XVIII. *Description of a sounding board in Attercliffe Church, invented by the Rev.* John Blackburn, *Minister of Attercliffe-cum-Darnall, Sheffield.*

Read June 5, 1828.

THE material is pine wood. The surface is concave, and is generated by half a revolution of one branch of a parabola on its axis.

The distance from the focus to the vertex = 2 feet.

The length of the abscissa is   .   .   .   . = 4 feet.

The length of the ordinate to the axis   . = $\sqrt{32}$ feet.

= nearly 5.7

= rad. of outer circle.

The axis is inclined forwards to the plane of the floor at an angle of about 10 or 15 degrees, and elevated so as that the speaker's mouth may be in the focus.

A small curvilinear section is taken away on each side from beneath, that the view of the preacher from the north and south galleries may not be intercepted; whence the outer semicircle is imperfect.

This, however, gives an appearance that is not inelegant; and the outer edge being ornamented with crockets and leaves and with a finial at the highest point, and the concave surface being painted in imitation of a groined oak canopy, the effect of the whole is pleasing to the eye.

A curtain is suspended from the lower edge of the canopy for about 18 inches on each side.

1. By means of this erection the volume of sound is increased in a very considerable ratio (perhaps as 5 : 1), and is thrown powerfully, as well as distinctly, to the most distant parts of the church; so that whereas formerly the difficulty of hearing an intelligible sound was very great, now that difficulty is effectually removed. e. g.

The preacher was scarcely audible even in the pews near the pulpit, and not at all in those more remote: he may now be heard in every part, and nowhere more distinctly than in the west gallery, or under it, on the ground-floor.

2. It should seem that the voice is reflected in a direction parallel to the axis; for let A stand in the pulpit, and B stand first in the west gallery opposite to the pulpit, and then in the side galleries; though B is much nearer to A in the latter case than in the former, he can yet hear with decided advantage when opposite to A (i. e. at the greater distance from him).

The side galleries appear to be benefited rather by the increased volume of sound, and by the secondary vibrations excited in a lateral direction.

3. It appears also that vibrations proceeding from a distant point and moving in the direction of the axis, are reflected from the parabolic surface towards the focus. For let A stand in the pulpit as before, and B in a distant point opposite to A, A can then converse with B in a whisper; whilst C, standing at an intermediate point, cannot at all distinguish the words spoken by B; he can however hear what is said by A. Also if B, at a distance, opposite to the sounding board, speaks; whilst A places one ear in the focus of the parabola and one ear towards B, the effect produced is that of a voice close to the ear, and in a direction the reverse of that from which it really proceeds.

4. The converse of this also appears true from the following experiment.

Front View.
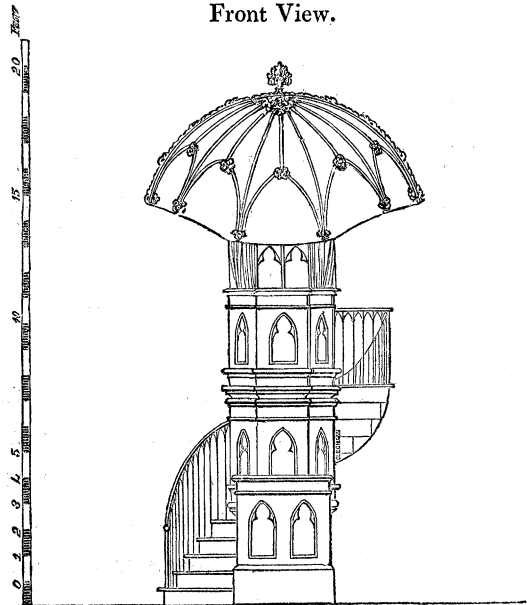
Side View.
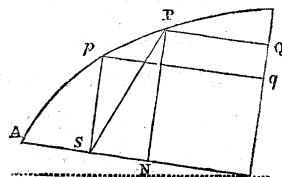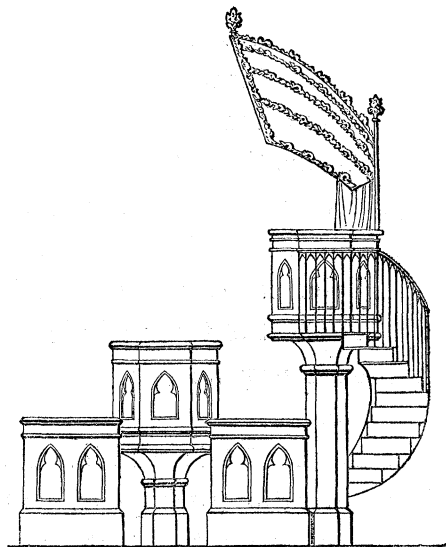
Let B remain in the situation last supposed, and let A place his face towards the parabolic surface, and his back towards B; let A now speak, having his mouth in the situation of the focus, and he will be heard as distinctly as when his face was turned towards B.

5. If the mouth of the speaker is placed much within or without, above or below the focus, the effect is proportionably diminished.

6. The distinctness of articulation preserved may perhaps in some measure be accounted for thus. Assuming that the sound issuing from the focus is reflected in a direction parallel to the axis; assuming also that the velocity of sound is uniform; then the vibrations of the air proceeding from the focus and striking the parabolic surface, at whatever point, will arrive at the same moment of time at a plane perpendicular to the axis. For (according to the properties of the parabola) the sums of the distances (from the focus to the paraboloid, and from the paraboloid to the plane so situated) are always equal to each other: it must however be admitted, that the velocity of sound is too great to allow much dependence to be placed on this conclusion; but it is here proved beyond dispute, that a parabolic surface is capable of being successfully applied to the purpose of a sounding board; whether other concave surfaces similarly situated would be equally successful, or other materials better adapted to answer the end than pine, it might be worth while by experiment to ascertain.

7. Whilst the figure of the canopy remained perfect, the effect was most complete; perhaps it might be improved if constructed larger, or in other words, if continued further; or (should circumstances permit) if the parabola were to perform an entire revolution round its axis; but the distance from the focus to the vertex (which regulates the curve) must depend on the supposed situation of the speaker, which will vary according to the diameter of the pulpit.

<div align="right">JOHN BLACKBURN.</div>

Attercliffe Parsonage, near Sheffield,
May 23, 1828.