and often of iron. The two ends of this tube being curved up, so as to give it the form of the letter U, one of these extremities is applied to the boiler, and placed in com­munication with the steam ; mercury is poured into the tube, so as to fill one-half of it, and the pressure of the steam upon one of the extremities Figs. 241,242. Fig.243. of the column of mercury, forces the mercury to ascend in the other, and to indicate, ou a divided scale, the amount of pressure, which is about one pound on the inch for each inch of height on the scale. It is necessary, in all these mercurial gauges, that the tube be of equal diameter through­out its length. If the tube be of iron instead of glass, it is necessary that a float of wood, or iron, or ivory, figure 241, resting on the top of it, thou;d ascend above the tube, and indicate on a scale the place of the mercury. For high-pressure boilers a longer tube and scale are, of course, necessary ; and a very con­venient form for this purpose is given in figure 243. From a float resting on the fluid stretches a string carrying a counterpoise at the other end, and passing over a pulley raises or depresses the index of a valve on which the pounds of pressure are indicated by the inches of the scale.

Another very convenient index of pressure, preferable to any other with which we are acquainted, is the piston­gauge. A tube of small diameter, two or three inches, is bored truly cylindrical, and attached to the steam

chest of the boiler, figure 244. This cylinder has a solid plug or piston truly turned, and ground exactly, but not loosely, into it. The pressure of the steam bearing up the piston on the lever, one end of which is attached to the spring indicator, gives the true indication of the pressure on the piston. The spring is also applied di­rectly above the piston, as shown in the second figure; but this instrument is used on a smaller scale than the other. The ordinary safety-valves are described in an­other part of this article.

There is a species of safety boiler apparatus in which great faith has been placed by many mechanicians and men of science. It has been proposed and enacted that boilers be furnished with fusible plugs, or that in parts of a boiler exposed to high temperature and pressure, there should be placed plugs, forming small parts of the boiler, which plugs being composed of metals easily melted, shall give way when by acci­dent too great pressure and heat have been employed, and so, by a less evil, prevent the greater one of total disruption of the boiler. This method of creating a less evil to avoid a greater, has lately been shown to be fallacious, and ought to be abandoned. For the com­plete exposure of the inadequacy of the system of *rodelles fusibles,* we are indebted to the Committee of the branklin Institute, already so often named with gratitude. The American experimenters found, that when alloys of tin, lead, and bismuth are applied to steam boilers in the way recommended by the Commis­sion des Rodelles Fusibles, the alloy does not melt in the manner of an homogeneous metal, ns has been sup­posed ; but that, in fact, the more fusible metal melts in the minute cells of the less fusible metal, long before the whole mass becomes liquid; that the minutely divided, but more obdurate metal, forms a grating, or rather sponge, in which the other lies melted, so that when the temperature of the steam rises to melt the first metal, the pressure of the steam gradually expels the one metal out of the meshes of the other unmelted metal in globules, in such a manner, that the plate at last consists merely of the one unmelted metal, the other having, by repeated heatings, completely exuded from it, and been replaced by such particles of debris as the water of a boiler in common use always supplies in abundance. Thus, a plate of two metals, originally designed to give way at 250°, may still deceive the unconscious attendant, and withhold its warning till it have reached a temper­ature of 500°, and contain a combination of caloric and water as dangerous as gunpowder, and greatly more treacherous.

The following experiment will illustrate the whole of this enquiry. A plate of alloyed metals, of which the melting point in the crucible was about 260°, was sub­mitted to heat under pressure. Such a plate would be applied to a boiler, of which the temperature was not designed ever to exceed in the most extreme case one atmosphere, and of which the usual working pressure would not be more than 5 or 10 lbs. It was found that at 256° small particles of melted metal began to ex­ude from the cells of the unmelted metal ; the globules thus driven out were carefully examined, and found to be fusible at 222°. At 260°, a second portion exuded, and their dross were found to melt by themselves at 232°∙ At 270°, the remaining metal was still tenacious, and was not burst until the steam reached a temperature of nearly 300°, with an explosive force of three times that at which it should have given warning by fusion, and the escape of water and steam, from the small aper­ture it had filled. This last residual porous plate of metal was found not to melt until it reached the temper­ature of 345° instead of 260°. “These experiments the Committee (properly enough) deem conclusive, in regard to the use of fusible plates in the ordinary way ; and they conceive that substituting fusible plugs of greater thickness, say half an inch, as has been directed by a recent ordinance in France, would not serve as a remedy to the defect thus exposed.”

The true remedy for this evil was the next object o the enquiries of this excellent Committee. They pro­perly inferred, that the fusion of an alloy of metals at a given temperature was only to be depended on when it was not exposed to the mechanical action of steam, that is, when not exposed to its pressure, but only to its temper­ature. “ The true remedy is to be sought in enclosing the fusible metal in a case, in which it shall not be ex­posed to the pressure of the steam ; so that the more fluid parts of the metal shall not be exposed to being forced out of the mass, but the whole become fluid, as if exposed to heat in a crucible.” With this view of the sub­ject, trial was made of an apparatus described by Pro­fessor Bache, in the Journal of the Franklin Institute for October 1832, under the title of “An Alarm to be applied to Steam Boilers.”

The construction of Professor Bache’s alarm is suffi­ciently simple. “ A tube of iron or copper, according to the material of the boiler, closed at the lower end, passes through the top of the boiler, its closed end reach­ing the flue to which it is attached. This tube, it will be observed, affords a ready access to the flue to ascer­tain its temperature, without any restraint from packing.