation, not because critics habitually judge records by the picture on the sleeve, but because there exists a fierce cleavage of opinion, apparently unbridgeable, on the type of gramophone a critic ought to use. Or to put the thing in its most usual form: should the critic rely on the evidence of a complex, technically advanced, and genuine high-fidelity reproducer; or ought he, because such a machine is still thought, rightly or wrongly, to be the preserve of either the specialist or the idle rich, use only such a gramophone as is most likely to be found by the domestic hearthside of that ubiquitous but elusive being "the average man"? The question obviously harbours in its vitals a fundamental principle. It is also one that needs sorting out if the general reader of musical publications is to know where he stands in relation to his professional mentors and guides. One or two record magazines have adopted the sensible policy of publishing details of their reviewer's equipment, so that their readers will know what to expect.

Because of the growing importance to the record buyer of reliable and comprehensive reviewing, and because really high-class criticism can do much to improve and maintain standards both of recording and of reproduction, I wish to make clear at once my own conviction that the practising record critic ought to use only the best equipment available—or what he believes to be the best. It is only fair that he should stand in judgment only after listening to a gramophone that makes at least a pretence of being noble

and lordly of lineage—fair to his readers, to himself, and, perhaps most important of all, fair to the recording engineers. No doubt the argument that reviewers should confine themselves to “average” machines for the benefit of “average” folk sounds sweet enough on the surface, but under the pressure of analytical scrutiny it is, unfortunately, found to leak. Indeed the whole of responsible criticism would founder hopelessly were it to be generally accepted that the “average man’s” gramophone was the only true standard of reference. It might just as well be argued that the record companies needn’t really trouble to chase elusive frequencies and an ever greater faithfulness of tonal quality because the “average man” won’t be able to hear the difference anyway. It is the critic’s job to give his own individual reaction to what he hears, regardless of the limitation of this or that reader, and in the light of his own training, experience, and sensibility. He should be in a position to give reliable guidance both on the subject of musical performance, and of recording technically considered. And he can do that only if he is equipped with a gramophone capable of revealing comprehensively the inherent virtues and defects, in some detail, of the record under review. In other words, when dealing with a high-fidelity recording a high-fidelity gramophone is absolutely essential. The word of any critic who argues a preference for the small “average” gramophone should never be trusted on matters of recording, no matter how brilliant and penetrating may be his observations on the music itself.

The view that the reviewer or critic should be satisfied with a modest reproducer might be more convincing if the characteristics of all “average” gramophones were the same. But they aren’t, not by a long shot. If all reviewers would seek out and regularly employ the genuine “hi-fi” machines only there might be less confusion in the minds of record buyers of the sort caused by frequent widely divergent technical reports on the same recording. A standard is essential in reviewing, as in all else, if muddle and perplexity are to be avoided at all. A top-class modern gramophone can usually be relied on to give a more or less exact account of what precisely is on the record: if a less exalted

machine covers up some of the sins, so much the better. But a critic who can't or won't discover for himself and report to his readers those faults—and, of course, virtues as well—is failing in duty and efficiency.

I have an idea that the argument about the average man and his possessions is a legacy of the days when most musicians looked upon the gramophone as a peculiar toy with an uncomfortable popularity but with little musical value. Some critics have never taken the trouble to acquire a decent technical knowledge of the basic principles and requirements of record reproduction—therefore they fall back on careless talk and “average” mechanics. Perhaps they have little aptitude for technicalities—if so they have my full sympathy; but they can't really expect to set up as-reliable guides on what is after all a highly technical scientific process. As I say, I am sorry to tread on the toes of some of my most respected colleagues in musical criticism; but I am here to serve the record buyer, and he, poor confused soul, relies much on the written word of the critics, inevitably. I have been often in the same position myself, so I know. The critic, if he is to have any value at all, has to become pontifical on occasion. But he can't really raise an honest finger in either praise or blame if he lacks the proper tools of his trade to hand. And, since we are at the moment concerned principally with music on records, one of these tools is a top-class gramophone, which must be used in conjunction with his inherent capability as a critic of music on the broadest basis. We shouldn't have much time for a record critic who was not a musician but only a clever manipulator of electronics: we ought also to look warily on one who reverses the state of knowledge, else all our striving towards higher standards of reproduction will be rendered vain and useless. It is as though a man were to write reports on motor cars solely from the passengers' seat.

The second big and persistent argument about record criticism is whether the critic should place more emphasis on music and performance or on the technical qualities of the recording itself. I have argued elsewhere,* perhaps against

* *The Gramophone Record Review*, April, 1954

myself in part, that music ought always to come before technics. By which I mean that the gramophone should always be regarded as servant of musical genius and **not** as an end in itself—a sort of magic box for the grown-ups. Even a poor recording of a great performance of a masterpiece is often worth time and trouble in order to get to the heart of at least some of the musical glory. That, fundamentally, is why our ideal gramophone must be flexible of control—we are not concerned only with faultless recordings; we have often to correct errors and immaturities of technique; we have even from time to time to cope with horrors like some of the Toscanini emanations in such a way that enjoyment of Toscanini does not entail permanent damage to the eardrums. Obviously, then, the critic has to balance one thing against the other: perfectionism is all very well and all very laudible—but it is a two-edged passion or hopeless longing in the record world.

The ideal, as we have already agreed, is great performance finely recorded, and nowadays we come nearer to our heart's desire more often than we dare to hope. But we have still to recognize the fallibility of technique and strike a balance in consequence. The ideal, as I say, is obvious; and if all records could be relied on to reach the standard of the best we shouldn't have much of a problem to argue over. None the less, as Dr. Johnson once remarked, sadly but with truth, “Man is not born to happiness”, and while we remain apart from perfection we have to erect our own hierarchy of values and speak as our hearts and our imaginations dictate.

Severed as we are from perpetual felicity, we are obliged to make the best of our world; and in order to do so we have to set standards of recording and performance side by side, not in opposition, but as complementary factors in our domestic musical enjoyment. The critic who has no good word for any record that isn't technically blameless will serve us no better than the one who blandly dismisses the whole matter of recording as no fit subject for the musician. The reviewer who will persist in telling us that this or that recording will or will not show off our pet reproducer is hardly to be borne with at all. We are not interested in

using Beethoven or Mozart or Brahms as a show piece, although we shouldn't grumble if they happen incidentally to lend their genius to a demonstration of frequency response. It is all a matter of putting first things first: we want fine music; we also want fine recording; but we have constantly to recognize that the living qualities of human genius stand eternally before graphs, calculations, and technical jargon. In other words, if we keep our eye firmly on the main purpose of our speaking and listening we shall not stray far from the path of sense and sensibility.

The business of record criticism is complicated and brow-furrowing. We have to prevent the engineer from stealing too much thunder: we have also to stop musicians adopting towards technical problems an attitude wilful and obstinate. The critic must always work towards keeping both the designer of equipment and the recording engineer on his toes; but he must at the same time see to it that first place goes to music as a living, vital, and everlasting manifestation of human genius not finally dependent on the laboratory or the microphone. Few deny the truth of these remarks—they ought to be self-evident. All the same, it is as well to set them down in cold print occasionally, just in case enthusiasm for new wonders sometimes tends to get the better of us and endangers our sanity.

VII

Tape Records

DURING 1954 H.M.V. and Columbia began to issue for public sale a number of high-fidelity tape recordings of musical works already available in standard LP versions. These "tape records" are intended to be played on dual-track instruments at $7\frac{1}{2}$ inches per second, and are capable of giving up to one hour of completely uninterrupted music or speech. Thus the owner of a standard tape-recorder or tape-deck found himself suddenly in the happy position of having yet another means of domestic musical reproduction to hand, and the progressive "hi-fi" enthusiast had another new and obviously exciting field to explore. It is still too early to become pedantic about the future of tapes as a commercial proposition. At the moment high initial cost and one or two unresolved technical problems seem to be standing in the way of a free and unfettered public acceptance of a reproducing medium that, in many ways, has evident advantages over the standard disc; but there can be little doubt that both technically and from the point of view of comfort and convenience the new availability of tapes marks an advance along the road that leads towards the highest attainable standard of reproduction. Despite a certain amount of initial eyebrow-raising on the part of critics and public—not uncommon with technical innovations—tapes have undoubtedly come to stay; although, for the moment at least, no one, their own manufacturers included, envisages them ousting disc as the normally recognized reproducing medium. Tapes are generally regarded as complementary rather than antagonistic to the LP disc: none the less, now that the first step has been boldly taken a rising tide of tape records from the factories, and an increasing use of them by gramophone users, can logically be expected. I am anxious to make this point at once because in spite of the explosion or eruption caused in the gramo-

phone world by the advent of LP, a natural conservatism of mind still causes the glance of suspicion to be cast warily in the direction of all new technical phenomena. Was not LP itself accepted only after much probing and in many quarters only with reluctance?

Reproduction by tape removes a few more of the remaining disadvantages of music on record. As I have said before, we are still some way from perfection, "absolute fidelity", and the like; but the introduction of tape records does unmistakably mark another step towards that laudable end. Naturally enough, this book is largely devoted to the problems of disc reproduction; all the same, the day may not be far off when large-scale musical works at least will be most happily and most normally accommodated on tape. The potential advantages are immense; the limitations not beyond the scope of technical ingenuity to iron out.

At the moment the vexed question of nomenclature or definition is causing some dissension. The commonly used term "pre-recorded tape" is liked by nobody—least of all by E.M.I. It is tolerably accurate, though tautological, but it is awkward and sounds ambiguous. As usual, the simplest statement appears to be the most satisfactory—"Tape Record", or possibly "Tape Recording". A "Tape Record" is what it says it is: a recording made on tape—it ought to suffice for most purposes. The only trouble I foresee is one of ingrained prejudice. For most people a "record" is a flat thing with a hole in the middle: something wound on a spool or reel is generally thought to belong inside one's camera. However, no doubt most of us can in time outgrow our own juvenile preconceptions, and it shouldn't really take us too long to come to regard a "Tape Record" as simply another form of the same thing. It is the word "record" that matters—the adjective is only there to indicate what sort of record it is. Therefore, let us remove the inverted commas and accept Tape Record as the logical and definitive end of the argument.

The disadvantages of tape records are comparatively few, and in no case such as are likely to stand in the way of future development. The executives of E.M.I. who have most willingly and frankly laid all their cards on the table

for my detailed inspection have left me in no doubt that not only are they perfectly aware of these disadvantages and limitations, but also that they propose to deal with and eliminate them without fuss or argument. For the moment E.M.I. are the only group to issue tape records here (though not in the U.S.) and therefore they have the field to themselves; but there is no possible question that those concerned with the production and marketing of tapes will join in the general battle. Particularly are they concerned to simplify the operation of tape replaying in the home: much thought and activity is being directed towards such not unimportant details as ease of load and wind, elimination of expensive errors of operation, and a simpler means of locating particular passages or sections of the recording. Tape records are still in their teething infancy—so are the machines for playing them—but, make no mistake about it, those teeth are strong and healthy. They will certainly bite a few holes in our long-established conventions before long.

A lot of loose talk has been in circulation over the alleged ease with which expensive recordings can be wiped off the tape by a faulty setting of the recorder. Certainly no tape recording is indelible; and certainly it can be erased, completely and finally, if one intentionally turns the machine to “RECORD”. But, as E.M.I. demonstrated to me convincingly, there are full and adequate safeguards—on their own players at any rate. To achieve erasure one has to perform an operation or manipulation of some complexity, and one that isn't likely to happen by itself. Two hands have to be employed, and a positive sequence of manoeuvres performed before one can attain that state of adjustment to the machinery which will result in one's precious and costly tape being returned as it were to a state of nature. I can hardly envisage the accidental erasure of a tape record happening to anyone in command of even half his senses. Indeed, short of stupidity, I think it a good deal more difficult to do lasting hurt to a tape than to any other recording format.

Apart from a few, and no doubt temporary, errors in technique and crudities of operation, what is unquestionably

retarding the general acceptance of tape records among the broad run of music-lovers is the initial high cost. A single tape costs from £2 15s. to £4 4s. according to playing time and category (no purchase tax is chargeable), while an equivalent LP costs from 24s. 6½d. to 36s. 5½d. (tax paid), also according to duration and category. The difference is large and not easily dismissed from mind. The first cause is the high cost of raw material and production of tapes. But here again my inside information suggests that with public co-operation some lightening of the burden may soon be contemplated. The point is that, as with most other things in life, the law of supply and demand is operative. If the market is big enough the cost can definitely be brought down—exactly how much I hesitate to say, but substantially at any rate. Quantity demand means lower costs all round; so if we want tapes we shall be obliged to support the venture in its first and expensive stages with an eye to future benedictions both to pocket and to musical enjoyment. I doubt if the cost of a tape record will ever compete absolutely with an LP—although to-day one can hardly make sweeping remarks—but, given a decent public response, an acceptable bridging of the gulf ought to be possible.

I do not propose to say a great deal about the equipment required for playing tape records, because new developments can soon be expected. The owners of tape recorders can, of course, use their existing apparatus as it stands, either on its own or in conjunction with “high-fidelity” amplifiers and loudspeakers. For those not so equipped a number of playing decks alone (without facilities for recording) are, or soon will be, available at moderate prices—certainly not more than a high-class pick-up and motor unit. Among tape recorders proper, those made and marketed by E.M.I. and Grundig, though expensive, carry design and construction to a high pitch of accomplishment. The Grundig TK819 at 95 gns. undoubtedly represents an exceptional achievement in the realm of portable tape recorders. Its facilities include simple and efficient push-button controls; Magic Eye tuning; two tape speeds; and a built-in clock timer. The tonal fidelity is remarkable,

considering the inherent limitations of a small unit built into a portable machine; but it is really the convenience and mechanical efficiency of the whole unit which gives it its present-day pre-eminence. I understand that the range of E.M.I. tape machines will shortly be expanded in order to meet the demands of those who wish to exploit the advantages of the new tape records. Therefore, it is not reasonable to say too much here until further information is forthcoming. There are, of course, many other excellent tape-recorders now on the market, and there will certainly soon be more. In particular, the man who is more interested in using the E.M.I. tapes for musical enjoyment will be served by a growing number of high-class playing decks alone which, like the conventional motor and pick-up assembly, can be connected straight into the appropriate socket on the pre-amplifier of his existing "high-fidelity" equipment.

The acquisition of tape records does not necessitate the purchase of entirely new and expensive reproducing equipment. I doubt if enough has yet been said on this subject. There seems to exist a notion that tapes need special equipment of their own which is not less costly than, and not interchangeable with, existing "hi-fi" apparatus. Most modern amplifiers, however, incorporate input circuits to deal with tapes, and some—notably Leak and Rogers—provide jacks on the front of the control panel to accept plugs from tape apparatus, either for recording or playback. Furthermore, the tape and pick-up circuits are separate and independent and in no way interfere with pick-ups or radio tuners already installed and in daily use. If a tape deck is regarded simply as another form of pick-up and motor unit connected independently to its own circuit in the amplifier, much panic and confusion will probably be avoided by those who want tapes but fear mightily the cost of installing the proper and necessary appendages. Modern amplifiers are designed with some forethought to accept inputs from radio, pick-up, microphone, and tape recorder concurrently—but not, I hasten to add, all working simultaneously. In fact, the more various and complicated modern means of reproduction appear to become, the more readily is modern "hi-fi" equipment

appreciated for what it is—a triumph of intelligent application of basic principles.

So far I have said little about the advantages of tape as a medium of domestic reproduction. I am, however, convinced that apart from a further increase in uninterrupted playing time, it has technical features which go far towards removing the remaining obstacles between the original sound and the reproduced sound. For one thing there is absolutely no variation in quality from the beginning of a tape record to the end. Modern discs and modern pick-ups have done much to eliminate the old bogey of deterioration in quality at the inner grooves due to the decrease of linear speed. All the same, the trouble, though greatly diminished, is still there. It is still impossible to be certain that heavily recorded passages on the inner grooves will not bring about distortion audible and disturbing to sensitive ears. With tape there is simply no such problem at all. Also there is no danger from faulty pressings, however slight, to ruin a finely engineered original—which is a tape anyway. Nor are tape records subject to wear and tear in the same way as discs. They do not attract dust, nor are they susceptible to frequent, often inexplicable, scratches and abrasions. Even if they are broken they can be mended with little trouble and without subsequent trace of the join. They are easily stored, will not warp or go off-centre, and they can't be damaged by careless dropping or joltings of a hard stylus point. Altogether, then, tape records promise to be patient, long-lived, and trustworthy servants of our private musical inclinations.

But the greatest boon of all lies in the fact that tapes undoubtedly banish once for all the weakest link in the chain of reproduction—to put it plainly, the scratching of a blunt point over a rough surface. I am not casting nasty reflections at my friends and helpers the designers and makers of pick-ups; but even the best of pick-ups is clumsy in the context. When one thinks of the accepted limits of tolerance both in the size and shape of the point, and even more in the record groove itself (remember that millionth of an inch at 10 k/cs.), it becomes clear that reproduction by friction is at best heavy-handed. The modern pick-up—

whether ribbon, moving-coil, or crystal—is, by any other standard, an incredibly fine and precise instrument. But seen against the dimensions of recorded sound waves at the highest frequencies it can hardly be regarded as more than a temporary, though necessary, expedient. No doubt the modern pick-up and the modern record deserve our heartfelt admiration—none deny it who know what problems are involved: all the same, the ultimate has for long been thought to lie not in improved discs and pick-ups at all, but in the use of a completely different system. The LP record delivered the death-blow to that ingenious monstrosity the automatic-changer—or should have done: but the introduction of tape records may well deliver us from the pick-up altogether.

I am not suggesting that domestic reproduction by conventional disc and pick-up will suffer immediate, or even easily foreseeable total eclipse. On the contrary, present techniques will almost certainly remain predominant during the period of interest of the contemporary generation of record users. I will go further: I doubt seriously if the time can be envisaged at all when tape will oust disc altogether, except perhaps for musical works on the largest scale. Although efforts are already being made at E.M.I. for devising means of producing "recitals" on tape in such a way that each individual item can be immediately located, the use of tape for jumbles of bits and pieces seems at the moment an even more nonsensical procedure than the ubiquitous but usually infuriating LP "recital". As always, enthusiasm for a new technique must not be allowed to run about standing every other logical and reasonable system on its head. We need our Hans Sachs in technique as well as in art. All I am saying in essence is that the tape record is a technical innovation to be used with sense and discretion. But I remain convinced also that the widespread acceptance of tape for the larger musical works and forms cannot be long delayed. The advantages are too great and obvious for either conservatism of mind or operational difficulty, such as it is, to prevent the eventual conquest by tape of home and demonstration hall. After all, tape is the accepted medium nowadays for making the original

recording; therefore, to use tape for reproduction also seems on the face of it not a complication but a logical and obvious simplification of the whole process. And, as I say, with the elimination of the pick-up the last piece of mechanical awkwardness in the chain of reproduction will go. Then at last the complete process will be electronic. I have written that last sentence in the future tense; but the foresight of E.M.I. in taking the first step has already turned it from future speculation into present reality. It should be a cause for general rejoicing not less than that which justly accompanied Decca's courage in issuing the first British LPs, for the quality of the best tape is as faithful as disc, the operation hardly more complex, and the principle a good deal sounder.

Tape recorders, of course, need looking after just the same as pick-ups. Heads have to be kept clean, azimuth alignment regularly checked, and worn heads replaced when necessary if high-frequency response is not to suffer through a widening of the gap due to wear and tear. Head replacement can be expensive—but it oughtn't to be either more costly or more frequent than replacement of a diamond stylus. Also capstans must be kept clean and in free running order, else tape speed will go awry and danger of breakages become severe through stiffness and unevenness of stress and tension. But in the end is that so much more than an ordinary pick-up and motor unit regularly require? A worn point has to be replaced or it will do far more damage than a worn tape head; a sluggish motor needs cleaning and oiling—a tape-recorder needs neither more nor less in the way of care and maintenance. Taken all round, then, there seems to be no valid reason for looking sideways at a young aspirant to fame who may still be at a stage of infant exuberance, but whose inheritance will year by year grow more secure.

On April 4, 1955, the future of reproduction by tapes was given much encouragement when Sir Malcolm Sargent inaugurated the new H.M.V. Stereosonic Tapes at the Abbey Road Studios. This development may in the long run prove to be one of the most significant and musically important of any that has taken place in the past few years, for it

bids fair to do away once and for all with the overwhelming disadvantage of all reproduced music by whatever means or format—that is, the single channel effect. The stereosonic tapes add a new dimension to reproduced sound in much the same way that 3-D adds a new dimension to the film. It is still possible to argue with some insistence that the illusion of perspective, and antiphony, instrumental and vocal “placing” can be achieved by ingenious microphone setting and intelligent recession on conventional disc and tape records. A whole crop of existing records bear eloquent witness to what can be done to overcome existing limitations: none the less, as we have seen in Chapter I, the basic problem of accommodating multi-sourced sounds in single-channel recording and reproduction remains a perpetual limitation on musical realism.

I think no one who was present at Abbey Road for the inaugural ceremony will deny that stereosonic tapes must in the future open up possibilities for the realistic recording and reproduction of the utmost importance. Expense and limitation of material will for some time keep the whole business as a more or less connoisseur’s market. But the evident fact remains that, if we can both afford it and get it, the stereosonic system will offer us advantages not to be obtained elsewhere. To take one simple example—it was an entirely new experience when listening to recorded opera to find one’s eyes automatically following the actual movements of the characters across the stage, even though that stage was hidden from us by a blameless white curtain behind which were installed four modified 3000 (Electrogram) loudspeaker units, in two blocks of two and two. There lay the first and most obvious gain.

Briefly, the stereosonic system requires two independent channels from the recording studio to the listener. Two channels are placed side by side on a spool of quarter-inch magnetic tape and replayed through two identical sets of amplifiers feeding two separate and independently movable loudspeakers, the full effect being achieved by so placing the two loudspeakers in the listening room that action and interaction produces the most realistic result. This in effect means two separate reproducers—hence the

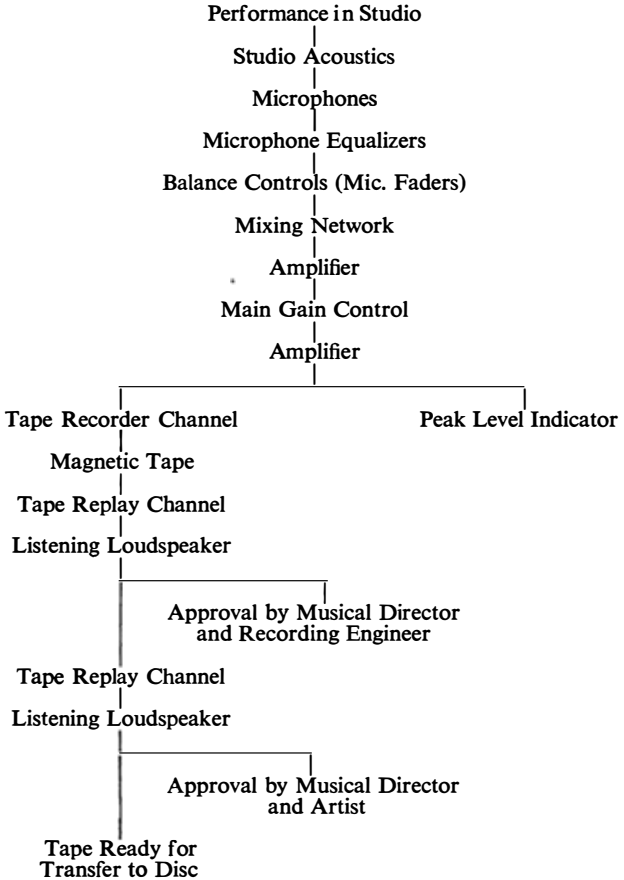
inevitably high cost if quality is not to suffer—although at least as far as the E.M.I. “twin-set” is concerned the equipment can be used also for playing standard disc and tape records.

By familiar aural measurements the quality of stereosonic tapes seems exactly the same as any other sort of tape or disc. Here we have a genuine gesture on the side of naturalness and authentic high-fidelity. We shall now have to await further developments both from E.M.I. and from other companies. As with ordinary tapes no one need think that “stereosonics” are going to render all existing equipment and records obsolete in one blow. The ordinary, enthusiastic, and probably impecunious music-lover in search of high-quality reproduction in the home will be content with current techniques for a long time to come, even though the wealthier seeker after perfection will now be able to knock his friends over backwards from time to time if he has a mind to.

APPENDIX A

TABLES OF RECORDING PROCESSES
(By courtesy of E.M.I.)

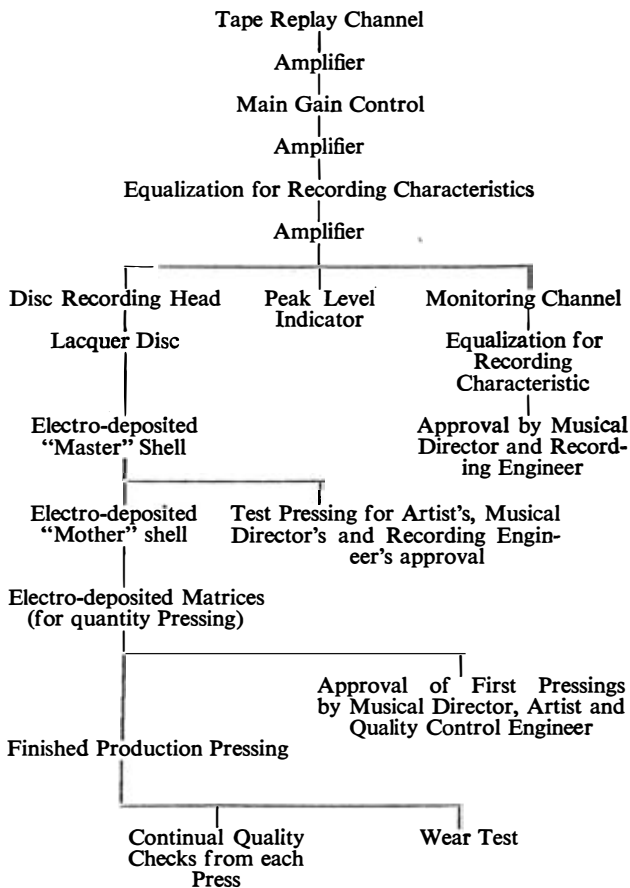
RECORDING ON MAGNETIC TAPE



APPENDIX A

(By courtesy of E.M.I.).

FROM TAPE RECORDING TO FINISHED DISC



APPENDIX B

RECORDING CHARACTERISTICS

Some people seem to adopt towards recording characteristics and replay curves an attitude of abject terror, as though without the exact letters printed plain on the input selector of the reproducer, no record can possibly be played adequately at all: others dismiss the whole complicated business with a breezy wave of the hand. Let us examine the mystery and see if we can strike a reasonable balance.

The British Standards Institution defines a recording characteristic as "the curve of recorded velocity versus frequency that is obtained when recording with tone of various frequencies but of fixed level applied to that point in the chain where the normal signal has the frequency characteristic that it is desired subsequently to reproduce." Or, to put it in terms more readily comprehensible, a recording characteristic is determined by the degree of deliberate non-uniformity of frequency response induced at the source by the recording engineers. Such a characteristic invariably takes the form of a falling response in the bass to obviate the tendency of the lower frequencies at large amplitudes to become so inflated that they run into each other; and a gradual rise from around 1,000 cps. in the upper part of the recorded range. The replay characteristic is the inverse of the recording characteristic—in other words, it is the degree of equalization applied by the reproducing apparatus in order to return the recorded sound throughout its entire range to substantially linear. The trouble arises, so far as the reproduction of gramophone records is concerned, from the fact that until recently different recording companies used different recording characteristics and therefore required different replay curves for their records. If a record is played through an equalizing network which does not give a characteristic substantially the inverse of the recording characteristic it will not, and cannot, achieve an acceptably close approach to the original sound source—that is, to the actual "live" performance.

In the old days of 78s the recording characteristics used by the two major British companies—E.M.I. and Decca—were substantially the same, except that Decca “ffrr” records, while employing the same bass attenuation (roughly 6db per octave below 250 cps.), gave a rise of approximately 3db per octave above 3,000 cps. In practice however, the same replay characteristic serves for both—a slight adjustment of the treble control where necessary can be relied on to give the required correction. Records of American origin, however, whether issued on domestic labels or not, required a totally different curve—usually either the A.E.S. or N.A.B. curves—hence much of the disgruntled criticism of American records when played uncorrected on British reproducers.

With the advent of LP, not only did the basic recording characteristics change for all makes; but, in America especially, a whole crop of variations crept in making the reproduction of a varied collection of records a positive nightmare on wide-range equipment where minor variants produce results audible and often distressing. As the LP eruption settled down, however, a certain recognizable uniformity began to be accepted, so that some half-dozen or so curves will serve for most reasonable purposes. Now, after much protracted discussion, an international standard has been largely agreed, and it really does seem as though the days when one was obliged to seek with some persistence the right replay curve for all sorts and kinds of records are nearly behind us. But many of the older records are still in circulation and will remain so for a good many years to come; so the problem still needs a little sorting out.

For records made since the advent of LP, but before the international acceptance of the new standard curve, the following notes may be of some assistance. It must be remembered, however, that because a record is made theoretically to a certain characteristic, it does not necessarily follow that it will sound best when played on the inverse of that particular curve. In spite of the theoretical recording characteristic, the acoustics of the recording studio or hall, the balance favoured by the particular

conductor at the performance, or the engineers' placing of the microphones, can alter the basic characteristic substantially. It is obviously a complicated problem. None the less, a knowledge of the theoretically correct replay curve will help us at least to start on the right track. We may have to alter or adjust it later; but, if we begin by setting the input selector switch at the right curve, we shall at least save ourselves the trouble of playing every record "by guess and by God."

NOTES

E.M.I. With too few exceptions to be worth bothering about, all E.M.I. microgroove records are produced to the same basic recording characteristic. Those of alien origin are "cooked" in the E.M.I. factory to agree with the curve normally used by all labels issued by the E.M.I. group. This applies, of course, to *all* microgroove records, whether 33 $\frac{1}{3}$ or 45 r.p.m. There exists an idea that 45s are not identical in quality and general characteristics to standard LPs. This, however, is an illusion. 45s and 33s are indistinguishable in quality of sound and pressing, and in their basic characteristics.

DECCA. Nowadays all microgroove records marketed by the Decca group are identical in point of view of recording characteristics, no matter what the colour of the label or the name on it may be. Until recently, however, Brunswick and Capitol records, although marketed in this country by Decca, were made to the A.E.S. characteristic, and needed, therefore, a different replay curve. It is impossible to say for certain which particular Brunswick or Capitol records want A.E.S. and which the standard Decca curve. Decca themselves cannot give an infallible indication. The ear, as so often, has to judge.

NIXA. Because Nixa issue a lot of recordings from different American origins, it is impossible to be precise about curves. But broadly speaking the choice lies between A.E.S. (for records of Urania origin—prefix U) and N.A.R.T.B. (N.A.B.) for most others. All Nixa tapes are processed in America; therefore one or other of the American

characteristics apply and not the basically similar curves used by E.M.I. and Decca.

PHILIPS. Messrs. Philips have kindly supplied me with a graph of their characteristic. If my reading of this document is correct, it does not seem to tally with any of the others exactly. No doubt the variation is not such as to make Philips records unplayable on standard equipment; but it does mean that a little further adjustment is required to make the best of them. Often they sound best on the British 78 characteristic.

SUPRAPHON and MONARCH. Messrs. James Quality Recording Co. Ltd., who market Supraphon and Monarch records, inform me that these discs should be played to the N.A.B. characteristic.

ARGO. An amusing letter in response to my request for information about Argo records tells me that basically the curve follows the Decca characteristic. Messrs. Argo, however, indulge in a little playful complication of their own by stating that each recording is dealt with according to its musical content—"Our advice to listeners is always to set their controls in that position whereby our record sounds best." Well, of course. That is the view plainly expressed to me by Mr. Leak, Mr. Walker, Mr. Mordaunt, and by various technicians and executives at E.M.I. and Decca, where "boffins" habitually swarm. It is the soundest advice of all; but one ought to know how to set about making the best of a difficult world. For Argo then, the Decca or standard British curve—plain LP on some amplifiers—with a variable degree of top control according to individual records.

Many of the smaller companies have been unable to give me precise information about their characteristics. They have often no studios of their own, and rely for processing on the big companies. Therefore they have, broadly speaking, little or no final control over their finished products. This is the burden of a friendly reply sent to me by one frank concern. Experiment is the only way of penetrating to the central truth. As always, play it where it sounds best.

Before I go on to the new proposed International standard, there is one point that needs clearing up. This is the setting marked on some tone control units—"Col.

LP”. Some confusion has arisen because this setting has been taken by the unwary—not unreasonably—to refer, not to American Columbia, but to E.M.I. Columbia which it doesn’t suit at all. I think manufacturers ought to change the lettering to “Am. Col. LP” so that uninformed folk won’t be led astray. American Columbia were, of course, the pioneers of LP recording, and like many of the pioneers—like in fact Decca when they first entered the battle—the recording characteristic was largely experimental: it was arrived at to suit a particular purpose at a particular stage of development. In the case of American Columbia the curve was a modification of the existing N.A.B. characteristic. It shouldn’t be confused with the E.M.I. product simply because it has the same name.

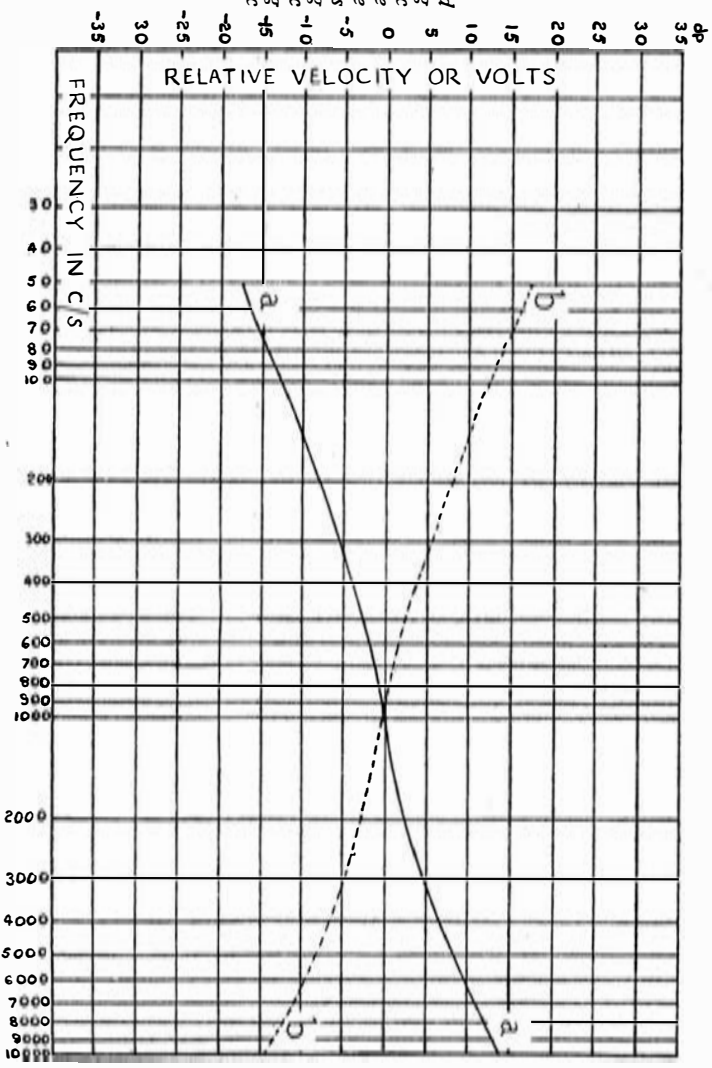
I have not the space to go into all the negotiations and discussions which have led us to the threshold of an internationally agreed standard recording characteristic. This was largely arrived at at the meeting of the International Electrotechnical Commission in Philadelphia, U.S.A. in 1954. It is expected that very shortly the new curve will be published as the agreed standard of all nations taking part in those discussions. I must once again express my most grateful thanks to the British Standards Institution for their courtesy in letting me have a preliminary draft of the document B.S. 1928 which is the revision and extension of B.S. 1928:1953. This will eventually contain all the agreed specifications and standards relating to “Lateral-cut gramophone records and direct recordings”. I must point out that B.S. 1928 is not at the time of writing (Feb. 1955) finalized: it is still only in draft form, and is not to be taken as a British Standard. I understand, however, that major modifications are not anticipated: therefore, in giving the proposed curve for the internationally agreed and accepted recording characteristic, I am confident that I shall not be wilfully misleading anyone.

The characteristic in question is that devised and published by the Record Industry Association of America (R.I.A.A.), and is essentially the same as that used by R.C.A. Victor and known as the New Orthophonic. The curve is as follows.

Recording and reproducing characteristic for fine groove gramophone records

(a) Recording characteristic

(b) Reproducing characteristic



It will be seen that the new curve is substantially the same as that now in use by Decca and E.M.I. in this country, and differs by not more than 2db from the old A.E.S. curve so frequently used up till now in America. The new curve has already been accepted in America by A.E.S. and N.A.R.T.B. and is, as we have seen, very little removed from the current British curves. It is therefore clear that the new curve will smooth out all the tiresome old variations without necessitating the design of basically new equalization circuits on existing amplifiers. It will simply mean that fussing and fiddling will be behind us once and for all. We can give thanks that good counsels have prevailed after some thirty years of progressive but not uniform recording activity. There is also a new curve for both 78 r.p.m. records and for transcription records; but there is in the present context no need to go deeply into these. The vital characteristic for present purposes is the one for all microgroove recordings whether $33\frac{1}{3}$ or 45 r.p.m.

To sum up then, for older records some flexibility of equalization is required, but no one should make a fetish of it. Even the old curves, numerous as they were, seldom differed so violently that the inclusion of every single one of them could reasonably be regarded as essential in a good amplifier. None the less, as I have remarked in the main text of this book, a basic minimum should be included so that we can, without undue fuss, make the best of the many and varied recordings that come our way in this hectic age of LP. It is often not the extreme ends of the recorded range that make necessary the various replay curves: these can usually be dealt with by the tone controls. It is in the middle, out of the range of bass, treble, and filter controls, that the significant difference sometimes lies; and here correct equalization circuits "pay off". For my own part I have usually found that the right characteristic produces the best result. But no one ought to become a slave to letters and numbers. It is in the end, as Schumann once remarked, with obvious insight, "Anything that sounds right is right". We can leave it at that.

APPENDIX C

CURRENT PRICE LIST

I give the following list simply as a rough guide to the price groups into which some of the components discussed or mentioned in the main text fall. I cannot, of course, guarantee that any quoted price will remain accurate, even from month to month. I hope, however, that it may help those who are contemplating the purchase of new equipment to see at a glance approximately how they can best make the necessary equation between what they want and what they can afford. Purchase tax is included where applicable.

Amplifiers and Pre-amplifiers (Control Units)

	£	s.	d.
Acoustical QUAD II and control unit	42	0	0
Leak TL/12 power amplifier only	28	7	0
Leak Varislope II pre-amplifier	16	16	0
Leak TL/10 amplifier and pre-amplifier	28	7	0
Tannoy Hi-Fi amplifier only ..	32	0	0
Tannoy De Luxe pre-amplifier ..	31	0	0*
Tannoy Standard pre-amplifier ..	16	10	0*
Rogers RD Senior amplifier and control unit	43	0	0
Rogers RD Junior amplifier and control unit	25	0	0†
Pamphonic "1002" amplifier and pre-amplifier	42	0	0
Armstrong A10 amplifier and pre-amplifier	29	10	0

*Add £3 extra for mahogany polished ends.

† Different colours and stylings of control panel available.

Pick-ups and Motors.

	£	s.	d.
Acos G.P. 20 p.u. with 2 Hi-g heads	5	10	11
Collaro Studio Crystal p.u. (turn-over head with two sapphires)	3	14	8
Collaro 2010 transcription unit complete (p.u. and 3-speed motor)	18	4	9
Collaro AC 3/554 3-speed unit complete (p.u. on standard 3-speed motor)	8	18	4
Ferranti ribbon p.u. with two diamond heads and transformer ..	36	6	8
Leak dynamic p.u. with two diamond heads and transformer ..	20	19	9
Tannoy variluctance turnover cartridge (two diamonds) ..	16	0	10
As above, but with two sapphires	9	7	2
Connoisseur super-lightweight p.u. (one sapphire head)	5	19	3
Connoisseur p.u. heads (sapphire)	3	6	3
Decca XMS magnetic p.u. (one sapphire head)	3	14	7
Decca head (sapphire)	2	14	8
"BJ" pick-up arm	2	19	11
Connoisseur variable-speed motor	25	15	5

Loudspeakers (complete assemblies—mounted units)

Acoustical Corner Ribbon ..	95	0	0
Tannoy Autograph	140	0	0
Tannoy GRF	99	15	0
Vitavox Klipschorn	145	0	0
Davey DCR 60	75	0	0
Davey DCR 61	46	0	0
Tannoy Canterbury	50	0	0
Tannoy York with 12-inch unit ..	61	10	0
Tannoy York with 15-inch unit ..	66	0	0
Tannoy Landsdown with 12-inch unit	67	0	0

			£	s.	d.
Pamphonic Victor	57	15	0
Rogers Junior Corner Horn with 8-inch unit	25	0	0‡

‡ *This figure will vary slightly according to the precise unit selected.*

I want to emphasize once again that the above list does not necessarily include every good component now on the market. I have compiled it so that readers of the text can have in simple form a sort of ready reference on the matter of cost with which to start planning their campaign in search of "hi-fi". Every item listed can logically be accepted into the category known or thought of as authentic "high-fidelity", although some, not unnaturally, approach more nearly our ideal than others.

ABBREVIATIONS AND DEFINITIONS

(Again, this section does not pretend to be comprehensive. It contains simply definitions of a few terms and abbreviations in current use. For those who want something more substantial, B.S.I. will very shortly be issuing an official glossary.)

A.E.S. Audio Engineering Society (of America).

Azimuth alignment. The adjustment necessary to ensure that in tape recorders or decks the tape exactly bisects the magnetic field of the head at right-angles.

Cantilever. In pick-ups based on the cantilever principle—most crystals and variable reluctance cartridges—the stylus is held on the end of a small arm projecting from the base of the movement. In such designs it is essential to make sure that the cantilever only transmits vibrations from the stylus and does not either generate voltage or set up resonances by its own movement.

Cartridge. An independent pick-up movement designed for insertion into various pick-up heads and arms.

Co-axial. Having the same axis.

Crystal pick-up. A crystal pick-up uses Rochelle Salt or a similar substance to generate voltage. The particular properties of crystals are called “piezo-electric”, from the Greek word “piezen”, to press.

Decibel—abbr. db. The “decibel” equals one-tenth of a “bel” (after Alexander Graham Bell, the inventor of the telephone), a unit by which one may express power ratios and gain or loss of related quantities.

Dynamic pick-up. A pick-up in which the armature or coil vibrates in the magnetic field.

Dynamic range. The difference, usually measured in decibels, between the softest and loudest passages in speech or music. The full dynamic range of a symphony orchestra is said to be in the region of 90 db.

E.M.I. Electric & Musical Industries Ltd., Hayes, Middlesex (H.M.V., Columbia, Parlophone, Marconi, etc.).

Filter. A device for filtering out or removing unwanted portions of the frequency range. In practice this usually means the suppression to a greater or lesser extent of HF response above a selected point. Efficient filter circuits enable one to vary both the position and the rate of cut-off independently.

FFRR. "Full frequency range recording"—the Decca trade mark and 78 recording characteristic.

Flutter. Rapid variations of pitch not easy to detect but having a deleterious effect on the reproduced sound, often causing apparent coarseness and lack of clear definition.

Harmonic. Multiple of the fundamental.

HF. High frequency.

Horn Loading. The horn loading of a loudspeaker means that a large horn is used to provide a big column of air to assist a small unit to provide a substantial volume of sound. In an exponential horn the flare increases at a logarithmic rate.

LF. Low frequency.

Magnetic pick-up. Also called a "moving iron". An armature is pivoted between the poles of a permanent magnet around the yoke of which is a winding of fine wire. In some cases the stylus or needle itself acts as the armature.

Matrix. Electro-deposited metal disc used for pressing copies of recordings in quantity.

Moving-Coil Loudspeaker. In a moving-coil loudspeaker a coil of wire is wound on a cylindrical former and suspended so that it can travel backwards and forwards, piston fashion, in the direction of its axis; it is then mounted in the field of a permanent magnet. In design the great difficulty is to ensure that the coil moves as a true piston at all frequencies—that is to say, that it doesn't set up opposition inside itself.

Moving-coil pick-up. In a moving-coil or “dynamic” pick-up the stylus is attached to a small coil pivoted between the poles of a permanent magnet. In a ribbon pick-up the coil is replaced by a single strip or “ribbon” of aluminium.

N.A.R.T.B. National Association of Radio and Television Broadcasters (of America): formerly N.A.B.—National Association of Broadcasters.

Negative Feedback. “In a negative feedback amplifier a voltage derived from the output of the amplifier is superimposed upon the input voltage in such a way as to oppose the latter within the band of frequencies it is desired to amplify. This definition is conditioned upon the amplifier remaining stable.” (H. J. Leak & Co. Ltd.)

Pinch effect. Because the cutter head is a chisel and the reproducing stylus either a spherical or an elliptical point there are places in the groove where the latter is pinched through a narrowing of the groove due to the cutter-head's movement in a diagonal direction. Where this occurs the reproducing point tends to ride up and down in the groove, introducing distortion. An elliptical point greatly helps in overcoming pinch effect; but the best remedy is a very free mounting of the stylus, especially where there is free vertical compliance, as in pick-ups with a cantilever mounting or in ribbon pick-ups. All pick-ups with a stiff mounting of the point are highly susceptible to pinch effect.

Recording characteristics. *See* Appendix B.

Surface noise. The random sounds caused by the physical contact of the stylus or needle with the record groove. To-day, with improved materials and refined techniques, the problem of surface noise or needle scratch is much reduced. With 78s, however, surface noise is always more or less prominent owing to the fact that shellac records have a filling that acts as a mild abrasive. The degree of surface noise depends to some extent on the age and condition of the record. With new records it is fairly light and inoffensive, and because it occurs in the higher frequency bands it can be filtered out. If, on the other hand, the record is old or worn the chances are that surface noise will fall between 2,000 and 4,000 cps.—that is, *within* the musical range—so that removing it entails a not inconsiderable loss of actual musical notes also. Surface noise can be greatly increased in nuisance value by a pick-up which has peaks within the audible range or undamped resonances which accentuate the inherent physical vibrations. Pick-up resonances and peaks are directly related to aggressive noise of all sorts; and here again the designers of the Tannoy cartridge, by leaving no resonance whatever undamped, have done much to make the best of even the worst of recorded worlds.

Tracing distortion. Distortion caused by the inability of the stylus or needle to follow accurately the modulations of the record grooves.

Tracking error. The angle of difference between the path followed by the pick-up head across the record and that followed by the cutter-head. The former moves in an arc, the latter in a straight line—therefore all conventional pick-ups have a certain degree of tracking error which varies in extent at different points in the arc. The “BJ” arm is an attempt to overcome the inherent tracking error of conventional pick-up.

Transcription recording and turntable assembly. The British Standards Institution defines transcription recordings as “recordings made for programme interchange between

broadcasting organizations and for other specialized purposes not normally on sale to the public”, and transcription turntable assembly as “a reproducing turntable and its driving mechanism specially adapted for the reproduction of transcription recordings”. In actual practice a motor unit described as transcription is one that is suitable for playing transcription recordings—that is, 16-inch or 17-inch discs—but is also made for general use to a level of precision that ensures a high standard of steadiness and sturdiness.

Wow. The term “wow” is used to indicate comparatively slow variations in pitch that are easily recognizable by the ear and are due to unsteadiness in the motor or tape capstans, warped records, or to the centre hole in a record being off-centre. Wow may be caused either in the recording or the reproducing process. It is extremely unpleasant in effect and must be eliminated from high-class recording or reproduction.

NOTES

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