\*\*\*\*\*AB×(AB-ED) . , , . , , ,

= - ⅛ fD ' 0n t\*le 0t\*ler hand, because

AB\* — AB × ED = 2 GF × ED, we have AB≈ — AB X ED + ; ED = 2 GF × ED + ί ED≡, or (AB — ⅛ ED)2 = 2 GF × ED + ( ED2, and AB = √ (2 GF × ED 4- ⅛ EDi) + i ED.

Let *x* represent the length of the trumpet, *y* the diame­ter at the great end, and *m* the diameter of the mouth-piece.

Then *x =.* ——-, and *y —* √(2 *xm* -f-1 m2) -∣- ⅛∕λ. Thus

the length and the great diameter may be had reciprocally. The useful case in practice is to find the diameter for a proposed length, which is obtained by the last equation.

Now if we take all the dimensions in inches, and fix *m* at an inch and a half, we have 2 *x m ~* 3 *x,* and ⅛ *ι∣r =* 0∙5625, and m = 0∙75 ; so that our equation becomes *y =* √,(3 *x* -∣- 0’5625) -f- 0∙75. The following table gives the dimensions of a sufficient variety of trumpets. The first column is the length of the trumpet in feet ; the second co­lumn is the diameter of the mouth in inches ; the third co­lumn is the number of times that it magnifies the sound ; and the fourth column is the number of times that it in­creases the distance at which a man may be distinctly heard by its means ; the fifth contains the angle of the cone.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| GF Feet. | AB Inches. | Magnifying. | Extending. | ACB. |
| 1 | 6∙8 | 42∙6 | 6∙5 | ° '  24 53 |
| 2 | 9∙3 | 77∙8 | 8∙8 | 18 23 |
| 3 | 11∙2 | 112∙4 | 10∙6 | 15 18 |
| 4 | 12’8 | 146∙6 | 12∙1 | 13 24 |
| 5 | 14∙2 | 1804 | 13∙4 | 12 04 |
| 6 | 15∙5 | 214∙2 | 14∙6 | 11 05 |
| 7 | 16∙6 | 247∙7 | 15∙7 | 10 18 |
| 8 | 17∙7 | 281∙3 | 16∙8 | 9 40 |
| 9 | 18∙8 | 314∙6 | 17∙7 | 9 08 |
| 10 | 19∙8 | 347∙7 | 18∙6 | 8 42 |
| 11 | 20∙7 | 380∙9 | 19∙5 | 8 18 |
| 12 | 21∙5 | 414 6 | 20∙4 | 7 58 |
| 15 | 24∙ | 513∙6 | 22∙7 | 7 09 |
| 18 | 26∙2 | 612∙3 | 24∙7 | 6 33 |
| 21 | 28 3 | 711∙2 | 26∙6 | 6 05 |
| 24 | 30∙2 | 810∙4 | 28-5 | 5 42 |
|  | ED in all is = 1∙5. | |  |  |

The last two columns are constructed on the following considerations. We conceive the hearer placed within the cylindrical space whose diameter is BΛ. In this situation he receives an echo coming apparently from the whole sur­face TGV ; and we account the effect of the trumpet as equivalent to the united voices of as many mouths as would cover this surface. Therefore the quotient obtained by di­viding the surface of the hemisphere by that of the mouth­piece will express the magnifying power of the trumpet. If the chords *g* E, *g* T, be drawn, we know that the sphe­rical surfaces T *g* V, E*g*D, are respectively equal to the circles described with the radii T *g*, E*g*, and are therefore as T*g2* and E*g2*. Therefore the audibility of the trumpet, when compared with a single voice, may be expressed by T *g2*

\*\*\*\*\*E~s∙ *Now* the ratio of T*g2* to E*g2* is easily obtained. For if E*f* be drawn parallel to the axis, it is plain that BA ED

Bι∕= g , and that E/is to B∕ as radius to the

tangent of BCF ; which angle we may call *a.* Therefore

tan. α = , and thus we obtain the angle a. But if

the radius CE be a<coιnted 1, Tÿ is = √ 2, and Eÿ is — 2 sin. -. Therefore ∣, — ~~~u' an^ the magnifying

∙, 2 sin. “

2 ]

power of the trumpet is = — . The num-

4 sin.9 2sin.\*^∙

'∙> \*2

bers, therefore, in the third column of the table are each = .

2sin,≡l

But the more usual way of conceiving the power of the trumpet is, by considering how much farther it will enable us to hear a voice equally well. Now we suppose that the audibility of sounds varies in the inverse duplicate ratio of the distance. Therefore if the distance *d,* at which a man may be distinctly heard, be increased to *z,* in the propor­tion of EG to T*g,* the sound will be less audible, in the proportion of T*g2* to E G2. Therefore the trumpet will be as well heard at the distance *z* as the simple voice is heard at the distance *d.* \*\*\*\*\*Therefore ~ will express the *ex-*

*V 2 tending power* of the trumpet, which is therefore = .

2 sin A 2 ln this manner were the numbers computed for the fourth column of the table.

When the angle BCA is small, which is always the case in speaking trumpets, we may, without any sensible error, consider Eg> as = = And *Tg* = TC × √ 2 =

AB AB *y*

v 2 = —— = ——∙. 1 his gives a very easy com-

ä 4 V

putation of the extending and magnifying powers of the trumpet.

The extending power is = √ 2 —.

The magnifying power is = 2

We may also easily deduce from the premises, that if the mouth-piece be an inch and a half in diameter, and the length *x* be measured in inches, the extending power is very nearly \*\*\*= *⅛ x* ∣ and the magnifying power — ⅛ *x.*

An inconvenience still attends the trumpet of this con­struction. Its complete audibility is confined to the cylin­drical space in the direction of the axis, and it is more faintly heard on each side of it. We are therefore obliged to direct the trumpet very exactly to the spot where we wish it to be heard. This is confirmed by all the accounts we have of the performance of great speaking trumpets. It is evident, that by lengthening the trumpet, and therefore enlarging its mouth, we make the lines TB*t* and VA*v* ex­pand (fig. 4) ; and therefore it will not be so difficult to direct the trumpet.

But even this is confined within the limits of a few de­grees. Even if the trumpet were continued without end, the sounds cannot be reinforced in a wider space than the cone of the trumpet. But it is always advantageous to in­crease its length ; for this makes the extreme tangents em­brace a greater portion of the sonorous sphere, and thus increase the sound in the space where it is all reflected. And the limiting tangents TB, VA, expand still more, and thus the space of full effect is increased. But either of these augmentations is very small in comparison of the aug­mentation of size. If the trumpet of fig. 5 were made an