which forms the subject of Report No. 208 under the Boiler Explosions Acts, the engineer in testing the water-gauge omitted to see that the passages in the cocks B and D were clear *when the handles were in their proper working-position*. This defect could easily have been discovered if proper attention had been paid to the condition of the cocks. A defect of this nature may be due to faulty construction originally, or to the handle of the cock having been overstrained and the neck twisted. Whether the passages in the plugs are fair and clear can, however, be verified in a few minutes. As an illustration, the water-cock D, Fig. 6, Plate II, can be verified by blowing through E with B shut, and then removing the handle of D to one side until it is just closed, and then to the other side until it is again just closed. The proper working-position of the handle is about equally distant from each of the above positions. The other cocks can be verified in the same manner.

Another serious casualty occurred through the handle of the cock A, Fig. 3, having been twisted from its original position relatively to the orifice of the cock, resulting in the cock being shut when apparently open.

When a water-gauge that is clear in all its parts has been thoroughly blown through, the water in the glass rises above the level at which it formerly stood immediately the drain-cock E is closed, but if left undisturbed for a time it gradually falls to its former position. The amount of rise which occurs on these occasions depends chiefly on the temperature of the contents of the boiler and on the length of the pipes by which column Y is connected top and bottom to the boiler; but in cases where the gauge is of the description illustrated in Figs. 3, 4, and 5 it amounts in high-pressure boilers to about 4 in., while the time occupied by the water in returning to its former level ranges from thirty to forty minutes. The cause of this rise is twofold—namely, (*a*) the displacement of the comparatively cold water in pipe H by hotter and proportionately lighter water from the boiler, and (*b*) a slight condensation of the steam and a corresponding fractional reduction of pressure in pipe I. The cause of the gradual subsidence of the water in the glass to its former level is also of a dual character—namely, (*a*) the cooling of the water in pipe H, and (*b*) the diminution in the condensation of steam in pipe I owing to the collection therein of air released from the steam condensed.

These results will, however, be somewhat modified if the water in the boiler is of higher density than in pipe H, and this will nearly always be the case owing to the condensation of the steam in the glass and upper fittings of the water-gauge causing the water in the lower part to be fresher than that in the boiler.

The Examiner should impress upon candidates the necessity for periodically blowing through the water-gauge on each boiler (no matter what the form may be) in a systematic and thorough manner, and in cases where a boiler is fitted with two water-gauges of keeping both in constant use. Finally, he should further impress upon them the necessity for keeping the water-gauges well lighted, clean, and in all respects efficient.

APPENDIX E.

Dangers attending the Existence of a Vacuum in Boilers.

The attention of Examiners of engineers is called to the following report relating to a fatal accident to an engineer on board a British ship, and they are requested to see that all candidates for engineers' certificates realize the danger of removing a manhole door without taking the necessary precautions:—

Board of Trade Surveyors' Office,
79 Mark Lane,
London E.C.,

Sir,— 1st December, 1898.

We beg to report that in accordance with your instructions we visited the s.s. "Elderslie," O.N. 89,929, and inquired into the cause of the death, at Smyrna, of Ernest Marshall, third engineer of that steamer, on the 15th October, 1898.

The "Elderslie" is a screw steamer, built in 1884, of 2,761 tons gross and 1,801 tons net register. The engines are compound, direct-acting, and there are two double-ended boilers of the usual marine type, each boiler having six furnaces, three at each end, W.P. 90 lb. Mr. E. Marshall, the third engineer, was found dead in one of the boilers under circumstances which are not readily understood.

The chief engineer, Mr. Bishop, repeated to us a statement which he had previously made, and he was corroborated, so far as his personal knowledge went, by the second engineer, and also by a Greek fireman, Spiloni, and the other firemen in the engine-room and stokehold at the time. It is clear that on the vessel's arrival at Smyrna on the 14th October, after the fires had died out, the boilers were blown down between 5 and 6 p.m., and, by the instructions of the chief engineer, the third engineer proceeded at 7 a.m. on the following morning to take the manhole doors off. (The manholes are 16¼ in. by 12¼ in., and are in the end plate at the after end of the boiler.) He was assisted by Spiloni, who was usually detailed to work with him, and who says that one nut and one dog or cross-bar had been taken off the door, and the other nut started, when the third engineer sent him to prepare to take the door off the manhole of the other boiler. Spiloni left the third engineer, went down a ladder into the stokehold, across the stokehold, up another ladder to the starboard boiler, and immediately afterwards, hearing a loud report, went back to the port boiler where he had left the third engineer, and saw nothing but that the door was off and not in sight. What happened in the interval between this fireman leaving the third engineer and his return in a few minutes can only be reasoned out from the conditions and circumstances of the case, as there is nothing definitely known.

The engineers and engineers' crew were at this time engaged as follows:—

Chief engineer on deck.

Second engineer in engine-room at H.P. cylinder; one fireman with second engineer; one fireman with third engineer; four firemen cleaning engines, and two trimmers cleaning tubes in boilers.

The second engineer in the engine-room heard the report—he says, about 7.15 a.m.—and describes it as being like the sound caused by coal falling in the bunkers. The chief engineer knew nothing until informed that the third was missing. Spiloni and others had been looking about and inquiring for him. The chief joined in the search and finally went to the manhole, when he noticed that the door was off and not to be seen. He states that the boiler was so hot inside that he could not keep his hand in, and that on trying to put his head in the manhole he found it impossible to do so. Hot vapour was coming out of the manhole. His first thought was that the third engineer had allowed the door to drop into the boiler, and, attempting to get it out, had gone into the boiler and been overcome by the heat. He tried to look in with lamps, &c., but could not see