this take C*e = CA/12 =* ***2,*** and the length of the trumpet is 2 2 inches. The diameter at the mouth is 2C*e, =* 4 inches. With this inſtrument one voice ſhould be as loud as 144.

If it were required to approximate the ſound only four times, making it 16 times ſtronger than the natural voice at the same diſtance, the angle ACB muſt be 29⁰ ; *Ae* muſt be 2 inches, AB muſt be 11/3d inches, and *ef* muſt be 1/3d of an inch.

It is eaſy to ſee, that when the ſize of the ear-end is the ſame in all, the diameters at the outer end are proportional to the approximating powers, and the length of the cones are proportional to the magnifying powers.

We ſhall find the parabolic conoid the preferable ſhape for an acouſtic trumpet ; becauſe the sounds come into the inſtrument in a direction parallel to the axis, they are re­flected ſo as to paſs through the focus. The parabolic conoid muſt therefore be cut off through the focus, that the sounds may not go out again by the ſubſequent reflec­tions ; and they muſt be received into a cylindrical pipe of 1/3d of an inch in diameter. Therefore the parameter of this parabola is 1/6th of an inch, and the focus is 1/12th of an inch from the vertex. This determines the whole inſtrument ; for they are all portions of one parabolic conoid. Suppose that the inſtrument is required to approximate the ſound 12 times, as in the example of the conical inſtrument. The ordinate at the mouth muſt be 12 times the 6th of an inch, or 2 inches ; and the mouth diameter is 4 inches, as in the conical inſtrument. Then, for the length, obſerve, that DC in fig. 7. is 1/6th of an inch, and MP is 2 inches, and AC is 1/12th of an inch, and DC2 : MP2 = AC : AP. This will give AP = 12 inches, and CP = 11 1/11/2ths; whereas in the conical tube it was 22. In like manner an inſtru­ment which approximates the sounds 4 times, is only 11/3d inches long, and 11/3d inches diameter at the big end. Such ſmall inſtruments may be very exactly made in the para­bolic form, and are certainly preferable to the conical. But since even theſe are of a very moderate ſize when intended to approximate the ſound only a few times, and as they can be accurately made by any tin-man, they may be of more general uſe. One of 12 inches long, and 3 inches wide at the big end, ſhould approximate the ſound at leaſt 9 times.

*A general rule for making them. —*Let *m* expreſs the ap­proximating power intended for the inſtrument. The length of the inſtrument in inches is (m × m *— I)/6,* and the diameter at the mouth is m/3. The diameter at the ſmall end is always 1/3d of an inch.

In trumpets for aſſiſting the hearing all reverberation of the trumpet muſt be avoided. It muſt be made thick, of the leaſt elaſtic materials, and covered with cloth externally. For all reverberation laſts for a ſhort time, and produces new sounds which mix with thoſe that are coming in.

We muſt also obſerve, that no acouſtic trumpet can ſe­parate thoſe sounds to which we liſten from others that are made in the ſame direction. All are received by it, and magnified in the ſame proportion. This is frequently **a v**ery great inconvenience.

There is alſo another imperfection, which we imagine cannot be removed, namely, an odd confusion, which can­not be called indiſtinctneſs, but a feeling as if we were in the midſt of an echoing room. The cauſe ſeems to be this : Hearing gives us ſome perception of the direction of **the s**ounding object, not indeed very preciſe, but ſufficiently ſo for moſt purpoſes. In all inſtruments which we have described for conſtipating ſounds, the laſt reflections are made in directions very much inclined to the axis, and in­clined in many different degrees. Therefore they have the appearance of coming from different quarters; and inſtead of the perception of a ſingle ſpeaker, we have that of **a s**ounding ſurface of great extent. We do not know any method of preventing this, and at the ſame time increaſing the ſound.

There is an obſervation which it is of importance to make on this theory of acouſtic inſtruments. Their performance does not ſeem to correſpond to the computations founded on the theory. When they are tried, we cannot think that they magnify ſo much : Indeed it is not eaſy to find **a** meaſure by which we can estimate the degrees of audibility. When a man ſpeaks to us at the diſtance of a yard, and then at the diſtance of two yards, we can hardly think that there is any difference in the loudneſs ; though theory says, that it is four times leſs in the laſt of the two experiments ; and we cannot but adhere to the theory in this very ſimple caſe, and muſt attribute the difference to the impoſſibility of meaſuring the loudneſs of sounds with preciſion. And becauſe we are familiarly acquainted with the ſound, we can no more think it four times leſs at twice the diſtance, than we can think the visible appearance of a man four times leſs when he is at a quadruple diſtance. Yet we can completely convince ourſelves of this, by obſerving that he covers the appearance of four men at that diſtance. We cannot eaſily make the ſame experiment with voices.

But, beſides this, we have compared two hearing trum­pets, one of which ſhould have made a ſound as audible at the diſtance of 40 feet as the other did at 10 feet diſtance ; but we thought them equal at the diſtance of 40 and 18. The result was the same in many trials made by different perſons, and in different circumstances. This leads us to ſuſpect ſome miſtake in Mr Lambert’s principle of calcula­tion ; and we think him miſtaken in the manner of eſtimating the intensity of the reflected sounds. He conceives the proportion of intensity of the simple voice and of th**e** trumpet to be the ſame with that of the ſurface of the mouth-piece to the ſurface of the ſonorous hemiſphere, which he has ſo ingeniouſly ſubſtituted for the trumpet. But this ſeems to suppoſe, that the whole ſurface, generated by the revolution of the quadrantal arch TEG round the axis CG (fig. 4.), is equally ſonorous. We are aſſured that it is not : For even if we ſhould ſuppoſe that each of the points Q, R, and S (fig. 3.), are equally ſonorous with the point P, theſe points of reflection do not ſtand so denſe on the ſurface of the ſphere as on the ſurface of the mouth-piece. Suppoſe them arranged at equal diſtances all over the mouth-piece, they will be at equal diſtances also on the ſphere, only in the direction of the arches of great circles which paſs through the centre of the mouth-piece. But in the direction perpendicular to this, in the circum­ference of small circles, having the centre of the mouth­piece for their pole, they muſt be rarer in the proportion of the sine of their diſtance from this pole. This is certainly the caſe with reſpect to all ſuch sounds as have been re­flected in the planes which paſs through the axis of the trumpet ; and we do not ſee ( for we have not examined this point) that any compenſation is made by the reflec­tion which is not in planes paſſing through the axis. We therefore imagine, that the trumpet does not increaſe the ſound in the proportion of *g*E2 to *g* T2 (fig. 5.), but in *g* E2 *g* T2

that of gE2/GE to gT2/CT.

Mr Lambert ſeems aware of ſome error in his calculation, and proposes another, which leads nearly to this concluſion,