radii DK, DT, are equal to the spherical surfaces generated by the revolution of the arches DK and DKT round the axis CD, the sound will be condensed in the proportion of DK2 to DT2.

This appears to be the best general rule for constructing the instrument ; for, to procure another reflection, the tube must be prodigiously lengthened, and we cannot suppose that one reflection more will add greatly to its power.

It appears, too, that the length depends chiefly on the angle of the cone, for the mouth-piece may be considered as nearly a fixed quantity. It must be of a size to admit the mouth when speaking with force and without constraint. About an inch and a half may be fixed on for its diameter. When therefore we propose to confine the sound to a cone of twice the angle of the trumpet, the whole is determined by that angle. For since in this case LM is equal to CD, CD2 we have DK : CD = LM (or CD) : CM and CM = \*\*\*iyκ~.

\*\*\*But 2 sin. Ie: 1 = DK : CD, and 2 sin. À *a* : 1 = CD : CM ; therefore 4 sin.2 ⅛ a: I = DK : CM,

And CM = 7 = very nearly. And

4sιn∕⅛α sin. *a*

since DK is an inch and a half, we get the length in inches counted from the apex of the cone = -r-⅛-, or 1 sm.a *a*

3 ———. From this we must cut oft’ the part CD, which 2sm.-α 1

DK , DK 3

is ;—i-, or very nearly -; , or - , —-, measured in

2sm.⅜o sin. *α 2* sin. *a*

inches, and we must make the mouth of the same width 3

2 sin. *d*

On the other hand, if the length of the trumpet is fixed on, we can determine the angle of the cone. For let the 3 length (reckoned from C) be L ; we have 2 sin.9 α = γ, or sin.9 *a* =., j » ood sin. *α =*

Thus let six feet or 72 inches be chosen for the length of the cone, we have sin. *a — ∣J* =0’144-34

= sin. 80 17' for the angle of the cone ; and the width at 3

the mouth is ^gs∙n tf= 10’4 inches. This being taken from 72, leaves 61-6 inches for the length of the trumpet. ’

And since this trumpet confines the reflected sounds to DTli a cone of 16° 34,, we have its magnifying power = ∣jj-⅛, (⅜DT)' sin.2 45° ne , 1 t r

*= (t^DK)≈=* sh‰r4≡8'∣zz 96 near'y∙ lt therefure condenses the sound about 96 times ; and if the distribution were uni­form, it would be heard √7j⅛, or nearly 10 times farther off; for the loudness of sounds is supposed to be inversely as the square of the distance from the centre of undulation.

But before we can pronounce with precision on the per­formance of a speaking trumpet, we must examine into the manner in which the reflected sounds are distributed over the space in which they are all confined.

Let BKDA (fig. 3) be the section of a conical trumpet by a plane through the axis ; let C be the vertex of the cone, and CW its axis ; let TKV be the section of a sphere, having its centre in the vertex of the cone ; and let P be a sonorous point on the surface of the sphere, and P *a f e l* the path of a line of sound lying in the plane of the section. In the great circle of the sphere take KQ — KP, DR = DQ, and KS = KR. Draw QB *h*; also draw Q *d n* pa­rallel to DA ; and draw PB, P *d,* P A.

1. Then it is evident that all the lines drawn from P, within the cone APB, proceed without reflection, and are diffused as if no trumpet had been used.

2. All the sonorous lines which fall from P on KB are reflected from it as if they had come from Q.

3. All the sonorous lines between BP and *d*P have suf­fered but one reflection ; for *d n* will no more meet DAA' so as to be reflect­ed again.

4. All the lines which have been reflected from KB, and afterwards from DA, proceed as if they had come from R. For the lines reflected from KB proceed as if they had come from Q ; and lines coming from Q and re­flected by DA, proceed as if they had come from R. Therefore draw R A *o*, and also draw R *g m* parallel to KB, and draw Q*c* A *q,* Q *b g*, P*c*, and P*b*. Then,

5. All the lines between *b* P and *c* P have been twice reflected.

Again, draw SB*p*, B *r* R, *r u q,* S *x* A*,* R *y x*, Q *z y*.

6. All the lines between *u* P and *z* P have suffered three reflections.

Draw the tangents T A *t,* VBr, crossing the axis in W.

7. The whole sounds will be propagated within the cone *v* W *t.* For to every sonorous point in the line KD there corres­ponds a point similar to Q, regulating the first reflec­tion from KB ; and a point similar to R, regulating the se­cond reflection from DA ; and a point S regulating the third reflection from KB, &c. Ami similar points will be found regulating the first reflection from DA, the second from KB, and the third from DA, &c. ; and lines drawn from all these through A and B must lie within the tan­gents TA and VB.

8. Thus the centres of reflection of all the sonorous lines which lie in planes passing through the axis, will be found in the surface of this sphere ; and it may be considered as a sonorous sphere, whose sounds first concentrate in W, and are then diffused in the cone *v* W*t*.

It may be demonstrated nearly in the same manner, that the sonorous lines which proceed from P, but not in the plane passing through the axis, also proceed, after various reflections, as if they bad come from points in the surface of the same sphere. The only difference in the demonstra­tion is, that the centres Q, R, S of the successive reflections are not in one plane, but in a spiral line winding round the surface of the sphere according to fixed laws. The fore­going conclusions are therefore general for all the sounds which come in all directions from every point in the area of the mouth-piece.

Thus it appears, that a conical trumpet is well fitted for increasing the force of sounds by diminishing their final di­vergence. For had the speaker’s mouth been in the open air, the sounds which are now confined within the cone *v*W*t* would have been diffused over a hemisphere ; and we