of the tube. The inclination of this mirror may be varied, by means of a milled head, fixed to the axis on the outside of the tube; the other adjustment at right angles being made, by turning the box of the microscope.

Into the tube, above the opening, a conical piece, E, B, is soldered, into which is screwed a small cylindrical tube, carrying the perforation A, before described. The plano-convex lens, U, T, is fixed in a spring tube, which slides into that which forms the body of the microscope. The position, consequently, of the lens, may be varied, so as to bring the image of the perforation into the same plane with the object to be viewed. A piece of plate glass, about two inches square, or less if it be thought more convenient, is attached to the top of the tube, and serves to support a stage, having lateral adjustments at right angles to each other. The piece into which the magnifiers fit, may be moved by a rack and pinion, and great care must be taken to arrange this adjustment, so that the magnifier may move precisely in the prolongation of the axis of the tube. The tube is divided into two pieces of equal lengths, which screw into each other at the middle; and which, when taken asunder, will allow of the whole instrument being packed in a box, about four inches square.

Supposing the plano-convex lens to be placed at its proper distance from the stage, the image of the perforation may be readily brought into the same plane with the object, by fixing temporarily a small wire across the perforation, with a bit of wax; viewing any object placed upon a piece of glass upon the stage of the microscope, and varying the distance of the perforation from the lens, by screwing its tube, until the image of the wire is seen distinctly at the same time with the object upon the piece of glass.

On employing Disks of Fusible Metal to prevent Explosions in Steam Boilers. By M. GUALTIER DE CLAUBRY.

[From De Moleon's *Recueil Industriel*.]

THE fatal accident which happened to a steam boat at Lyons, has caused steam navigation to be held in great disesteem, as well as high pressure steam boilers; and notwithstanding the reasons which have been assigned, on the probable causes of the above accident, yet we see that fears are renewed, and, until more certain means of preservation shall have been brought into use, these fears will be productive of great inconvenience.

The explosion of the boiler of this steam boat, has been attributed to the imprudence of the engineer or his workmen, who, in order to start the boat, loaded the safety valves, to increase the force of the steam. M. Clement thinks, that perhaps in this boiler, as well as in that which burst several years since, at the manufactory of M. Ferrey, at Essone, and which was also constructed by the same engineer, Mr. Steel, the openings of the steam valves were of too small a diameter to give passage to all the steam produced. But whatever may have been the causes of the accident, we should endeavour to prevent

a repetition of it; and here an important question presents itself, which merits the greatest attention; namely, can we find, amongst the various safety valves hitherto employed, one which is calculated to preserve us from all the accidents attending the use of high pressure steam boilers.

We have seen long since, that, owing to various accidental causes, the ordinary safety valves do not always act, so as to ensure safety; and the curious observation of M. Clement, respecting the valves of the blowing machine at Fourchambault, which observation perfectly applies to those of steam engines, has proved, that with safety valves of a large diameter, and under a feeble pressure, but a false security is afforded; as truly so as when their levers are loaded by too great a weight. We must, therefore, recur to other means, in order to avoid those accidents which arise from the too strong pressure of the steam.

The disks of fusible alloys, which melt at the temperature required by the pressure to which we would raise the steam, have, for several years, obtained the approbation of the most enlightened men; and positive experiments have proved that their use would be most advantageous.

Nevertheless, a man of science, whose name is of authority, and to whose opinions we should with pleasure defer, has adopted an opinion of a contrary nature; and which would exercise an unhappy influence, were we to suffer it to pass without examination; it therefore seems proper to provoke a discussion on this important subject, one of the most useful kind, and which may produce results that certainly will benefit science.

These disks of alloy are composed of various proportions of the three metals, bismuth, lead, and tin, and which, according to their relative quantities, melt at particular temperatures; and thus, by a fusion more or less complete, open a free passage to the steam, and hinder the fracture of the boiler, which might otherwise experience too strong a pressure; but the greatest care ought to be taken to insure that these disks should produce their intended effect. They should therefore be composed in such proportions, that they should melt at a temperature but little higher than that at which the steam boiler of the machine ordinarily works.

They should also be placed in a situation well chosen, as it is known that in different points of the surface of the boiler, the temperature is not perfectly equal, and that a disk which would melt at one point, will remain solid in another; and thus it is not sufficient to provide disks which should melt at the temperature indicating a pressure of two, three, or four atmospheres, &c., unless we have also well determined the point at which this pressure and temperature exist. For instance, if the safety valve be placed over the fire-place, or at the extremity of the boiler, it is not likely, that under similar circumstances, the disk should always melt at the convenient time, nor if it be placed in a pipe more or less elevated. It seems that the best position for the disk would be over the fire-place.*

* It was in this position that Mr. Trevithec placed his safety plugs, in the bottoms of his high pressure steam boilers.—*ERROR TECH. REC.*

This observation agrees with the opinion of M. Clement, who says, in his course of lectures on the applications of chemistry to the arts, that in pursuing the theoretic idea of adopting the use of the fusible disks, we must not only calculate upon their fusion, but also upon their softening; and he exhibited one to his auditors, in which its change of form was visible, and this before it had become soft.

In order to judge of the defect in this disk, it would be necessary to know, in the first place, whether it had been placed in the most convenient situation; and, secondly, whether it was composed of good proportions; two circumstances which might exert a remarkable influence upon its change of figure. When a fusible disk is subjected to steam, at a temperature nearly approaching to that of its fusion, as the alloys, according to the proportions of which they are composed, soften at different temperatures, some small parts of them experience a liquation, which we see appear in the middle of the surface of the disk, in the form of globules, of which the number continually augments, so as at length to form a swelling, resembling the head of a cauliflower, in the midst of which an opening is produced, which affords an issue to the steam: but if the temperature be raised gradually, the liquation will continue, and bulge out the metal, especially in the centre, where the fusion has taken place, but not towards the edges, and thus form a projecting disk.

[TO BE CONTINUED.]

Danger from the premature explosion of Gunpowder in the Blasting of Rocks, with suggestions as to the means of prevention.

THE deep interest excited by the following letter, induced me to submit the subject to the consideration of a gentleman whom I knew to have had considerable experience in blasting rocks, and in whose science and skill, I have the greatest confidence. As he has favoured me with an answer, which contains very important suggestions, I am happy to lay it before the public, in connexion with the letter of Dr. Catlin. I have added also, some suggestions of my own.

B. SILLIMAN.

I. Letter of Dr. Catlin.

Haddam, Con. August 25, 1829.

TO PROF. SILLIMAN.

DEAR SIR,—Being desirous to promote the welfare of my fellow citizens, and to render the situation of those engaged in a hazardous employment, as safe as the nature of the case will admit, I take the liberty to address you for the purpose of obtaining some information, on a subject important to mankind.

It is undoubtedly well known to you, sir, that a large number of men in this place, are engaged in the quarrying of stone. They are under the necessity of using large quantities of gunpowder, for the purpose of liberating the rocks, and injuries have not unfrequently