Albertus Magnus, Commentary on Aristotle's De anima.*

Book II, Tractatus 3

Chapter 19: Concerning echo, which is reflected sound

But echo occurs when, from air which is made one and continuous by a jar or similar container which limits it, prohibiting its escaping, an expansion causes the same air to be repelled a second time, like a spear which rebounds when thrown against a wall.

In this regard, it must be understood that, like all things related to sensibles, sound is especially generated circularly, and there is a similarity between sound and a stone thrown into water, which, wherever it falls, is like a center, and moves the water circularly in recurring cycles, and the circles widen to become more and more distant, as long as the impetus of the stone which first struck the water lasts, and if anything prevents the generation and movement of the circles, the circulation returns towards the center, where the stone fell. And sound is generated similarly in air, and the first sounding thing is like the location of the center, and sound spreads over circulations of the air; and if there is a solid, slightly concave and tall wall preventing their circulation, it is reflected back to the first sounding thing, and there will be sound in it; and this is thusly called "echo", i.e. a reflection of sound. But echo is also called "ringing" by Avicenna, but in Latin "ringing" and "echo" are different, since ringing is the reflection of sound by a property of metals, such as happens with cymbals and bells, since in these cases [the air] is contained and prevented from escaping, and is reflected from wall to wall. And thus such things ring also because of what we said above, i.e. that they are full of air, and thus shaken and trembling they emit sound for a long time.

If, therefore, as has been said, echo is such a reflection of sound, it appear that there will always be produced an echo, although it is not audible; for echo is not manifest, except when the same air is reflected back to the first percussed thing by some solid obstacle which is slightly concave. But we said above, that air also resists air, when one air is strongly and swiftly percussed by another, and then it is also necessary that a reflection come about; but this occurs in all sound; therefore it is necessary that echo come about in all sound, although it may not be clearly perceived.

But that air which is the same in number is reflected, is clear from this, that when a cultured and articulate voice yells, it is reflected with the same cultured and articulate traits; and in such figures air cannot be struck by the reflecting thing; therefore it must be the case that the first percussed air, being one in number, is reflected.

But even though it may not be perceived, as we stated, nevertheless there always is produced some reflection of sound, and thus the same thing happens with sound as happens with light; for this is always reflected. The sign of this is that when a ray enters in a house via a window, if the light were not reflected, we would not see, nor would the air underneath the wall be illuminated, since the ray does not strike there, if light were not reflected there; but nevertheless the reflection which is caused by air is not manifest, but that which is caused by a solid plane, is manifest; and thus when someone puts the width of his hand in a ray, the light is reflected much more than before. But if something polished and clean is placed [in the ray], then it is reflected by irradiation of splendor. And it is clear that, since light is reflected from water, even though it is permeable, much more than from air, but [it is not reflected] just by air, but also by any other smooth and flat-surfaced body, that an object can produce shadow by means of light; that is, what we called above a "limited body", and which some philosophers call a "limited diaphanum"; for thus reflected light is the act of the transparent, as we defined this above, when we spoke on vision.

But since the inundation and reflection of such a sound comes to be in invisible and intangible air, some [philosophers] stated correctly that vacuum is proper to hearing. For by "vacuum" they meant a subtle air, which is highly apt for being struck; for this sort of air is the cause of hearing according to act, when, in the above-mentioned manner, it is moved as an existing

* This translation is based on the 1967 Stroick edition of the text.

and preserved whole. But nevertheless, because it is fragile and divisible many times, it does not produce sound, unless there is something smooth and solid which is percussed. For then an expulsion of air is produced by the surface struck, because of the flatness of the surface; for the surface of that which is a smooth and solid body is uniform. And thus, if its surface were rough, then when one part was percussed, another part would not be, because the parts are not in a single surface, but in many, and among the jagged parts there will be contained air that is not expelled; but the smooth thing which is percussed sounds strongly, if there were to obtain the conditions determined above, and especially if they were many and non-continuous, they would be as repercussers of the same percussed air. And thus stony forests and mountains are sonorous places, along with well-concealed caverns. And if the sounding thing is above a concavity, then the continually sounding thing's own sound will return to it, and a harmony will be generated; and thus musical instruments nearly always produce their sound above a concavity. And because subtle air produces more sound, therefore rain and cold, which make air more dense, obscure sound; for hearing, as we stated, comes to be in air, which is like a vacuum, which does not impede the generation and spreading of sounds. For sound-producing motion occurs in air which is continuous up to the ear; and if there were to be something intervening in the air, sound would not be heard; and thus far away sounding things are not heard, because they cannot move the air all the way up to the ear, as we stated above, because when the motion ceases the sound ceases.

But someone might propose the following objection concerning two sounds which meet each other in air, as for instance in the space we will call AB, where one sounding thing is at A and another at B, and with C as the medium, where the sounds of the [two sound producers] meet; for either the sounds are equally strong, and then one of them should halt the other; or else one is stronger, and it will then prevail and the other will not be heard. And this is false, because both will be heard clearly and distinctly, because otherwise two speakers could not be heard, so that the one withstands the other.

And thus the solution fails which was proposed by those who say that sound occurs according to circles, but one circulation will not be contrary to another circulation, and thus one will not destroy the other. But this is entirely false, because the circles of water which come from opposite points collide and interfere, as experiment shows. For although one circle is not contrary to another circle, nevertheless the impetus ??? is countered by another impetus, and water which is one in number is not structurable simultaneously and at the same time in two circles which come from opposite points; and it appears that the same thing occurs in air. And it appears to us to necessary to say that the circles which are transmitted, coming from opposite points, touch each other in a part, which is like a point, and in that very place one breaks up the other; but the arcs do not touch in other parts nor break each other up, and in these parts there is a structuring of sound, and [this] is produced by them again in neighboring air, where, in touching the opposite circle, a breaking up occurred. But this does not occur by iteration of sound, but by reflection, as we stated above; for the generation of sound is easy, because in a certain air it does not exist except by intention, as we said above: but two sounds can be structured exactly the same small [volume of] air, because they interfere with each other, and generate a confused sound; and thus two sounds coming to the ear via a small amount of air, are heard confusedly. < 85% Orphan segments >