

A proper understanding of the mechanism of stereo perception requires extended reading, in general terms or at greater depth for those with a mathematical bent<sup>1</sup>, but for my present purpose it can be safely stated that the accuracy with which stereo images may be localised by the listener depends on four factors:

(i) Clearly differentiated electrical information in the stereo signal, given either by Blumlein-inspired coincident microphone techniques, or by unambiguous amplitude pan-potting of discrete signals on to the soundstage.

(ii) Use of identical or near-identical loudspeakers.

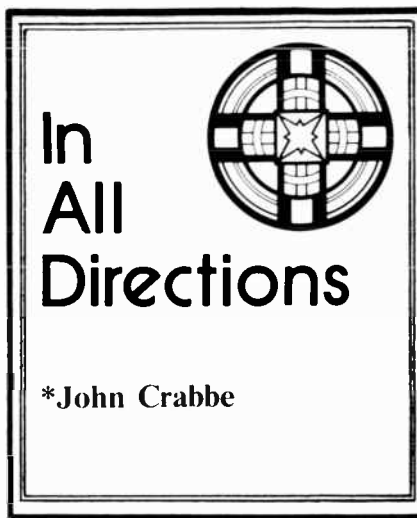
(iii) An unobstructed sound path between each loudspeaker and the listener's ears.

(iv) Either an equal path length from the listener's head to both loudspeakers *or*, if the listener is placed to one side, a radiation pattern from the speakers which compensates subjectively for the resulting time differential.

We must assume that the first condition is satisfied, which is reasonable at least for the direct instrumental sounds in most modern recordings (almost invariably pan-potted), though not for the reverberation, which tends to be anomalous. Most good loudspeakers should satisfy the second point except for laboratory measurements, and the third requirement is a matter of common-sense usage.

With perfect two-channel stereo reproduction the full panoply of sound-sources is heard accurately displayed between and beyond the loudspeakers. This accuracy applies not only to the direction of individual instruments or voices, but also to their apparent widths. Now it so happens that in any system that is well balanced and has adequate electrical separation between signal paths, the performance with a central (double-mono) signal is a reliable indication of overall stereo accuracy. If a left-only signal produces a narrow sound image from the left-hand speaker, a right-only signal likewise from the RH speaker, and a double-mono signal produces a narrow image centrally placed between the speakers, then it follows automatically that a stereo signal will be reproduced accurately right across the soundstage. Unfortunately, this perfect stereo can normally only be obtained if the listener is equidistant from both speakers—that is, if he is in the 'stereo set' placed on the apex of an isosceles triangle subtended by the speakers.

Any reader who doubts this can try it for himself: it will be found that there is a precise listening line along which a double-mono signal is heard as a very



narrow and clearly detached sound-source. If this elementary first-step fails there is something faulty somewhere—either in the speakers, the room or the ears! Movement to one side from this ideal position normally causes two things to happen: (i) the image shifts more or less with the listener, and (ii) it broadens and is therefore less precisely located. In any system, insofar as mono does *not* sound as if it were coming from a separate central speaker, there is some falsification of stereo signals—an element of pseudo-stereophony. A major problem in domestic sound reproduction is to minimise this effect over a reasonable listening area, thus providing good stereo for practical use in the home.

The normal approach to this stabilisation of stereo images is to employ to best advantage any directional characteristics possessed by the speakers. Essentially, the central image (and everything else with it) becomes distorted when listening away from the bisecting line because one is then nearer to one speaker than the other, which gives its signals a time-lead. Because of Haas-effect (precedence-effect), this lead in time produces a subjective boost in loudness from that channel, which shifts and broadens the apparent sound-source in that direction. Now, if movement to one side resulted in a *lower* acoustic level at the listener's ears from the speaker on that side (and/or a higher level from the other side), the image-shift due to a time differential could be cancelled by a contrary shift due to the loudness change. This is the basis of the well-known Hugh Brittain loudspeaker placing<sup>2</sup>, pursued more fully to overcome certain anomalies by Joseph Enock.

Practical loudspeakers vary enormously in the shape and frequency-dependence of their forward radiation patterns, and since an ideal 'Enock'

speaker would have one particular lobe shape and no tendency at all to extra beaming at high frequencies, it is evident that the whole business is full of compromise. However, with patience most conventional speakers can be made to perform quite satisfactorily in most rooms. Setting up may be a tedious business<sup>3</sup>, and it may sometimes involve very curious angling as advocated from time to time by Ralph West in his speaker reviews. But my experience is that if one is prepared to sit fairly well back from the speakers and not unreasonably out to the left or right extremities, it is possible to obtain good stereo over a sensible listening area. By 'good stereo' I don't mean the pin-pointed accuracy heard from the stereo seat, but a fairly consistent and well defined sound-stage of the sort associated with a double-mono signal that never shifts more than a third of the way towards one side or broadens to an angular width of more than about five degrees.

What has all this to do with omnidirectional speakers or their advertising? Taking the second point first, it is extremely relevant, for we have been shown families of seven people ridiculously huddled around one chair in the middle of a room whose only other contents are a pair of conventional speakers, an amplifier and a player. This is a gross falsification of the domestic listening situation, attempting to create a myth that until recently it has been necessary to upset one's living arrangements in this manner in order to enjoy the benefits of stereophony. Even a hi-fi dealer wrote to me in support of this extremist position, conceding that 'there is a place for the lone listener in his throne the stereo seat' who can 'choose from a mass of direct sound speakers . . . but there are many more readers with a family and friends who like to sit round the fire-side', etc. Now it is true that sitting in a semi-circle around a fire does create difficulties for desiderata (iii) and (iv) listed earlier, but I suggest that this is only one special case among endless domestic possibilities, and that it is unfair to adopt such an extreme 'either-or' attitude about those who listen to music in their homes.

1. *Stereophony* by N. V. Franssen. (Philips Technical Library).
2. *Two-channel Stereophonic Sound Systems* by F. H. Brittain and D. M. Leakey. 'Wireless World', May/July 1956.
3. *Installation: Loudspeakers* pp. 223-229. 'Hi-Fi in the Home' by John Crabbe (Blandford Press).
4. *Two Channel Quadraphony* by David Hafler. 'Hi-Fi News', August 1970. (See also 'A New Quadraphonic System' David Hafler, 'Audio' July 1970.)

\*Editor, *British Hi Fi News*,

(abridged version)

In any case, stereo is really a fairly subtle business and can only be appreciated fully by those who *listen* to music—it is hardly necessary for background while sitting around the fire!

The other important point about the adverts is their claim that omnis surround the listener with stereo sound wherever he or she is in the room, obviating the supposed need for 'stereo seat' listening and implying that the type of stereo obtained on the bisecting line with conventional speakers is achieved everywhere with omnis. This is where my earlier remarks about stereo perception come into the argument, for it can be shown both theoretically and practically that omni-directional loudspeakers distort the stereo sound picture more or less severely.

Firstly, they cannot by definition offer a sound intensity pattern that compensates for precedence-effect because they radiate equally in all directions; thus even in an anechoic room there would be considerable shifting and broadening of a centre-stage image as heard by an off-centre listener. Secondly, in a normal room there is relatively little direct sound from omnis of the Sonab type (without *any* forward radiating unit) so that the ears are presented with a very complex series of confusing reflected wavefronts which upset the localising faculty. This means that even in the stereo seat a nominally central sound-source seems vague and broad in most rooms, the only really precise directional information (if the room permits any at all) arising from extreme left or right sounds. In my own sitting room, which is acoustically rather 'dead' compared with most and therefore relatively disinclined to scatter the stereo sound-picture, a pair of Sonab OA-5s was quite incapable of producing anything remotely approaching a narrow sound-source from a double-mono signal. On a stereo recording of a harpsichord concerto on which a seemingly small solo instrument is contrasted nicely with a broad orchestral backdrop, the harpsichord stubbornly occupied the full space between the speakers as heard from any point in the normal listening area.

This is not good stereo—it is hardly stereo at all—and I must beg to differ most strongly with critics who state that omnis 'do provide a good stereo image virtually anywhere in the room'. They do not and they cannot. Neither can they provide a satisfactory and reasonably consistent frequency response from sample to sample, depending as they do entirely on the environment in which they are used; this is contrary to all good loudspeaker design criteria. Despite all this there are bound to be a few freak

rooms in which it is impossible to obtain a satisfactory listening area with conventional speakers but which reflect the sound from omnis in a manner that happens to provide some compensation for Haas-effect in a pseudo-Brittain fashion. Any readers with such rooms (one was amongst my correspondents) may ignore the bulk of this article—but my general thesis stands.

Some people not in this special category may nevertheless *like* the sounds produced and many will welcome the fairly constant type of sound pattern throughout the listening room that was mentioned and praised by Donald Aldous in his review of the Sonab in November. Some have referred to this review as if it vindicated their viewpoint, apparently failing to notice that Donald did not claim that the relatively stable sound-field represented good stereophony. Indeed, he scattered a fair number of serious doubts, stating that 'there is loss of definition and precise images', that it is 'true that stereo is often anomalous . . . and this may prove disconcerting, especially to the more experienced listener', and that 'it is essential that the reader should be aware that the contention concerning directionality, at least, is fallacious when related to sound *reproduction*'. It is a case of distortion that remains equally distorted from all points of view!

I think that covers the objective side of the matter and explains why we commented so adversely on the Sonab advertising—though I see that more recently we have been asked to believe that these loudspeakers have some curious extra property enabling them to reproduce the quarter tone scale of Indian music that is 'too much for most systems'. It's certainly too much for me—I give up!

On the musical and subjective side there is much more room for argument and manoeuvre. Once the supporters of omni-directional speakers have admitted that they generally lose a lot of directional information and suffer from rather extreme distortions of lateral perspective, then I will admit that they may indeed actually prefer this sort of sound and that they have every right to. But it must be understood that in terms of sound *reproduction*, of producing an accurate acoustic equivalent of the signals passing through the stereo amplifier, omni-directional loudspeakers represent a firm step backwards. Musically, this may not seem to be the case but if so this can only be due to other limitations of two-channel stereo which are receiving partial compensation via the loudspeakers. This indeed is part of the Sonab philosophy, emanating from Stig Carlsson, the argument being

that in real life most of the sound energy arriving at our ears in the concert hall comes via reflections. This was outlined in the November review and is a point that has been made on many occasions when discussing the philosophy of stereo reproduction. It is basic also to the Bose loudspeaker, though this is in a rather different category to the Sonab, without the latter's flimsy construction and rather obvious colorations, and with at least one forward-facing drive unit. However, developments in quadraphony or pseudo-quadraphony promise a more satisfactory type of solution, taking us much closer to a live concert-hall atmosphere than the rather unreliable use of multiple short room reflections via omni speakers.

I am sure that it is this missing sense of all-round atmosphere that leads people to look beyond conventional stereo, with its sound-stage at one end of the room and no reverberation from around or behind the listener. But things are now on the move, and even limited experiments with 'difference' signals<sup>3,4</sup> can be a revelation in added spaciousness compared with the effects achieved by omni speakers. And there is no penalty to pay in the accuracy of spatial reproduction on the forward sound-stage.

Several of my correspondents were slightly offended by the phrase 'undifferentiated wodge of sound' used to describe the omni type stereo picture. The dealer whom I mentioned earlier pointed out that in his view this is just what many people want and that it gives a great deal of musical pleasure. Well, that may be so for some stereo beginners, especially if their taste is for big, lush orchestral music—Strauss tone-poems for instance—just as upward-facing column speakers were all the rage for a while when stereo recordings were first introduced. We have been through all this great debate before; but gradually, as people listened more carefully and became more critical, they came to realise that what they thought was stereo was really little more than mono thrown around somewhat by two speakers—in fact an undifferentiated wodge.

One reader claimed in a letter that omni speakers are 'as great an improvement over ordinary stereo speakers as stereo itself is over mono'. Well now, if this is so it would follow that to switch a pair of omnis from mono to stereo would be at least as revealing or dramatic as a similar switch using conventional speakers. But it is generally a good deal *less* revealing, for the simple reason that omnis dilute the stereo image and inflate a mono signal to the point where they are rather similar.

Finally, a few words in favour of the

musical subtleties of conventional stereo, subtleties not demanding bisecting-line listening accuracy, but simply ordinary loudspeakers and ordinary seating sensibly arranged in an ordinary room.

This was exactly what happened when I played the aforementioned harpsichord concerto recording: on conventional speakers in mono the whole orchestra and solo instrument appeared to occupy a fairly narrow band in the centre of the speaker wall, while in stereo the orchestra spread out correctly and grandly in its various sections with the harpsichord remaining of slender proportions at front-centre; on omni speakers in mono both harpsichord and orchestra appeared to occupy the whole wall, and in stereo the only change was a suspicion of upper strings more prominent on the left. The moral of this story is that if you want a stereo recording to make an impression on omni speakers you must exaggerate the left/right instrumental separation and minimise centrally placed sources for all you are worth—a thoroughly unmusical and reprehensible business, yet my same correspondent goes on to say that he 'looks forward to the record industry catching up with the equipment manufacturers by producing records suitable for reproduction on these omni-directional speakers'. God forbid!

listen to the sound first from the stereo seat and then from a point far enough to one side to shift and stretch the sound image unreasonably. My ears register a change of tonal quality which seems to be independent of HF beaming effects. Tone-colours are part of music, so this sort of thing must affect musical pleasure at some level.

Much music demands, and some conductors use, spatially separated 1st and 2nd violins. Done discreetly, as on many recordings, the two string groups are placed to left and right of stage-centre, but not pulled apart ridiculously. A lot of delightful antiphonal effects are there for the hearing, but they are certainly less easily distinguished in a 'wedge' of sound. Solo instruments set against an orchestral backcloth sound quite unnatural if stretched out in the manner of the harpsichord already mentioned; in violin concertos, particularly, some of the musical drama is dissipated if the instrument's physical smallness is lost. This applies also to voices, especially in opera where both subtlety of movement or placing, and moments of high drama, may be lost or even contradicted in the proverbial sonic wedge.

Complex many-stranded counterpoint is sometimes difficult to follow without the aid of a score, especially

when the music is for multiple divided strings and therefore unsignposted by a variety of instrumental timbres. Such music benefits from good stereo because of the audible but often subtle separation in space. Finally, chamber music, and particularly the string quartet, which can sound so very convincing when well reproduced but quite vague and silly when distorted by omni loudspeakers. Anyone with experience of listening to a real quartet at fairly close quarters soon realises the absurdity of the freakish quasi-stereo offered even by a moderately differentiated 'wedge'.

This all means that sooner or later people will get fed up with omni-directional loudspeakers—just as most people eventually abandoned their column speaker about ten years ago. (There is a possible analogy here with headphone listening, the present popularity of which—due to its consistently accurate stereo—could be a reaction against the vague stereo heard even from improperly used conventional loudspeakers.) Singers' mouths or solo violins several feet wide which cannot be placed at all certainly in an particular direction are tiring and irritating to live with. They will come home to roost. This I know from personal experience, having been a keen advocate of reflected sound not many years ago! **AE**



**S**umming up: there is no doubt that omni-directional speakers or systems that specifically use walls for reflection do give a more spacious kind of sound. Under the right circumstances, one is less aware that one is listening to two loudspeakers. It is also true that this effect is achieved at the cost of definition. On the other hand, very directional loudspeakers give a sharp stereo image but the listening area is restricted. In the early days of stereo (two channel) I maintained that the optimum dispersion angle was 120 degrees but in these days of 16-channel mixers and multi-mic techniques I cannot be so dogmatic. Stereo itself is an illusion and the program

material goes through many processes of mixing, dubbing, equalising and so on. Some producers exaggerate separation, some transport the listeners to the conductor's podium and others try and give him the impression of being in the middle of the 10th row back. Then again, most of today's music is recorded in the studios—not the concert hall at all! Finally, there is the question of room acoustics. The room must be considered acoustically as an extension of the loudspeakers and what sounds superb in one room can be incredibly bad in another.

Perhaps the best answer to some if not all of these problems lies with the intelligent use of the quadrasonic

medium. This can give us a better sound image without relying on random room reflections or being so affected by room acoustics—especially standing waves. Moreover, as Jim Long stated in his recent article on microphones, "Four mic/four channel recording reduces the need for accent microphones. The ability of four-channel stereo to sort out a single event amidst complex aural confusion—if the recording is properly handled—can be downright uncanny!" The big question will be: What kind of loudspeaker radiation pattern will give best results with quadrasonic sound? My own tests indicate a dispersion of 90 degrees but I am reserving judgment for the moment. *G.W.T.*