concourſe of feeble undulations will produce or be equiva­lent to a great one. The reaſonings of all theſe reſtorers of the ſpeaking trumpet are almoſt equally ſpecious, and each point out ſome phenomenon which ſhould characteriſe the principle of conſtruction, and thus enable us to ſay which is moſt agreeable to the procedure of nature.—Yet there is hardly any difference in the performance of trumpets of equal dimenſions made after theſe different methods.

The propagation of light and of elaſtic undulations ſeem to require very different methods of management. Yet the ordinary phenomena or echoes are perfectly explicable by the acknowledged laws either of optics or acouſtics ; still how­ever there are ſome phenomena of ſound which are very un­like the genuine reſults of elaſtic undulations. If sounds are propagated spherically, then what comes into a room by a ſmall hole ſhould diffuſe itself from that hole as round a centre, and it ſhould be heard equally well at twelve feet diſtance from the hole in every direction. Yet it is very ſenſibly louder when the hearer is in the ſtraight line drawn from the ſonorous body through the hole. A perſon can judge of the di­rection of the sounding body with tolerable exactneſs. Can­non diſcharged from the different ſides of a ſhip are very eaſily diſtinguiſhed, which ſhould not be the caſe by the New­tonian theory ; for in this the two pulſes on the ear ſhould have no ſenſible difference.

The moſt important fact for our purpoſe is this: An echo from a ſmall plane ſurface in the midſt of an open field is not heard, unleſs we ſtand in ſuch a ſituation that the angle of reflected ſound may be equal to that of incidence. But by the uſual theory of undulations, this ſmall ſurface ſhould become the centre of a new undulation, which ſhould ſpread in all directions. If we make an analogous experi­ment on watery undulations, by placing a ſmall flat ſurſace ſo as to project a little above the water, and then drop in a ſmall pebble at a diſtance, so as to raiſe one circular wave, we ſhall obſerve, that when this wave arrives at the project­ing plane, it is diſturbed by it, and this diſturbance spreads from it on all ſides. It is indeed ſenſibly ſtronger in that line which is drawn from it at equal angles with the line drawn to the place where the pebble was dropped. But in the caſe of ſound, it is a fact, that if we go to a very ſmall diſtance on either side of the line of reflection, we ſhall hear nothing.

Here then is a fact, that whatever may be the nature of the elaſtic undulations, sounds are reflected from a ſmall plane in the ſame manner as light. We may avail ourſelves of this fact as a mean for enforcing ſound, though we cannot explain it in a ſatisfactory manner. We ſhould expect from it an effect ſimilar to the hearing of the original ſound, along with another original found coming from the place from which this reflected ſound diverges. If therefore the reflected ſound or echo arrives at the ear in the ſame inſtant with the original ſound, the effect will be doubled ; or at leaſt it will be the ſame with two ſimultaneous original sounds. Now we know that this is in ſome ſenſe equiva­lent to a ſtronger ſound. For it is a fact, that a number of voices uttering the ſame or equal sounds are heard at a much greater diſtance than a single voice. We cannot perhaps explain how this happens by mechanical laws, nor aſſign the exact proportion in which 10 voices exceed the effect of one voice ; nor the proportion of the diſtances at which they ſeem equally loud. We may therefore, for the preſent, ſuppoſe that two equal voices at the ſame diſtance are twice as loud, three voices three times as loud, &c. Therefore if, by means of a ſpeaking trumpet, we can make 10 equal echoes active at the ear at the same moment, we may suppoſe its effect to be to increaſe the audibility 10 times; and we may expreſs this ſhortly, by calling the ſound 10 times louder or more intenſe.

But we cannot do this preciſely. We cannot by any contrivance make the ſound of a momentary ſnap, and. thoſe of its echoes, arrive at the ear in the ſame moment, becauſe they come from different diſtances. But if the original noiſe be a continued ſound, a man’s voice, for example, ut­tering a continued uniform tone, the first echo may reach the ear at the ſame moment with the ſecond vibration of the larynx ; the ſecond echo along with the third vibration, and ſo on. It is evident, that this will produce the ſame effect. The only difference will be, that the articulations of the voice will be made indiſtinct, if the echoes come from very different diſtances. Thus if a man pronounce the ſyllable *taw,* and the 10 ſucceſſive echoes are made from places which are 10 feet farther off, the 10th part of a ſecond (nearly) will intervene between hearing the first and the laſt. This will give it the ſound of the ſyllable *thaw,* or perhaps *raw,* becauſe *r* is the repetition of *t.* Something like this occurs when, ſtanding at one end of a long line of ſoldiers, we hear the muſkets of the whole line diſcharged in one inſtant. It ſeems to us the ſound of a running fire.

The aim therefore in the conſtruction of a ſpeaking trum­pet maybe, to cauſe as many echoes as poſſible to reach a distant ear without any perceptible interval of time. This will give diſtinctneſs, and ſomething equivalent to loudneſs. *Pure* loudneſs ariſes from the violence of the ſingle aerial un­dulation. To increaſe this may be the aim in the conſtruc­tion of a trumpet ; but we are not ſufficiently acquainted with the mechaniſm of theſe undulations to bring this about with certainty and preciſion ; whereas we can procure this accumulation of echoes without much trouble, ſince we know that echoes are, *in fact,* reflected like light. We can form a trumpet ſo that many of theſe lines of reflected ſound ſhall paſs through the place of the hearer. We are indebt­ed to Mr Lambert of Berlin for this ſimple and popular view of the ſubject ; and ſhall here give an abſtract of his moſt ingenious Dissertation on Acouſtic Inſtruments, published in the Berlin Memoirs for 1763.

Sound naturally ſpreads in all directions ; but we know that echoes or reflected sounds proceed almoſt ſtrictly in cer­tain limited directions. If therefore we contrive a trumpet in ſuch a way that the lines of echo ſhall be confined within a certain space, it is reaſonable to ſuppoſe that thc ſound will become more audible in proportion as this diffuſion is prevented. Therefore if we can oblige a ſound which, in the open air, would have diffuſed itſelf over a hemisphere, to keep within a cone of 120 degrees, we ſhould expect it to be twice as audible within this cone. This will be accompliſhed, by making the reflections ſuch that the lines of reflected sound ſhall be confined within this cone. *N. B.* We here suppoſe that nothing is loſt in the reflection. Let us examine the effect of a cylindrical trumpet.

Let the trumpet be a cylinder ABED (fig. T.), and let C be a sounding point in the axis. It is evident that all the ſound in the cone BCE will go forward without any reflection. Let CM be any other line of ſound, which we may, for brevity’s ſake, call a *ſonorous* or *phonic line.* Being reflected in the points M, N, O, P, it is evident that it will at laſt eſcape from the trumpet in a direction PQ, equally diverging from the axis with the line CM. The ſame muſt be true of every other ſonorous line. Therefore the echoes will all diverge from the mouth of the trumpet in the same manner as they would have proceeded from C with­out any trumpet. Even ſuppoſing, therefore, that the echoes are as ſtrong as the original ſound, no advantage is gained by ſuch a trumpet, but that of bringing the ſound forward