is given. It was found that in the explosion the right hand flue ruptured at the angle bar connecting it to the back end plate, and collapsed along its whole length. It also ruptured on the circumferential seam marked *F*, on the sketch between the first and second rings near the front end. On the rupture occurring on the back of the boiler the bricks and iron work of the flue were blown out, and the water going to the front end of the boiler and escaping to the flue leading from the heating furnace, which contained gas at a high temperature and molten cinder, caused a second explosion which scattered the brick and iron work of the flue. The primary cause of the explosion, in the opinion of the court, was the rupture of the angle bar connected to the back end plate. The rupture at the back end occurred at the point where it was manifest that grooving had been going on for some time, which grooving should have been detected by proper inspection. The owner was ordered to pay £60 towards the expenses of the investigation. The question, then, becomes one of inspection before or after, of the responsibility of nobody in particular, or the complete and full responsibility of the owner.

THE INSPECTION OF STATIONARY BOILERS.

BY J. H. KILLEY, HAMILTON.

For THE CANADIAN ENGINEER.

Fatal steam boiler explosions are becoming common in Canada, frequently attended with the loss of valuable lives. Yet it is known that they can be prevented on land, as they have been on steamers, ever since the Steam Boiler Inspection and Machinery Act came into operation, together with the examination and licensing of the engineers in charge of them. Before this, explosions and loss of life were common on sea as they are now on land. Many attempts have been made to have laws passed to secure this licensing and inspecting, but without success. Why this should be so it is difficult to understand, as it would be to the ultimate advantage of the owners of the boilers and those in charge of them, and also to those whose business brings them into proximity to such a dangerous reservoir of destructive power as a defective or carelessly or ignorantly cared for steam boiler often turns out to be.

Boilers are often run through ignorance of the danger, under pressure that should not be permitted, and safety valves loaded, not with reference to the strength or safety of the boiler, but to a pressure that will do the work to be got out of the plant. Fires are urged far above what is safe, in fact, there are scores of boilers now running that, on a safe working pressure after inspection, would have to be reduced more than one half. Putting extra weights on the safety valves, sometimes fastening them down, is often practiced, a thing no well-informed engineer would think of doing.

After an explosion, shortness of water in the boiler is often spoken of as being the cause. This is not true, as experiments in this direction made for the purpose of ascertaining the effect of shortness of water have never resulted in a destructive explosion. The cause can always be traced to weakness of the boilers from defective construction, condition, or a pressure that the strength of the materials would not stand. In fact, it can be easily demonstrated that the greater the quantity of the water in the boiler the more destructive the explosion will be. For instance, suppose the pressure on the boiler was 120 lbs. to the square inch, the temperature conforming to this pressure would be 341°, or 129 above the boiling point. Should this pressure be suddenly liberated, about one-third of this water would be instantly converted into steam, projecting the water violently against the plates, and bringing about the total destruction of the boiler, and often of many of those about, as in the recent Ridgeway explosion, and that at Waterdown. In both cases it could have been proved that these boilers had plenty of water in them.

If the explosions and loss of life such as took place on steam vessels in Canada had continued after the Inspection Act had been passed, who would have been to blame? The Government. Many attempts have been made in the past ten or twelve years to get the Ontario Government to pass a law which would insure the safety of steam boilers from explosion, and determine the competence of the men in charge, but the effort was unsuccessful. A good steam boiler in the hands of a competent man, who might lose his certificate by carelessness, would save the boiler, save fuel, and would do more work.

EFFECTS OF ENGINEERING WORKS ON WATER CURRENTS.*

BY CYRUS CARROLL, C.E., M. CAN. SOC. C.E.

It is believed that in designing piers, abutments, breakwaters, wharves, and the like, too little attention is generally given to the effects such works are likely to produce by reason of their inducing currents or interfering with those already existing. We see fairly navigable rivers ruined for purposes of navigation by their currents being interfered with by costly works that have not fully answered the purpose intended. These failures very frequently result from ignoring certain fundamental laws that should guide us in working in harmony with the natural tendency of the elements we have to deal with. If at present a breach is forming, let us, if possible, in using it so manage as not to prevent it from continuing its formation. If a rivers enters a lake in a peculiar manner, beware of diverting it—rather assist it in keeping its normal course. In whatever way the bar across its mouth has been made, heightened and strengthened in one part so as to form a basin at the mouth of the river, by penning back its waters by the dam so made—and in another part washed away to form a deeper channel for the river, the natural tendency of *the elements* is to continue such action and formation.

Does a current follow along the lake shore or meet a river-current in any prevailing manner: do not obstruct it very much if you would avoid shoaling water. Do not divert it without weighing well the effect such diversion may have on works already constructed or hereafter to be made in such locality.

In the case of rivers having one constant direction of current, resulting from gravity, it has been found that the planting of abutments on either side, and piers in the stream, will cause a washing away of the banks above such works—that is to say, on the up stream side. This is especially true of rivers of 50 to 100 yards in width, and having a rapid current. Such effects will be minimized by planting the abutments well back into the banks, and making piers as narrow as possible. Where timber is easily got, the writer has found it most economical to drive a single line of piles for each pier for common road bridges, then to frame a heavy cap on top, making it a bent, in fact. The sides are planked

* A paper read before the Canadian Society of Civil Engineers.