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 = 1111/12ths ; whereas in the conical tube it was 22. In like manner, an instrument which approximates the sounds four times, is only 1¼th inch long, and 1¼th inch diame­ter at the larger 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 tinman, they may be of more general use. One of 12 inches long, and 3 inches wide at the larger 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*-1)/6, and the diameter at the mouth is m/3. The diameter at the small end is al­ways one third 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 very 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 sounding 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 sounding 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 de­gree of audibility. When a man speaks to us at the dis­tance of a yard, and then at the distance of two vards, 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 the 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. 8), 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 mouth­piece. 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 mouth-piece 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 pro- \*\*\*f/E' oT2 portion of *gE2* to *g*T2 (fig. 5), but in that of \*\*\*jjg t0 (Jτp∙

Mr Lambert seems aware of some error in his calculation, and proposes another, which leads nearly to this conclu­sion, but is founded on a principle which we do not think in the least applicable to the case of sounds. (b. b. b.)

Trumpet, *Murine,* an old musical stringed instrument, said to derive its name from its inventor Marino or Ma- rigni. Mersenne describes it as a monochord and as a di­chord. See his Harmonicorum libri xii. Paris, 1652, pro­position 37 of book 2d, pp. 56, 57, 58. It was played with a bow, and the sounds were stopped by the fingers gently touching the string, so as to produce the harmonics of the string, in the same manner as is practised on the violin, &c. The loud, harsh, and peculiar tone of the trumpet-marine was increased by the bridge being fixed by one end only to the sound-board, while the other end was free, and al­lowed to strike against the sound-board, according to the vibration of the string, &c. The sounds above the funda­mental of the open string, followed those of the aliquots mentioned in article Music. The reader may consult an ingenious paper upon the marine trumpet in the fourth vo­lume of the late Professor Robison’s Mechanical Philoso­phy, edited by Dr Brewster in 1822, pp. 486-500.

TRUNCHEON, a short staff or baton used by kings, generals, and great officers, as a mark of their command.