hundred times longer, its power would not be increased one half.

We need not therefore aim at much more than to pro­duce a cylindrical space of full effect ; and this will always be done by the preceding rules, or table of constructions. We may give the trumpet a third or a fourth part more length, in order to spread a little the space of its full effect, and thereby make it more easily directed to the intended object. But in doing this we must be careful to increase the diameter of the mouth as much as we increase the length ; otherwise we produce the very opposite effect, and make the trumpet greatly inferior to a shorter one, at all distances beyond a certain point. For by increasing the length while the part CG remains the same, we cause the tangents TB and VA to meet on some distant point, be­yond which the sound diffuses prodigiously. The construc­tion of a speaking trumpet is therefore a problem of some nicety ; and as the trials are always made at some consider­able distance, it may frequently happen that a trumpet which is not heard at a mile’s distance, may be made very audible two miles off, by cutting off a piece at its wide end.

After this minute consideration of the conical trumpet, we might proceed to consider those of other forms. In par­ticular the hyperbolic, proposed by Cassegrain, and the parabolic, proposed by Hase, seem to merit consideration. But if we examine them merely as reflectors of echoes, we shall find them inferior to the conical.

With respect to the hyperbolic trumpet, its inaptitude is evident at first sight; for it must dissipate the echoes more than a conical trumpet. Indeed Mr Cassegrain pro­ceeds on quite different principles, depending on the me­chanism of the aerial undulations : his aim was to increase the agitation in each pulse, so that it may make a more for­cible impulse on the car. But we are too imperfectly ac­quainted with this subject to decide *a priori ;* and expe­rience shows that the hyperbola is not a good form.

With respect to the parabolic trumpet, it is certain that if the mouth-piece were but a point, it would produce the most favourable reflection of all the sounds ; for they would all proceed parallel to the axis. But every point of an open mouth must be considered as a centre of sound, and none of it must be kept out of the trumpet. If this be all ad­mitted, it will be found that a conical trumpet, made by the preceding rules, will dissipate the reflected sounds much less than the parabolic.

Those who have endeavoured to improve the speaking trumpet on mechanical principles, have generally aimed at increasing the violence of the elastic undulations, that they may make a more forcible impulse on the ear. This is the object in view in the parabolic trumpet. All the undu­lations arc converted into others which are in planes perpen­dicular to the axis of the instrument; so that the same little mass of air is agitated again and again in the same direction. From this it is obvious to conclude, that the total agitation will be more violent. But, in the first place, these violent agitations must diffuse themselves laterally as soon as they get out of the trumpet, and thus be weakened, in a propor­tion that is perhaps impossible for the most expert analyst to determine. But, moreover, we are not sufficiently ac­quainted with the mechanism of the very first agitations, to be able to perceive what conformation of the trumpet will cause the reflected undulations to increase the first undula­tions, or to check them. For during the production of a continued sound in a trumpet, it must happen that a parcel of air, which is in a state of progressive agitation as it makes a pulse of one sound, may be in a state of retrograde agitation as it is part of a pulse of air producing another sound. We cannot (at least no mathematician has yet done it) discriminate, and then combine these agitations, with the intelligence and precision that are necessary for enabling us to say what is the ultimate accumulated effect. Mr

Lambert, therefore, did wisely in abstaining from this intri­cate investigation; and we are highly obliged to him for deducing such a body of demonstrable doctrine from the acknowledged, but ill understood, laut of the reflection of echoes.

We know that two sounds actually cross each other with­out any mutual disturbance ; for we can hear either of them distinctly, provided the other is not so loud as to stun our ears, in the same manner as the glare of the sun dazzles our eyes. We may therefore depend on all the conse­quences which are legitimately deduced from this fact, in the same manner as we depend on the science of catoptrics, which is all deduced from a fact perfectly similar, and as little understood.

But the preceding propositions by no means explain or comprehend all the reinforcement of sound which is really obtained by means of a speaking trumpet. In the first place, although we cannot tell in what degree the aerial undulations are increased, we cannot doubt that the reflec­tions which are made in directions which do not greatly de­viate from the axis, do really increase the agitation of the particles of air. We see a thing perfectly similar to this in the waves on water. Take a long slip of lead, about two inches broad, and having bent it into the form of a para­bola, set it into a large flat trough, in which the water is about an inch deep. Let a quick succession of small drops of water fall precisely on the focus of the parabola. We shall see the circular waves, proceeding from the focus, all converted into waves perpendicular to the axis ; and we shall frequently see these straight waves considerably aug­mented in their height and force. We say generally, for we have sometimes observed that these reflected waves were not sensibly stronger than the circular or original waves. We do not exactly know to what this difference must be ascribed ; we arc disposed to attribute it to the fre­quency of the drops. This may be such, that the interval of time between each drop is precisely equal, or at least commensurable, to the time in which the waves run over their own breadth. This is a pretty experiment ; and the ingenious mechanician may make others of the same kind which will greatly illustrate several difficult points in the science of sounds. We may conclude, in general, that the reflection of sounds, in a trumpet of the usual shapes, is ac­companied by a real increase of the aerial agitations ; and in some particular cases we find the sounds prodigiously in­creased. Thus, when we blow through a musical trumpet, and allow the air to take that uniform undulation which can be best maintained in it, namely, that which produces its musical tone, where the whole tube contains but one or two undulations, the agitation of a particle must then be very great ; and it must describe a very considerable line in its oscillations. When we suit our blast in such a manner as to continue this note, that is, this undulation, we are cer­tain that the subsequent agitations conspire with the pre­ceding agitation, and augment it. And accordingly we find that the sound is increased to a prodigious degree. A cor de chasse, or a bugle horn, when properly winded, will almost deafen the ear ; and yet the exertion is a mere no­thing in comparison with what we make when bellowing with all our force, but with not the tenth part of the noise. We also know, that if we speak through a speaking trum­pet in the key which corresponds with its dimensions, it is much more audible than when we speak in a different pitch. These observations show, that the loudness of a speaking trumpet arises from something more than the sole reflection of echoes considered by Mr Lambert. The very echoes are rendered louder.

In the next place, the sounds are increased by the vi­brations of the trumpet itself. The elastic matter of the trumpet is thrown into tremors by the undulations which proceed from the mouth-piece. These tremors produce