JOURNAL
OF THE
FRANKLIN INSTITUTE
OF THE
State of Pennsylvania,
DEVOTED TO THE
MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,
AND THE RECORDING OF
AMERICAN AND OTHER PATENTED INVENTIONS.

JUNE, 1834.

*On the Seams, or Joints, of Steam-boilers. By THOMAS EWBANK, of
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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

To justify inquiry into the minutiae attending the formation of steam boilers, it is perhaps sufficient to observe that no general rule is adopted by workmen in putting them together; and that human life frequently depends upon the skill and workmanship employed in their construction.

The following remarks are designed to call attention to the seams of boilers, and to show the utility of instituting a series of experiments to determine their relative strength. This will appear the more necessary when it is considered that the strength of boilers has been calculated on the cohesion of the solid part of the sheets or plates, without reference to the seams. The tables of Oliver Evans and others are thus constructed.

In order to unite by rivets two plates of metal in the strongest possible manner, several particulars are necessary to be attended to—as the length and diameter, or thickness, of the rivets—their distance from each other—their distance from the edge of the sheets, or what extent of lap each sheet should have—their direction, whether in a right line, as usual, or alternating, thus

That there is a medium in all these, and some other particulars, the best calculated to secure strength in the seams, cannot be doubted. To determine it by experiment, the only sure way, would be of great practical importance.

The length and thickness of rivets, and other particulars relating to them, will depend upon the thickness of the plates they are intended to unite. In working thin sheet iron (when the effects of riveting are easily perceived,) with cold rivets, a good joint cannot be made, if they are either too long or too thick. In the former case the heads of the rivets are liable to burst, and in the latter, the holes to be enlarged. When too long, they also become hardened by hammering, and are liable to break. In forming steam boilers, the rivets are heated, and the plates being thick these results are not so obvious; yet they are sure to be produced in proportion as these causes are suffered to exist.

Supposing the average thickness of rivets to be .625 inch, and that of the plates .25, can the size of the rivets be reduced without injury to the joint? Or, would those of smaller dimensions, and an increased number of them, be preferable? It would seem that they should be sufficiently strong to endure a strain equal to the cohesive force of the plates at the joint, and *no more*; for if their thickness be unnecessarily enlarged, the strength of the plates will, in the same ratio, be diminished, by the extra portion of their substance punched out.

Another inquiry is, What is the proper distance of the rivets from each other? This is evidently important, because the strength of the plates on the line of the joints, is inversely as the number of the holes, or their sum collectively. Admitting the rivets to be half an inch in thickness, and the distance between each one inch (a common proportion) the strength of the plates at the joints is reduced *one-third* below that of the body of the plates:—or, taking the proportions in the boilers of the New England as the average, it is still further reduced, the holes being .625, and the distance between each 1.125. Hence it would appear that no joint can be so strong as the body of the plates. And from all calculations on the strength of boilers predicated on the tenacity of the metal, full one-third should be subtracted; that amount at least being always punched out in every joint for the rivets.

The distance of the rivets from the edge of the plates should also be determined. The holes for them should be made at such a distance that the texture of the metal between them and the edge should not be disturbed. Is there not some danger in this respect when they are but three-eighths of an inch from it? I have noticed some high pressure boilers where the rivets that secured the ends of them were less than that distance from the edge. In such cases it appears very possible for those ends to be blown out, in consequence of the small portion of metal opposite each rivet giving way, as at A.

It appears to me that in all joints or seams, the

centre of the holes should never be nearer the edge of the plates than twice the diameter of the rivets. This point, however, can only be satisfactorily determined by experiment.

Every one acquainted with the working of sheet iron is aware, that it is frequently formed of layers, or strata, which are imperfectly united, so that in punching a hole, or in cutting the edges, the space between the layers is often opened and made visible, which is another reason why the plates should lap over each other to the extent indicated. On this account, iron boilers require more lap than copper ones, the latter metal not being so subject to those defects.

Remarks on the Height of the Aurora Borealis, with a review of the accounts of some of the most remarkable Auroral Arches. By
JAMES P. ESPY.

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I might here terminate the discussion, as I have shown most conclusively that the auroral arches which have been the subject of this investigation, were not five miles high, and probably not more than two; but I shall adduce other proofs which will be satisfactory to those who may not choose to follow me in the preceding investigation. And first I shall give an account of a splendid aurora borealis as seen at the observatory of Gosport on the 7th of January, 1831.

In the afternoon of this day, there was a peculiar brightness in the atmosphere near the horizon, for several degrees on each side of the true north point which indicated the approach of an aurora; indeed, we have reason to suspect that it was a faint appearance of one; while the sun shone in all his splendour, without the interposition of cloud or vapour. Shortly after sunset an aurora borealis gradually rose above the northern horizon, and at a quarter past five o'clock it had assumed the form of an arch of refulgent light, ten degrees in height, and seventy degrees in width. From this time till half past five it continued to increase in the intensity of its light, expanding to the western point of the horizon, and fifty degrees to the eastward of north, which made the chord of the aurora 150° . Now, a bright *flame coloured* rainbow-like arch, between three and four degrees broad, and pretty well defined at its upper edge, emanated from the curved edge of the aurora to an altitude of thirty-five degrees; and while it remained apparently stationary, a beautiful rainbow-like arch, still more brilliant, formed about ten degrees south of the zenith, by streamers suddenly springing up from the N.E. by E. and W. by S. points of the horizon, and meeting in the zenith, so that these two bows presented themselves at the same time. At thirty-five minutes past five, the latter bow, in some parts four and in others six degrees in width, divided a little to the eastward of the vertex; and the long streamers which formed it passed off gently to the southward in very bright patches, two in the south-east and one in the south-west quarters, like