

WHAT IS SOUND?

BY ROBERT PASNAU

1. *The problem.* Our standard view about sound is incoherent. On the one hand we suppose that sound is a quality, not of the object that makes the sound, but of the surrounding medium. This is the supposition of our ordinary language, of modern science and of a long philosophical tradition. On the other hand, we suppose that sound is the object of hearing. This too is the assumption of ordinary language, modern science and a long philosophical tradition. Yet these two assumptions cannot both be right – not unless we wish to concede that hearing is illusory and that we do not listen to the objects that make sounds. To avoid these consequences we must recognize and repair the inconsistencies contained in our standard view of what sound is. I shall offer an account that describes sound as a quality belonging, not to the medium, but to the object that makes the sound.

2. *An initial assumption.* I assume throughout that sounds and other sensible qualities are features of the external world, not intrinsic features of our sensory experiences. The assumption seems a reasonable one to make, since no one other than philosophers has ever been much attracted to locating sensible qualities within the observer, and since even most philosophers reject such a strong form of subjectivism. Moreover, even if we were to accept this subjectivism, we might still legitimately enquire into the external counterparts to the internal quality of sound, and so my thesis could be redescribed along those lines.

3. *A brief history of sound.* Philosophers today have been too preoccupied with colour to give the case of sound much thought. But the history of philosophy shows that two views about sound became standard early on and remained dominant: first, that sounds are the object of hearing; second, that sounds are properties of the medium rather than of the object making the sound. (I

shall refer to these two claims, together, as the *standard view* of sound.) The historical credentials of the first claim seem too obvious to need much discussion. The *locus classicus* is in Aristotle, who identified sound as the proper object of hearing: 'sight has colour, hearing sound, and taste flavour' (*De anima* II 6, 418a 13). Augustine reaffirmed this account (*De libero arbitrio* II iii 25), and it was presupposed without question in both the later mediaeval and the early modern periods.

The second part of the standard view is perhaps more in need of documentation. Democritus gained notoriety early on in the history of philosophy for remarking that sensible qualities exist 'by convention' rather than 'in reality' (Diels-Kranz B 125). He does not mention sound explicitly, but his remarks seem to cover all of what would later be called the secondary qualities. Still, it has always remained standard to suppose that sounds exist in the air. Aristotle remarked that 'sound is a certain motion of air' (*De an.* II 8, 420b 11). Lucretius described how 'a voice is distributed abroad in all directions.... places hidden away from sight are filled with voices' (*De rerum natura* IV 603–7, tr. W.H.D. Rouse). For Boethius, 'sound is defined as a percussion of air that remains intact up to the point of hearing' (*De institutione musica* I 3). Aquinas likewise distinguished between sound and other sensible qualities, writing that 'in a body making a sound, that sound is only potential; the sound is made actual in the medium' (*Commentary on Aristotle's De anima* II xvi 71–3, tr. R. Pasnau). Early modern philosophers often followed Democritus' lead. Nevertheless the standard view on sound remained the same: 'sounds come to us indifferently from below, above, and all sides', as Galileo put it, before himself endorsing the view that such qualities 'have no real existence save in us'.¹ According to Descartes, 'Most philosophers maintain that sound is nothing but a certain vibration of air which strikes our ears',² and Berkeley accordingly gives just that view to Hylas (see §17 below).

4. *Ordinary language.* The standard view of the philosophers is mirrored in ordinary language. We say that we hear voices, and we also speak of those voices filling the air. Laughter rises up from the audience. The hills are alive with the sound of music. Objects do not have sounds, standardly, but instead make sounds. To squeak, squeal, wail, howl, quack – these are all ways of making a sound. To chirp is not to have a sound, but 'to make a short, shrill sound' (*Webster's New Twentieth-Century Dictionary*). Sounds emanate, rather

¹*The Assayer*, in *Discoveries and Opinions of Galileo*, tr. S. Drake (Garden City: Doubleday, 1957), pp. 276–7.

²*The World*, ch. 1, in *The Philosophical Writings of Descartes*, Vol. 1, tr. J. Cottingham, R. Stoothoff and D. Murdoch (Cambridge UP, 1984), p. 82.

than remaining within. We do not ask where sounds are, but where they come from. Yet sounds are the things we hear, they are what we listen to. Like philosophy, ordinary language reflects our standard view of sound. I shall not be advocating that we change the way we talk, only that we should resist letting how we talk seduce us into holding an incoherent view about what sound is.

5. *The incoherence of the standard view.* The standard view is incoherent, first and foremost, in as much as it makes our perception of sound illusory. We do not hear sounds as being in the air; we hear them as being at the place where they are generated. Listening to the birds outside your window, the students outside your door, the cars going down your street, in the vast majority of cases you will perceive those sounds as being located at the place where they originate. At least, you will hear those sounds as being located somewhere in the distance, in a certain general direction. But if sounds are in the air, as the standard view holds, then the cries of birds and of students are all around you. This is not how it seems (except perhaps in special cases; see §6). Sounds that were caused at a distance seem to be at a distance; they do not seem to be coming towards you, unless that which makes the sound is in fact coming towards you. On the standard view, in contrast, sounds come from an object, through the air, into our ears. So if the standard view is right, our perception of sound is illusory. Where the sound is – coming towards us, going past us, all around us – is not where we perceive it to be. Surely it is better to concede that the standard view of sound is wrong than to admit that our ears are constantly deceived.

6. *Non-located sounds.* Although we typically perceive sounds as being located at their place of origin, there are exceptions, and these exceptional cases may seem to undermine the argument just offered. But these counter-examples are not as common as they might seem. If you pay attention to your auditory experiences over some time, it is likely that you will hear very few sounds that seem entirely to lack location. The location will be more or less definite, depending on the circumstances. If you hear a bird outside the window, you are not likely to know exactly where the bird is. Still, you do not hear the sound as filling the air. You hear the sound as being somewhere outside the window. And if you stick your head out of the window, you will hear the sound as being either on the right or the left. (Crickets are a notoriously difficult case, but even there you will hear the sound as having some general location. And it *is* possible to find a cricket in your house, just by listening to its sound – see §9.) In these sorts of cases our hearing is imprecise, but even so this does not support the standard view that sound is a

property of the air surrounding us. Even in these cases one hears the sound as being in some general vicinity. And further investigation will almost always yield an even more precise impression about where the sound is.

It is quite rare to hear a sound as filling the air all around us, even though on the standard view this is how we should always experience sound. Perhaps this is how we experience loud music in a disco, or a jack-hammer in a narrow street. Such cases, I suggest, are analogous to seeing colours in a hall of mirrors. The amplification of sound, and the enclosed space, make it seem as if the sound is coming from everywhere. But we should not conclude that the sound is anywhere other than in the speakers, or in the jack-hammer, just as we should not say that the colours are in the mirrors (but see below). There is a kind of illusion here, then, in as much as the sound seems to be in places where it is not. But the illusion is readily explained by the unusually loud noise, and by the confined space. Even in these cases it does not seem as if the sound *is* everywhere. The sound, even if deafening, does not seem to be, say, one inch from your ear – as, again, the standard view would have it.

Sound waves bouncing around a disco have as their distant relative an echo bouncing off a canyon wall. The difference, of course, is the time it takes the sound to hit the canyon wall and bounce back. Again one might say that the echo is an illusion, and that the sound is not really where it seems to be. But there is perhaps room for arguing that the sound really is out there in the canyon where we hear it as being. This claim is no more (or less) counter-intuitive than the analogous claim that colours exist on the surface of a mirror. If one can make sense of the idea that a mirror, in virtue of its reflective properties, takes on colours, then it would seem equally intelligible to hold that the canyon wall, in virtue of its reflective properties, takes on sounds. There would then be no illusion in such cases. And much the same could be said for the noisy disco or the narrow street. The sound in such cases might actually be all around you, on the reflective surfaces of the surrounding walls, or even in the vibrating floors.

7. *The precedence effect.* In typical listening environments (reverberant rooms), our ears receive compression waves from many different directions. Reverberation, in other words, is a very common phenomenon. Interestingly, however, we do not hear it like that. Even when there is a significant reverberation in a room, we do not hear it as such, as long as the reverberation comes to the ear between 1 and 35 milliseconds after the initial wave enters the ear. In such cases, we hear the sound as being located at its initial source. Although the reverberation affects the perceived loudness and

quality of the sound, it does not enter into our perception of its location. (If the reverberation arrived more slowly than 35 milliseconds later, we would hear an echo. If it were faster than 1 millisecond we would hear the sound as centred between the source and the point of reverberation.) This is known as the *precedence effect*.³ On the standard view, this effect has to be described as a defect in the system. For if the object of hearing is sound, and if sound is a quality belonging to the surrounding air rather than to its source, then the precedence effect would serve to filter out information about sound. The precedence effect, in other words, would stand in the way of accurate detection of sound. Yet this seems absurd, which points to another reason for giving up the standard view of sound.

8. *Like colour, not odour.* A key strategy of this paper is to argue that our thinking about sound should parallel our thinking about colour. In particular, I have been arguing that we perceive sounds, like colours, as being located at their point of origin rather than as filling the air. One might urge a different analogy: that our perception of sounds is like our perception of odour, and that we should conceive of sounds as filling the air in just the way that we conceive of odours as filling the air. But there are good reasons for rejecting odour as a model for understanding sound, and for preferring colour. Hearing and smell fall on different sides of a dramatic (but neglected) distinction among our sensory modalities. Sight and hearing are what we might call *locational* modalities: they directly yield information not just about sensory qualities, but about the location of those qualities. This is not the case for taste or touch, or even for smell. Despite the fact that odours come to us from a distance, through a medium, we do not perceive odours to exist at the place where they were generated. If we perceive odours to exist anywhere, we perceive them to exist in our nose. (I am inclined to say that our experience of smell comes with *no* impression about where the smell is, but I shall not insist on that.) There is, then, a clear difference in kind between the locational modalities of sight and hearing and the non-locational modalities of taste, touch and smell. If hearing were instead non-locational, if one standardly just heard sounds without locating them, then it would be more reasonable to treat sounds as like odours. But the fact that hearing locates sounds should lead us to reflect on where we locate them as being, and this in turn should lead us to rethink our views about where, and hence what, sounds are.

³ For discussion see B. Moore, *Introduction to the Psychology of Hearing* (Baltimore: University Park Press, 1977), pp. 183–6; D. Wesley Grantham, 'Spatial Hearing and Related Phenomena', in B. Moore (ed.), *Hearing (Handbook of Perception and Cognition)*, 2nd edn (San Diego: Academic Press, 1995), pp. 332–8.

9. *The HOT/COLD game.* Heat is perceived in the way odour is, not in the way sounds and colours are. Even though we can sometimes make inferences about where the heat is coming from, based on which part of our body feels the heat most intensely, we do not perceive the heat to exist at its source. Accordingly, it is reasonable to think of heat, like odour, as existing in the object and in the medium. Again there is a fundamental difference between sight and hearing (the locational modalities) and smell, taste and touch. Only sight and hearing perceive things as being out in the world, at a distance from the body. The difference can be illustrated by comparing two ways in which we search for things. First, there is the search method exemplified by the game HOT/COLD. In this game one at first has absolutely no idea which way to move; one simply takes a guess, and waits to see what the clue will be. If the clue is HOT, then one keeps going in that general direction; otherwise one takes another random guess, in a different direction. This process is entirely inferential, in that one never directly senses that the object must be in one direction or another. The game faithfully mirrors our perception of temperature, and also the way we perceive odours. In contrast, hunting for a cricket in one's home by its sound is not like playing the game HOT/COLD. In hunting for the cricket one tries to discern where the sounds are located, and then one moves in that direction. One does not move randomly; one does not zero in on the target by listening to whether the noises get louder or softer as one moves around. What one must do instead is try to hear where the sounds are. The task is not inferential, but a matter of attempting to hear the sound accurately. Hearing, in my terminology, is a locational modality.

James Gibson, oddly, fails to recognize this point. He speaks of animals as guided in their movements by rules that tell them to, e.g., 'minimize the scent of the predator, or the sight or the sound of it'.⁴ This is perhaps true for scent, but it seems utterly wrong for sights and sounds. When an animal hears a hostile noise, surely it does not seek to 'minimize' that noise. The animal locates the sound without any information about whether the stimulus is increasing or decreasing. If such information were required, then one would expect fleeing animals to be plagued by false starts, where they run in the direction of the predator for a stride or two before sensing that – oh no! – the snarl is sounding louder and the wolf is looking larger.

10. *Error theories.* I have not claimed that the standard view of sound is internally inconsistent or contradictory, only that it is incoherent. What I mean is that the standard view fails to cohere with other things that we

⁴ *The Senses Considered as Perceptual Systems* (Boston: Houghton Mifflin, 1966), p. 148.

believe about sound and perception. So far I have claimed that it is incompatible with believing that our sense of hearing is generally veridical. Yet one might grant this point and continue to hold the standard view, as long as one were willing to embrace an error theory of perception. In fact many a philosopher has been willing to do just this. C.L. Hardin speaks of 'the illusion of colour'.⁵ P. Boghossian and D. Velleman hold that 'the best interpretation of colour experience ends up convicting it of widespread and systematic error'.⁶ According to Hobbes, whatever qualities our senses 'make us think there be in the *world*, they be *not* there, but are *seeming* and *apparitions* only'.⁷ So one might take my argument so far to have established, not that some element of the standard view is false, but that hearing is (at least generally) illusory.

But when Hobbes *et al.* embrace an error theory of perception, they do so in the name of a subjectivist account of sensible qualities. Philosophers from Democritus forwards who have gone down this path have done so because of the serious and well known difficulties that hamper identifying sensible qualities with any feature of the external world. For these subjectivists, the prospects of locating colours, etc., in the world seem so grim that they have felt forced to embrace an error theory of sensation. There is no such reasoning behind the standard view. Although I shall consider a number of superficially attractive reasons for locating sound in the medium, there is nothing to be said for the standard view that could even remotely justify the claim that hearing is a constant illusion. For many philosophers, and for virtually all non-philosophers, the idea of ascribing massive error to our senses is so unattractive that it makes subjectivism a non-starter. We have even less reason to take seriously the standard view of sound.

11. *Choose your error.* It may seem that one will be stuck with an equal amount of error on either my view or the standard one. It follows from the standard view that we misperceive the location of sounds. But I have conceded (in §4) that my view goes against ordinary language. So either our perceptions are illusory, or our language is false. If we are trying to minimize error, it looks to be six of one, half a dozen of the other.

But surely the choice is easy. Ordinary language is ordinarily imprecise, full of implicit metaphors. We may not mean what we seem literally to say. It is only slightly worrisome, then, when we seem to contradict ordinary language. (Only a fool would have argued against Copernicus by appealing

⁵ *Color for Philosophers: Unweaving the Rainbow* (Indianapolis: Hackett, 1988), pp. 109–12.

⁶ 'Colour as a Secondary Quality', *Mind*, 98 (1989), p. 82.

⁷ *Human Nature*, in *English Works*, Vol. iv, ed. W. Molesworth (London: Longman, 1845), p. 8.

to our talk of sunrises and sunsets.) We should be much more concerned to safeguard the veridicality of our sensory experiences. They, too, can be misleading. But to claim that perception is systematically illusory, over a whole modality (or perhaps over several), shakes the very foundations of our cognitive assumptions. It is one thing to claim that we are using the wrong words to talk about sound; it is quite another to claim that we are and shall continue to be fooled every time we hear something.

This distinction between kinds of error shows what is wrong with suggesting that the argument for realism about sensory qualities is largely based on some sort of principle of charity with respect to our talk about colour (or sound). Sydney Shoemaker, for example, makes such a suggestion in passing, and this is taken quite seriously by Boghossian and Velleman as the reason why many philosophers resist non-realist theories of colour.⁸ Their reading of the debate is highly misleading, however. The principle of charity is a weak principle of linguistic interpretation, easily overcome in particular cases. What in fact drives the opposition to non-realist theories is something much stronger: our nearly unshakeable presumption in favour of the fundamental veridicality of our senses.

12. *What is sound?* We should reject an error theory of hearing, unless we are forced to embrace the subjectivist's anti-realism. This leaves us with a choice about which part of the standard view of sound we should reject. I think that we should conceive of sound as like colour, rather than as like light (see §14). That is to say, we should continue to treat sound as the object of hearing, and we should think of sounds as existing within the object that 'makes' them. (Strictly, on my view, we should say that objects *have* sounds.) Instead of identifying sound with the vibration of air molecules (or any other medium), I propose identifying sound with the vibrations of the object that has the sound. More cautiously, I would say that sounds either are the vibrations of such objects, or supervene on those vibrations. The former would imply a physicalist account of sound, whereas the latter would leave room for a dispositional account. I do not wish to take a side in that long-running and technical debate (found in the literature on colour). No doubt many of the difficulties that arise in the case of colour would apply equally to the case of sound, and sound probably raises some special difficulties of its own.

13. *Do we hear sounds?* I have been assuming from the start that if the standard view is incoherent then we should reconsider the location of sounds. But the

⁸ Shoemaker, 'Qualities and *Qualia*: What's in the Mind', *Philosophy and Phenomenological Research*, 50 (1990), p. 110; Boghossian and Velleman, 'Colour as a Secondary Quality' p. 97.

standard view consists of two claims, and so there is of course another option: one might deny that sound is the object of hearing. It is not obvious how such a move could be defended. Surely it is part of the meaning of the term 'sound' that sounds are somehow the subject of our auditory experience. The subjectivist who would deny that sounds are outside us might deny that we hear sounds. But this subjectivist must grant that sounds are in some sense the content of our auditory experiences. On the standard view, sounds are properties of the external world. How, on that view, could sounds enter into our auditory experiences? Only, it would seem, by our hearing them. If sounds are outside us then they cannot be contained within our auditory experiences, and so must be the objects of such experiences. To say that sounds are in the world, and that yet we do not hear them, would require either a peculiar use of the word 'sound', or else a peculiar use of the word 'hear'.

Yet sounds are not the only things that we suppose ourselves to hear. We speak not just of hearing sounds, but also of hearing the objects that make those sounds. We hear orchestras, birds, students and cars, and we suppose that we hear these things as having a definite location. So perhaps the existence of sound in the air can be defended by clarifying what it is that serves as the true object of hearing. Perhaps sound is the means through which we hear objects.

This line of thought only makes more trouble for the standard view. How do we manage to hear an orchestra, if not by hearing the sound of its performance? (Could our sensations of sound really be just epiphenomenal experiences, floating above the serious work of listening to objects in the environment?) A proponent of the standard view would presumably claim that we hear sounds in the air, and that in virtue of hearing those sounds we listen to the objects that cause the sounds. This would lead to a curious result: that the sounds we hear exist in one place, and that in virtue of hearing those sounds, we listen to objects that are somewhere else entirely. That not only fails to accord with our experience of the process, but suggests that the process is indirect in the most unlikely way. We would listen to the orchestra in virtue of hearing sounds that have an entirely different location. This does sometimes happen, as when one listens to an orchestra through a loudspeaker. But it is odd to claim that all listening is like that. It seems far more natural to suppose that listening to an object just is listening to the sound that the object makes, and that the sound is right there where the object is.

This gives us a further argument for the standard view's incoherence. If we do hear sounds, and if sounds are qualities of the air, then it is hard to explain how, in virtue of hearing those sounds, we also manage to hear the

objects that make the sounds. It seems implausible, at best, to suppose that sounds are in the air, and that we hear these sounds, and thereby indirectly also perceive the objects that make the sounds. Can we really justify such a tangled account, when we might instead simply conclude that sounds, like colours, are the properties of the objects we perceive?

14. *The standard view in science.* Confusions of the sort just described turn up constantly in scientific accounts of sound. Among physicists, sound is conceived of as analogous to light, as a wave passing through a medium. John Tyndall, in his classic work on the physics of sound, occasionally locates sound within the brain, and occasionally within the object making the sound.⁹ (He does both, for instance, on p. 32.) But most often Tyndall speaks of sounds as propagated through a medium. Thomas Rossing begins a recent textbook by remarking ‘The word *sound* is used to describe two different things: (1) an auditory sensation in the ear; (2) the disturbance in a medium, which can cause this sensation’.¹⁰ Psychologists often take the same view. Stephen Handel writes that ‘the vibration of the sound body leads to the propagation of sound’.¹¹ Brian Moore distinguishes between ‘sounds which enter the ear and the sensations which they produce’.¹² The vibrating body producing the sound is always described as merely the source and origin of the sound. The sound itself is assumed to be elsewhere.

Yet at the same time as scientists think of sound as like light, they also think of sound as analogous to colour, as the object of hearing. As a result they end up offering contradictory accounts of what sound is. Some particularly clear examples occur in a standard technical handbook on the psychology and physiology of hearing, edited by Brian Moore, *Hearing (Handbook of Perception and Cognition)*. In the first paragraph of his chapter ‘Cochlear Structure and Function’, Graeme Yates defines sound as ‘a mode of energy transfer by longitudinal motion ... of air molecules’. In the very next chapter, ‘Neural Signal Processing’, Alan Palmer begins by writing ‘Following detection of a sound the auditory nervous system must decipher “What is it?” and “Where is it?”’. These two statements presuppose irreconcilable notions of what sound is. C.J. Darwin and R.P. Carlyon begin their chapter ‘Auditory Grouping’ with a statement that is internally inconsistent:

your auditory system ... in many everyday situations, is presented with an acoustic waveform made up from a mixture of sounds originating from a variety of sources. In

⁹ *Sound* (New York: Greenwood Press, 1969, orig. 1903).

¹⁰ *The Science of Sound* (Reading: Addison-Wesley, 1982), p. iii. I have been helped at several points in this paper by correspondence with Dr Rossing.

¹¹ *Listening: an Introduction to the Perception of Auditory Events* (MIT Press, 1989), p. 57.

¹² *Introduction to the Psychology of Hearing* p. 15.

the space of a few seconds these sounds might include a number of different people speaking, a car passing, music from next door's radio, a door slamming, and the wind whistling through a crack in the window.

First the authors locate sounds in a compression wave; then they identify sounds with the events that gave rise to the compression wave. At work in these passages is an unnoticed ambiguity in our usage of the term 'sound'. On one hand, we treat sound as analogous to colour, as a special object of the senses. On the other hand, we treat sound as analogous to light, as an event in a medium. Philosophers, scientists and ordinary folk have been going on as if these two usages are compatible. They are not.

15. *The measurement objection.* Apart from the technical objections that might be raised against any physicalist or dispositional account of sensible qualities, my own account of sound raises several distinct sets of difficulties, which I now want to consider. One very serious objection to my proposal arises from our practice of measuring sound according to the amplitude of compression waves in the air, standardly measured in terms of decibels (dB). There is, so far as I know, no technical objection to measuring the vibrations of the object that has the sound. But there are quite good reasons for focusing our measurements on the intensity of sound waves: most obviously, because the loudness of a sound varies depending on how far away from an object one is. The standard view can offer a seemingly natural explanation: sounds seem more intense when one is closer to the origin of the sound because they *are* more intense. I must disagree. On my view, sounds only seem more intense when one is closer to their source. In fact, the sound may not have changed in intensity; all that may have changed is one's sensation. One has the sensation of a louder sound, because one is closer to the sound. The sound itself remains unchanged. (In this and subsequent paragraphs I follow the standard practice of treating *loudness* as a subjective feature of one's experience, and *intensity* as an objective feature of the sound, measured in terms of a vibration's amplitude.¹³)

My proposal may strike the reader as implausible. But our practice of measuring sounds in terms of the intensity of sound waves is not as natural as one might suppose. On this system we have no straightforward way of measuring how much sound an object makes. We find it natural to ask how loud a jet engine is, or how loud a concert is, but all we can say in answer to such questions, on the standard view, is that the engine or the concert has such and such a sound when measured at a certain distance. Answers of the latter form will often be precisely what is wanted, and will perhaps always be

¹³ See Moore, *Introduction* p. 53; C. Plack and R. Carlyon, 'Loudness Perception and Intensity Coding', in Moore (ed.), *Hearing*, pp. 123–4.

good enough. But still there seems something peculiar about the standard view's inability to answer a simple question: how much noise does it make?

The peculiarity is illustrated by the 'typical examples' from a textbook chart of sound levels (Moore, *Introduction* p. 24):

Saturn rocket from 150 ft
 Loud rock group
 Shouting at close range
 Busy street
 Normal conversation
 Quiet conversation
 Soft whisper.

Of these examples, only the first and the third are intelligible as they stand. None of the others can be assigned a sound level at all without some further specification of distance from the source. The author's omission of such essential details reflects our sense that it seems natural to assign to an object an absolute, non-relative sound level.

If my proposal still seems counter-intuitive, our visual perception of size is a parallel. From farther away, objects seem to be smaller. But most philosophers would not say that we are seeing something smaller; certainly no one claims that we are seeing something smaller in the medium. We rather suppose that we are seeing the same object, of the same size, and that the object looks smaller because of the distances involved. This is precisely what I want to say about our perception of sound.

One might want to reply at this point that objects generally do not *look smaller* from a distance. (The football player looks huge from across the room, and equally huge from up close.) But much the same point can be made for sounds as well. (She still seems to be whispering, whether it is into my ear or into someone else's.) The point is that our perceptual systems automatically correct for variables such as distance, so that what we perceive remains constant even when our location relative to the object changes. (It is not just that we do not take the object to have changed size, but that in fact it does not even appear to have done so.) Yet this, if anything, gives us further reason to be suspicious of measuring sound according to the amplitude of compression waves. It is often not the case that sounds appear louder when we move closer to the object. The sensation is stronger, of course, but we do not hear the sound as growing in intensity.

I do not mean to suggest that it is misguided to care about the intensity of sound waves. Such measurements are often important, just as it is often important to measure light waves. But it is a mistake to regard these measurements of the medium as measurements of *sound*.

16. *The acoustics objection.* Everyone knows that the acoustics of a space affect the sound of a musical performance. The Philadelphia Orchestra sounds better inside, at the Academy of Music, than outside, at the Mann Music Center. But if sounds are a quality located at their source, as I claim, then such differences in acoustics should not affect the sound of an orchestra. The consequent seems obviously false. Therefore it seems that we must adhere to the standard view, and hold that sounds are in the air.

This objection is no more compelling than an analogous objection in the case of colour. Everyone knows that the lighting in a room affects the colour of a painting. But if colours are in the object, then differences in lighting should not affect the look of the painting. One problem with both of these arguments lies in an equivocation with the phrases 'sound of an orchestra' and 'look of a painting'. Differences in acoustics and lighting do of course affect our perceptual experiences, and so in that sense give the painting a different look and the orchestra a different sound. But it is easy enough to concede this point and still maintain that the sound and colour themselves remain unchanged. Our sensory experience depends on the environment, but the qualities we perceive remain the same.

Have I not just conceded that hearing is not veridical? If so, does that not undermine my principal argument against the standard view (in §5)? No, because the standard view commits us to massive and systematic error, whereas I am only conceding subtle differences. Moreover, the same line of reasoning applies in the case of colour: the leaves outside my window go from dark green to light green and back again, all in the course of one day. Just as there are various tactics for maintaining that colour is a property of external objects, so there will be various tactics in the case of sound. For example, if colours have standard conditions and standard observers, then it seems reasonable to claim that sounds do too. (The fact that you sound good when singing in the shower does not change the fact that your voice is weak and thin.)

17. *Vacuum.* I have found just one published argument for the standard view, and it is an argument that even its author does not believe. It comes from Berkeley's First Dialogue:

Philonous. Then as to *sounds*, what must we think of them: are they accidents really inherent in external bodies, or not?

Hylas. That they inhere not in the sonorous bodies is plain from hence: because a bell struck in the exhausted receiver of an air-pump sends forth no sound. The air, therefore, must be thought the subject of sound.¹⁴

¹⁴ *Three Dialogues*, in *Berkeley's Philosophical Writings*, ed. D.M. Armstrong (New York: Macmillan, 1965), p. 145.

The case of a vacuum is simply the limiting case of the preceding argument from acoustics, and proves nothing more. Moreover, just as we are inclined to say that objects have their colours in the dark, so should we say that objects make a sound in a vacuum. The fact that we cannot hear the sound is not to the point.

I concede that the case of a vacuum does have a certain pull. It seems counter-intuitive, for instance, to claim that the astronaut's hands make a sound when clapped together in space. It is not at all counter-intuitive, in contrast, to believe that the walls of a dark room maintain their colour. But there is a better explanation for our reactions here than the standard view provides. The source of our differing claims in the cases of colour and sound has nothing to do with where these qualities are located. The key difference is that colours are generally stable, lasting properties, whereas sounds typically last but a moment, and depend on how forcefully one object strikes another. In a world full of objects that make a constant, continuous noise as a matter of their own intrinsic nature (they need not, for instance, be struck), we would say that some objects have a noise, others do not, and we would classify objects in terms of the character of their noise (squeakers, murmurers, etc.). Our inclination in such a world would be to say that such objects maintain their noises even when placed in a vacuum. If x has the property of being a squeaker, it would seem peculiar to claim that x loses that property when it is put in a vacuum for five minutes. After all, it will still be squeaking when you take it out of the vacuum. Further, it would be natural to say that the object kept on squeaking inside the vacuum chamber, but that we could not hear it.

Our world is not that world. But if sounds are in objects in that world, then should they not also be in objects in this world? The fact that sounds here are typically short-lived should not make a difference to where they are located. In a world where colours typically last but a moment (either because of changing surface properties or because of lighting conditions that constantly and dramatically change), we would still conceive of colours as located in objects, but we might be more tempted to deny that colours really exist in the dark. Our ideas about colours in the dark and sounds in a vacuum are shaped by a difference in how long those properties typically endure for. Such ideas reveal nothing about where colours and sounds are located.

One might invert the argument from vacuum.¹⁵ Instead of a vibrating object without a receptive medium, there might be a medium in which compression waves are coming from some region of space, but (miraculously) no object is there making the sound. (You hear a bell ringing in the middle of

¹⁵ I owe this idea to a referee for *The Philosophical Quarterly*.

your living room. You inspect carefully and conclude that the sound is coming from the exact centre of the room. You cannot otherwise detect anything at that location.) On my view, it seems, there can be no sound. But that seems absurd.

This is not a special problem for my account. If a red cube appears to be suspended in the middle of your living room, but on closer inspection there turns out to be ‘nothing there’ – you see red shapes, in other words, but cannot otherwise touch or detect the presence of any object – then I would say that the colour is there; and I would say the same for sounds in an analogous situation. What is miraculous is that the colours (sounds) exist without an underlying subject. (Some Catholic theologians believe that something similar happens with the sacrament of the Eucharist.)

18. *How did we go wrong?* If the standard view about sound is as incoherent as I have suggested, then this itself is a fact that calls for some comment. How did we go so far wrong on the subject of sound? One obvious explanation is that we see colours only when we look directly at them, whereas we hear sounds round the corner, down the hall, etc. This suggests that sound fills the air, hence exists in the air, whereas colour seems located in a single place. Of course, this is not a satisfactory basis for saying that the one exists in the object, the other in the air. The difference seems merely a consequence of the different physical properties of light *versus* sound waves. Whereas light waves cast shadows, sound waves can pass around objects, and can bounce off common objects with far less distortion. (Both sound and light waves diffract equally well around objects that are proportionally the same size, relative to wavelength. But sound wavelengths are typically ten million times longer than light wavelengths.)

There is perhaps more to the story. Although it is obvious that sound is caused by vibration, we can imagine that our ancestors were unwilling to accept that sound just is a certain sort of vibration. All strings and bells do move; but surely sound is more than that, or so they thought. So they took the sound out of the object, where it belongs, and put sound into the invisible air. There its nature could remain a comfortable mystery, a primitive quality of the medium, caused by motion, but somehow something more than motion.

Similar worries about colour did not arise until philosophers began to ask hard questions – until after our standard view of colour was already formulated. Lucretius describes how a scarlet cloth loses all its colour when pulled apart into individual threads (*De rerum natura* II 826–33). Locke describes looking at blood through a microscope powerful enough to make it appear ‘some few globules of red swimming in a pellucid liquor’ (*Essay*

Concerning Human Understanding II xxiii 11; see also the example of pounding an almond at II viii 20). Such arguments led philosophers to remove colour from objects, and locate colour in the mind. Sound, I am suggesting, raised this same issue on its very face. We did not need John Locke to make us doubt that sounds are in objects – we could see for ourselves that they surely *could not* be there. But rather than make the eccentric claim that sounds are in our minds, we chose to put them in the air, safely mysterious and irreducible.

It is high time that we see the error of our ways. We should insist on putting sound back where it belongs, among the various sensible properties of objects: among colour, shape, and size.¹⁶

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¹⁶ This paper has benefited from comments by Dave Robb and referees for *The Philosophical Quarterly*, as well as from discussion with Kim Hult, Lisa Polumbo, Joe Moore, Mark Johnston and Eleonore Stump.