

cheap collecting-apparatus placed in both open and confined waters to catch a 'set' of spat, which can then be transferred to ponds or open beds. The methods of spawn-taking and pond-culture introduced by the writer are inexpensive and very simple, and can be understood and conducted by any person of ordinary intelligence, and are fully described in papers already published, or in course of publication, by the U. S. fish-commission, under the auspices of which he has been enabled to carry out his investigations. The experimental difficulties have been overcome. It remains for practical men to avail themselves of whatever of value has been determined by these experiments. There are thousands of acres of salt-marsh land along the eastern coast of the United States, which, with proper preparation, might be made to yield a living to a large number of persons, and which is now not productive of any thing except mosquitoes and malaria.

Pond-culture has one other decided advantage over culture in the open water; namely, that it is possible to effectually exclude from the artificial enclosures certain enemies of the oyster, such as whelks and star-fishes.

J. A. RYDER.

THE EXPLOSION OF THE RIVERDALE.

THE boiler of the steamer Riverdale exploded on the 28th of August, a few minutes after the boat had left her wharf at New York, and started for her destination on the Hudson River above the city. Several lives were lost, and the boat itself was sunk in sixty feet of water. The boiler was raised, and placed upon the wharf near the Delamater iron-works; and the boat, a worthless wreck, was towed to the New-Jersey side of the river.

The steamer had two 'flue-boilers' 25 feet (7.6 m.) long, 6 feet 4 inches (1.93 m.) in diameter, containing four 'direct' flues 14 inches (0.36 m.) in diameter, two of 9 inches (0.23 m.) diameter, and five 'return' flues of 11½ inches (0.28 m.) diameter. The shell was of no. 3 iron, and the area of heating-surface was 676 square feet (63 sq. m.). The iron was of good quality, and was in good condition throughout, except along the bottom, where it gave way. The form, proportions, and workmanship of the boiler were good. The builders, Messrs. Fletcher & Harrison of New York, were among the most reputable constructors of engines and boilers in that city, and were noted for doing good work.

On examination, it was found that the bot-

tom was corroded along its whole length, and had been patched in a number of places where the iron had become dangerously thin, and that in some places the sheets were reduced to one-fourth their original thickness. The shell had been repeatedly patched, and five 'soft patches' were found on the girth-seams. The rupture seems to have started in the thin parts of the bottom, and to have followed the weakened girth-seams quite around, and divided the mass into two parts of nearly equal size, tearing the middle sheet out of the shell entirely.

A coroner's jury made an inspection, examined such witnesses as could be found and such experts as could be induced to testify, and rendered a verdict to the effect that the boiler ruptured in consequence of the weakness of the sheets on the bottom of the shell, which were unable to sustain the working pressure allowed by the U. S. inspector; which weakness had been produced by corrosion on the interior, due to the action of the feed-water. It was further asserted, that the boiler was tested in June up to a pressure of 62 pounds (5 atmos. abs.), and burst ten weeks later under a pressure of but 32 pounds (3 atmos.), in consequence of the neglect of the inspector to observe its condition at the time of testing it. The engine-driver and the inspector were censured by a vote which was not unanimous. The jury expressed the opinion that the present law is not sufficiently explicit and mandatory, and that the use of the test by hydrostatic pressure is insufficient to detect and reveal such defects as here existed.

The inspector acknowledged that he did not try the strength of the boiler with the hammer, as is now usual in all thorough examinations by competent engineers, but merely looked it over; and that at previous inspections he had not entered the boiler, but had only looked in at the manhole. The evidence of the most superficial and inefficient 'inspection' was conclusive; and the fact that proper inspection would have revealed the dangerous condition of the boiler was equally well proven. The so-called 'inspection' was a farce; and the inspector, in a spirit of indifference or indolence, took the chances of an explosion.

The exploded boiler weighed 27,000 pounds (12,247 kilos), and contained 25,000 pounds (11,340 kilos) of water. The explosion was not remarkably violent, but was what old engineers are accustomed to call a 'burst' rather than an explosion. The consequences were, however, sufficiently serious. The energy producing the effects seen in the case of a

true explosion may be imagined, when the amount of heat-energy stored up in such a boiler is calculated. The quantity of heat transformed into mechanical energy by a mass of water and of steam of such magnitude, set free, and expanding down to the pressure and temperature of the atmosphere, from the pressure and temperature at which it existed in the boiler of the Riverdale, would amount to above 1,500,000,000 foot-pounds (over 200,000,000 kilogrammetres). This would be sufficient to throw the boiler and its contents, were the heat all utilized, as in a perfect steam-engine, five miles high. This may give some faint idea of the enormous forces at work, and the tremendous energy stored in a steam-boiler, even where the pressure of the steam is very low, as it was in this case.

It will be concluded, from what has been above stated, that a steam-boiler of the most ordinary and least dangerous type has stored within it an inconceivable amount of available energy in the form of heat, which may be at any moment transformed, in part, into mechanical energy with terribly destructive results, both to life and property; that this powerful agent for good or for evil can only be safely utilized when the utmost care, intelligence, and skill, are employed in its application, and in the preservation of the vessel in which it is enclosed; that the present code of law relating to the care, management, and inspection of steam-boilers, is entirely inadequate to insure safety; that the inspection of steam-boilers, as at present practised by the employees of the government, is not only liable to be inefficient, but is likely to prove worse than none, as it gives to the owner, and perhaps often to the man in charge, of the boiler, a feeling of security which is entirely without basis in fact, and which may therefore cause the neglect of that watchfulness which might otherwise prevent accident; that simple pressure produced by the test-pump, as now provided for by the law, is not a sufficiently effective method of detecting weakness in the boiler, or to be relied upon to the exclusion of other better and well-known methods of test.

The fact that the hydrostatic test is not conclusive as to the safety of a boiler has long been well known and admitted among intelligent engineers. The steam ferryboat Westfield met with precisely such an accident a dozen years ago; and it was shown at the coroner's inquest, at which the writer assisted that official in the examination of his expert witnesses, that the boiler had been inspected, and had been tested, but a few weeks before, by the

U.S. inspector, who applied a pressure considerably in excess of that at which the explosion took place. The cause of the accident, by which a large number of people lost their lives, was precisely that which caused the explosion of the Riverdale's boiler, and the method of rupture was the same. In either case, proper methods of inspection would have saved the lives of the sufferers.

It is undoubtedly true, that many of the inspectors are conscientious, experienced, skillful, and painstaking men, and do their duty in spite of the defects of the existing law; but it is also true that now and then a careless or incompetent inspector will neglect the simplest details of his work, and that we must expect occasional repetition of this sad experience, until the law is intelligently framed, and so administered that the passing of a defective boiler by the inspector shall become as nearly as possible an impossibility.

ROBERT H. THURSTON.

Hoboken, Sept. 23, 1883.

THE AMERICAN SOCIETY OF MICROSCOPISTS.

THE sixth annual meeting was held this year in Chicago, Aug. 7-11. The usual number of members was present, and the meeting was full of interest from the beginning to the end. The forenoon session of Tuesday was given to organization, and the report of the president on the official action of the executive officers for the year. At the afternoon session, papers were read as follows. Microscopical examination of seminal stains on cloth, by F. M. Hamlin. After pointing out the defects of Koblanck's method, that usually given in the manuals, he explained his own, which he had found eminently successful. It is in brief as follows. "1. If the stain to be examined is upon any thin cotton, linen, silk, or woollen fabric, cut out a piece about one-eighth inch square, lay it upon a slide previously moistened with a drop of water, and let it soak for half an hour or so; . . . then with a pair of needles unravel or fray out the threads at the corners, put on the glass cover, press it down firmly, and submit to the microscope. 2. If the fabric is of such a thickness or nature that it cannot be examined as above, fold it through the centre of the stain, and with a sharp knife shave off the projecting edge thus made, catching upon a slide moistened with water the particles removed. After soaking a few minutes, say five to ten, the powdery mass will sink down through the water, and rest upon the slide. The cover-glass may now be put on, and the preparation examined."

College microscopical societies, by Sarah F. Whiting. The author discussed, first, the question 'What use can a microscopical society subserve?' second, 'How can it be made a success?' Such a society, in its range of topics, can take in almost all the physical