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 found 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, we have DK : CD = LM (or CD) : CM and CM = CD2/DK.

But 2S, ½a : I — DK : CD,

and 2S, ½*a : I* = CD : CM ;

therefore 4S,2 ½a : I — DK; CM,

And CM = DK/(4S,2 ½a), = DK/(S,2a) very nearly. And ſince DK is an inch and a half, we get the length in inches, counted from the apex of the cone = I½/(S,2a), or 3/(aS,2a). From this we muſt cut off the part CD, which is = χ; i

very nearly 3-—, or —,τ—, meaſured in inches, and we muſt make the mouth of the ſame width ſt ,, 2 □, *a*

On the other hand, if the length of the trumpet is fixed on, we can determine the angle oſ the cone. For let the

3 length (reckoned from C) be L ; we have 2S,2a = or S,1<7 = ~γ , and S, λ= ∕--.

2L·’ *χ∕ 2L*

Thus let 6 feet or 72 inches be choſen for the length of the cone, we have S, a *= ∕ —— —* ∕ \_L, — 0,14434, V 144 48= sin 8⁰ 17' *for* the angle of the cone ; and the width at the mouth is 3/(2, S, a) = 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 a cone of 16⁰ 34', we have its magnifying power =

½DT2 S,245⁰— TjJ]ξI = ~~» vg,»~~ — 96 nearly. It therefore condenſes the sound about 96 times ; and if the diſtribution were uniform, it would be heard V,96, 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*afel* 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 QBh ; also draw Qdn parallel to DA ; and draw PB, Pd, PA.

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 ſrom it as if they had come from

3. All the ſonorous lines between BP and *d* P have ſuffered but one reflection ; for *dn* 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 RAo, and alſo draw *Rgm* parallel to KB, and draw QcAq, *Qbg,* Pc, and P*b.* Then,

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

Again, draw SBp, B*r*R, *ruQ,* S*x*A, Ryx, Qzy.

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

Draw the tangents TA t, VBv, croſſing the axis in W.

7. The whole sounds will be propagated within the cone vW*t.* For to every ſonorous point in the line KD there correſponds a point ſimilar to 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. And 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 founds 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 had 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 ſee that prolonging the trumpet muſt confine the sounds ſtill more, becauſe this will make the angle BWA ſtill ſmaller; a longer tube muſt alſo occaſion more reflections, and conſequently send more ſonorous undulations to the ear at a di­ſtance placed within the cone vW*t.*

We have now obtained a very connected view of the whole effect of a conical trumpet. It is the ſame as if the whole ſegment TKDV were sounding, every part of it with an intenſity proportional to the density of the points Q, R, S, &c. corresponding to the different points P of the mouth­piece. It is eaſy to ſee that this cannot be uniform, but