gun can be said to cause the projectile to shoot off, or than the waves seen in the track of a steamboat can be held accountable for the boat's forward motion. I pull a string so that it vibrates—moves to and fro—less than 16 times a second, and no sound is heard—the "air-waves" from this can't go very far or very fast, every one will admit. But supposing the vibrations are increased to 40—the low E of the contra-bass—instead of 15; then the string, moving on exactly the same principle, and travelling the same aggregate distance, instantly "carves the air into condensations and rarefactions," which travel at the enormous velocity of 1,120 feet a second! Why not explain it in this way, that "in the first instance the stops and starts are so slow that they give off nothing but air-waves, while in the second, the change of direction is rapid enough to generate sound pulses, as well as air-waves, producing such a molecular effect upon the atomic structure of the string itself as to cause the emission of that peculiar substance we call sound!" Is that definite enough. If it isn't, please explain how can we have two entirely different systems of air-waves, one travelling 7 or 8 inches per second, the other 1,120 feet! A bugle-horn can often be heard, in a still night, in all directions for three miles. Let the bugler blow directly through the horn without producing sound, and exert all his lung power, and he can't stir the light of a gas jet a dozen feet away. But let him adjust his lips to the mouth-piece, in the proper manner to produce tone, and, by a simple vibratory motion—as the current theory teaches—and without nearly the amount of lung power, he can manufacture and send off air-waves which *shake the entire atmosphere through 36 square miles*, moving all the particles with sufficient force to vibrate the tympanum of the ear at any point, or in fact, all the tympanums of all the ears which can be crowded into this space! We confess that this appalling deduction helped to shake our faith in the wave theory of sound.

But we were going to say something about the mobility of the atmosphere. Prof. Meyer (Amer. Cyc. Art. "Sound") tries to explain the transmission in this way: "If we imagine a long tube, open at one end and closed at the other by a piston which moves in the tube without friction, it is evident that if the piston is pushed into the tube a certain distance, the air would at the same time move out of the tube at the open end (*i. e.*, if air were incompressible.) But air is compressible and elastic, and after the piston has been pushed into the cylinder, a measurable interval of time will have elapsed before the air moves out of the open end of the tube. This interval is the time taken by sound to traverse the length of the tube." Now, first of all, if we pushed the piston in a little way, would the air travel along and out of the tube as fast as if pushed further, with consequently greater compression? And since "heat" adds to the velocity of sound—1 foot per second for every rise of temperature of 1°—it has occurred to us to ask, in all humility and teachableness, whether the learned professor ever *heated his tube* in order to find out, by actual experiment, how much faster the compressed air would travel through it than when cold? But why confine the air in a tube to demonstrate the air-wave hypothesis of sound? Evidently because the free air wouldn't answer the purpose, *it being extremely mobile*. When we run, the air, pressed away from in front, rushes round and takes its place behind us, and is not disturbed at any great distance around, but the tramping of our feet generates and sends off sound pulses, which reach the ear much farther off and travel with much greater velocity than the incidental shaking of the air caused by our moving bodies. A fish in the middle of the ocean, by moving its fins, pushes away the water from in front which immediately rushes to the rear on account of the great *mobility* of the element, whose mass is disturbed only a very short distance around the fish—the moving of the water being incidental to its propulsion, just in the same way that air-waves are incidental to the propagation of sound.

Another difficulty—which we have only time to suggest—is this: if sound be nothing but "air-waves," is it conducted through water, wood, lead, copper and iron—through all of which it is transmitted much quicker than through air—by means of undulations too? In the depth of our simplicity we ask, isn't it inconsistent? A little bird on the top of a huge oak, by the simple scratch of one of its tiny claws, can set into *undulatory motion* all the particles of the tree from the top to the bottom, and that in an instant too!!

One curious thing about sound which—without intending to weary ROUGE ET NOIR'S readers—we would like to dilate upon a little, is the subject of *sympathetic vibration*, or the surprising fact that if two strings or forks are tuned in such a way as to have the same number of normal oscillations per second, and if one be thrown into vibration its unison neighbour, if placed near enough, will also start into vibratory motion, and sound without any connection whatever with the first, except the intervening air. In a little book by us, "The Throat and the Voice," by Dr. Cohen, of Philadelphia, p. 109, the subject is very concisely treated, but on the old sound theory:

"The influence of the pitch of a sound in exciting a silent instrument attuned to the same pitch is well known to musicians. The response of a glass gas-globe to certain tones of the voice, for example, or the rattling of a pane of glass from a similar cause, must be familiar to all. The effect is mechanical altogether. It is similar to the effect of rhythmic vibration of a suspended bridge, which may accumulate force enough to throw it down. Hence marching in time is prohibited upon suspension bridges. There is an old saying that a bridge of this kind could be destroyed by continuous fiddling on a note of the same pitch as that of the bridge, from mere accumulation of force in the sonorous waves. Heavy bells are started by commencing with gentle impulses in rythmic accord with the proper oscillation of the bell. To quote from an excellent novel (Middlemarch, Chapter XXX):

> "'How will you know the pitch of that great bell,
> Too large for you to stir? Let but a flute
> Play 'neath the fine-mixed metal! Listen close
> Till the right note flows forth, a silvery rill:
> Then shall the huge bell tremble—then the mass
> With myriad waves concurrent shall respond
> In low soft unison.'"

Could all this be the effect of air-waves? Fancy a fiddler standing on the Suspension bridge at Niagara—the bridge has a certain pitch, or vibratory motion—he finds this out and then strikes the note which has the same number of of oscillations per second, keeps on playing this note, and lo and behold! according to this "old saying," combined with the wave hypothesis of sound, the atmospheric undulations given off by the motions "to and fro" of the fiddle string are enough to topple the mighty structure over! The "old saying" might possibly have some foundation to rest upon, but the "air-waves" generated by the vibrating string which "carves the air into condensations and rarefactions," producing heat