

The Argument from Vacuums

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1

A commonly shared assumption is that there are no sounds in vacuums. If the standard science-based view that sounds are waves that exist in and travel through a medium such as air or water is correct, then vacuums hold no sounds and the shared assumption is true. Recently, however, several philosophers (Pasnau 1999, 2000; Casati and Dokic 1994) have argued against the received view. These authors have claimed, primarily on perceptual grounds, that sounds are properties of their sources (Pasnau 1999) or events located at their sources. According to Pasnau (1999), sounds are either identical with or supervene upon the vibrations of objects ordinarily thought to make or produce sounds. For Casati and Dokic (1994), sounds are events constituted by such vibrations. These views share the consequence that sounds can exist in vacuums; sounds occur when an object vibrates alone in the absence of a surrounding medium. I do not wish here to directly engage the debate over whether sounds are properties or events in the medium or in the sources. Instead, I wish to indirectly address it by urging that the question of whether there could be sounds in vacuums should be decided neither by simply consulting common sense nor by reading off the consequences of one's favorite metaphysical theory of sounds. I argue that even independent of explicit theoretical commitments concerning the nature of

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sounds we have reason to resist the claim that there might be sounds in vacuums. This suggests that vacuums place a correctness constraint on theories of sounds, and are not mere spoils to the victor. I conclude with a brief discussion of what this means for developing a metaphysics of sounds.

2

In Berkeley's first dialogue between Hylas and Philonous, Hylas deploys this argument from vacuums in service of the claim that sounds must be in the medium:

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. [The sound which exists without us] is merely a vibrative or undulatory motion in the air.¹

Since we hear no sound when a bell is struck in a vacuum, Berkeley's first premise—that there are no sounds in vacuums—finds support from the dictum that nothing exists unperceived. Barring the dictum, however, we would like to have some reason for denying or affirming that sounds exist in vacuums. The problem (though no problem for Berkeley) is that the fact that no sounds are ever heard in the absence of a surrounding medium shows only that a medium is required for there to be veridical perception of sounds. It does not show that a medium is necessary for there to be a sound. Consider the case of colors in the dark. Objects do not shed their colors in the absence of light. The presence of light is a condition necessary for seeing the colors of things, but not for objects to have their colors.

¹Berkeley (1713/1975), pp. 171–2. Also quoted in Pasnau (1999), p. 321.

Intuition perhaps motivates thinking that the case of sounds in vacuums is similar. Suppose we strike a tuning fork in a chamber filled with air, then quickly remove all the air with a super vacuum pump, wait a few moments, and let the air back in. We first hear the sound of the tuning fork, then hear nothing, and finally hear it again, all while watching the tuning fork vibrate as it does when making a sound.² Does the sound continue through the removal and replacement of the air? Intuition may suggest that it does, and that we simply fail to hear it during the vacuum stage. Experiments that determine whether we perceive it to persist (as we perceive objects to persist as they pass behind barriers), however, seem beside the point. We want to know whether the sound is there, and not whether our perceptual systems implicitly judge that it is there. The former question is precisely one that cannot be answered on perceptual grounds alone. Short of Berkeleyan assumptions, the epistemic resources of perception alone aren't up to the question.

Talk of sounds and vacuums might end here, until we have chosen among competing accounts of the metaphysics of sounds. Against this suggestion, I argue below that good reasons indicate that sounds cannot exist in vacuums, whether we can confirm it or not. My own suggestion will be that no suitable ascription of audible qualities to sounds is available in the case of vacuums and thus that we should conclude that no sounds occur in vacuums.

3

Pitch, timbre, and loudness are qualities first and foremost of sounds. Ascription of pitch et al. to objects or to sound sources depends upon their producing or tending to produce sounds with these qualities.

Sounds produced by an object vibrating in a given way, however, are perceived to differ in audible qualities when the vibration takes place in different surrounding

²Thanks to Roberto Casati for this example.

mediums. The sound of a tuning fork appears to have different audible qualities in water, air, and helium. The perceived audible qualities of sounds vary across different surrounding mediums, and vibrations that take place with no surrounding medium appear to have no audible qualities. What audible qualities, then, does the tuning fork vibrating in a vacuum possess?

A straightforward answer is that because audible qualities of a sound are relative to the medium, the tuning fork in a vacuum possesses no audible qualities. Unless we grant that there are some special sounds without pitch, timbre, or loudness, the tuning fork in a vacuum thus has no sound. A response familiar from the case of colors avoids relativizing to lighting conditions by appealing to standard or ideal conditions which are revelatory of the true or genuine colors of things. Applied to the case of sounds, we could say that the sound of the tuning fork in a vacuum has the loudness it has or would appear to have in air or some other privileged medium.

Though air at sea level seems a natural choice for a standard condition, why not say that the tuning fork's true audible qualities are those it would appear to have in water or helium or liquid mercury? If audition ever reveals to us the audible qualities of sounds, any decision on this question appears highly arbitrary, as it does in the case of vision and colors. Why shouldn't the true color of an apple be the color it appears to have in some very non-standard illumination?

The choice, for example, of daylight as standard or ideal condition for seeing a thing's color is not as arbitrary as it might first appear. Colors of objects are intimately tied to the reflectance properties of their surfaces. The reflectance properties of interest are those in virtue of which a surface tends to absorb and reemit light energy of different wavelengths *across the visible spectrum*. Full-spectrum illumination (which daylight approximates) then has *normative significance* in revealing the colors of things because when reflected it carries information about how objects tend to interact with light across the entire spectrum. Full-spectrum light is revelatory of the range of reflectance properties of surfaces. The apple's color is the one it appears

to have in full-spectrum light because this variety of illumination provides maximal information about the way the apple's surface interacts with light.

No such normatively significant medium exists in the case of sounds. Neither air nor water nor helium reveals the subtle vibrations of an object in the way that full-spectrum light does the reflectance characteristics of a surface. Since the apparent audible qualities of sounds vary across different mediums, since the choice of air at sea level (or at 2000 meters, or at 20 degrees Celcius, . . .) is arbitrary, and since a range of different mediums are equally good for hearing sounds, we should conclude that the audible qualities of sounds depend on the characteristics of the specific medium in which the sounds occur. The audible qualities are medium relative.

Since there is no standard that determines the medium-independent audible qualities of a sound, and since vacuums contain no medium for audible qualities to be relative to, the best thing to say about tuning forks in vacuums is that they simply have no audible qualities. We are therefore justified in concluding not just that a necessary condition on sound perception is missing, but that a condition necessary for there to be a sound is missing in vacuums.

4

If Berkeley's first premise is indeed established by considering the medium-relativity of audible qualities, what are the consequences for theorizing about sounds? In particular, does it follow that sounds exist in the medium as a kind of pressure wave? Unfortunately for the wave theorist of sounds, the necessity of a medium does not entail that the medium is itself the *subject* of the sound or that the sound exists entirely in the medium. So, even though the unmodified property and event theories of Pasnau (1999) and Casati and Dokic (1994) are inconsistent with the vacuum arguments above, they might be modified to make the presence of a medium a necessary condition. For example, a sound might be a property an object has just when it

vibrates in the right way in the presence of a surrounding medium. Or it might be an event an object undergoes when it vibrates in the right way in the presence of a surrounding medium.

But the modification must in some way make the audible qualities of sounds depend upon the medium in which the sounding occurs. This seems to me to diminish the intuitive appeal of these formerly simple theories, since they no longer conceive of sounds entirely in terms of what goes on with an object. Since the properties of the medium in part determine the qualities of the sound, considering the pattern of vibrations of an object no longer provides the full story about its sound. The modification is nonetheless required. For this reason, I propose in closing that a hybrid account is best placed to capture the truth in both the wave theories and the object-based theories. My proposed hybrid makes the sound medium-involving but not entirely in the medium, and object-involving without being entirely determined by the activities of the object. Sounds, according to this proposal, are constituted by the *interactions* of objects with the surrounding medium. On this view, sounds are essentially a matter, in part, of the behavior of an object or objects and, in part, of the surrounding medium and its specific characteristics. The medium is not the sole subject of sounds; neither is the object. Audible qualities of sounds are medium dependent. There are no sounds in vacuums.

References

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- [2] Roberto Casati and Jérôme Dokic. *La Philosophie du Son*. Chambon, 1994.
- [3] Robert Pasnau. What is sound? *Philosophical Quarterly*, 49:309–324, 1999.