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NEW YORK, SATURDAY, DECEMBER 17, 1881.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 311,

For the Week ending December 17, 1881.

Price 10 cents. For sale by all newsdealers.

SOME GREAT ENGINEERING PROJECTS.

The shortening of commercial routes by means of ship railways and ship canals seems to be the great ambition of the engineers of to-day.

In addition to the De Lesseps Ship Canal at Panama, the Eads Ship Railway at Tehuantepec, the Florida Ship Canal, the Chesapeake and Delaware Ship Canal, the Cape Cod Canal, and others in the interior of this country, there are several other important projects of like nature under way or in prospect in various parts of the world. The old project of connecting the Bay of Fundy and Baie Verte, on the Gulf of St. Lawrence, across the Isthmus of Chignecto, has lately taken new form. It is now proposed to make the connection by a ship railway eighteen miles long, thus making a short cut for navigation between the United States and the ports on the St. Lawrence Gulf and River, and saving the long and dangerous voyage around Nova Scotia.

The projector of the ship railway, Mr. H. G. C. Ketchum, writes us that the plan grew out of a desire to save lockage and a deep channel in the design of the Baie Verte Canal. His first plan was to lift vessels by hydraulic power on pontoons and then float them through the canal. The idea then occurred that they might as well be lifted to the surface of the ground and hauled across the neck of land on rails. The road may be level and perfectly straight from end to end. The plan has been submitted to the Dominion Government and is favorably entertained. Mr. Ketchum has issued an interesting pamphlet relative to the project, which may be considered at greater length elsewhere.

Across the ocean the construction of the tunnel under the British Channel, connecting England with the Continent, is being prosecuted with an energy which is indicative of ultimate success, and thus far no obstacles have been encountered to make the undertaking a difficult or exceptionally hazardous one.

In France the connection of the Atlantic with the Mediterranean by a ship canal, to save the long and stormy voyage around the Spanish Peninsula, is under serious consideration, and the Council-General of the Seine have just adopted a resolution approving of the project.

The ship canal across the Isthmus of Corinth, in Greece, to shorten the route to Constantinople and the ports of the Black Sea, has, we believe, been definitely determined upon.

In the far East a bolder and more important project is in contemplation, with a view to shortening the commercial route to China and Japan by six hundred miles or more. At the head of the Malay Peninsula is the Isthmus of Kraw, connecting Upper with Lower Siam; and by the cutting of a ship canal at this point, about thirty miles in length, the need of sailing around the peninsula might be obviated. At Kraw, the Malayan Peninsula, which stretches southward for five hundred miles to Singapore, is at its narrowest breadth, and the distance across from the side of the Indian Ocean to that of the China Seas is further decreased by the existence of natural waterways for some distance inland from both shores. From side to side it is no more than fifty miles, and the Pakchan River, on the western coast, and the Htassay on the eastern, afford the ready means of further reducing it. The distance, therefore, over which it would be necessary to cut a canal would probably not exceed thirty miles. The neighboring districts are known to be fertile and to contain great mineral wealth. A tin mining company has been established for more than ten years at Malewon, on the Pakchan, and gold has been found in the neighboring stream of the Lenya. So far as known the engineering difficulties are not of a stupendous character, and political drawbacks and considerations fortunately do not exist.

The French appear to have taken the lead in proposing this important commercial short-cut, and, if the opinion of the London *Times* is well founded, the Government of British India will not decline to actively participate in its execution.

RAILROAD ACCIDENTS.

Railroad statistics show that there were an unusual number of accidents attended with fatal results on American railroads during the year ending October 31, 1881. They foot up 1,492 accidents, by which 397 persons were killed and 1,687 more were injured, being a monthly average of 124 accidents, 33 killed, and 141 injured.

The month of October, as reported by the *Railroad Gazette*, shows a greater number of accidents than the monthly average for the year, although the fatality was slightly less, the total for the month being 131 accidents, 31 persons killed, and 133 more injured. Of the October accidents, 51 were collisions, 77 derailments, 2 boiler explosions, and 1 fire. More than half the number of mishaps, where the time of day was reported, happened in the daytime, which appears to be remarkable, although it is said to be not an uncommon thing for more train accidents to occur in daylight than in the night time.

January took the lead in number of accidents, 223 having occurred in that month, while the greatest number of fatal casualties were in September, namely, 56 killed.

There were no less than four successful attempts at train wrecking in October. In one case obstructions were put on the track, in another a rail was removed, and in two more switches were misplaced. In only one case were the wreckers caught, and they are to be tried for murder, an engineer having lost his life in the wreck.

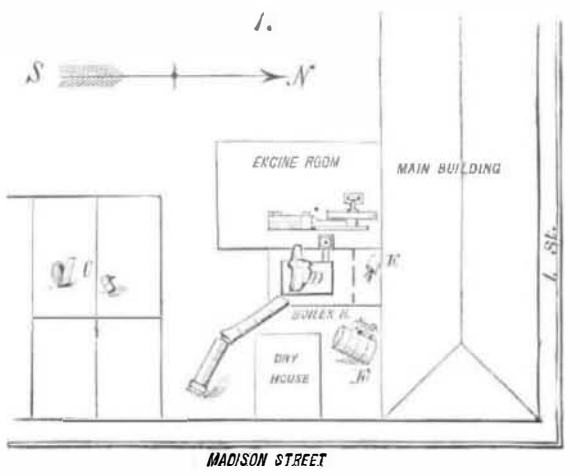
Six broken bridges are in the record for the month, an unusually large number. One of these had its abutments washed out, and in two other cases they were small wooden bridges.

TERRIBLE BOILER EXPLOSION IN OHIO.

The new Dayton Wheel Works, one of the finest manufactories of light vehicle wheels in this country, owned and occupied by Pinneo & Daniels, Dayton, Ohio, was, on October 25, the scene of a most astonishing and lamentable boiler explosion.

Three persons were killed, a number severely injured, and extensive damage was done to the works.

Henry Rokel, the only man in the fire-room at the time of the explosion, which took place at the noon hour, was blown into the fuel room and fatally mangled. Katie Makley, a girl of thirteen years of age, was killed by a flying brick while at play with her companions in St. Joseph's schoolyard, a square away from the boiler house. A young man

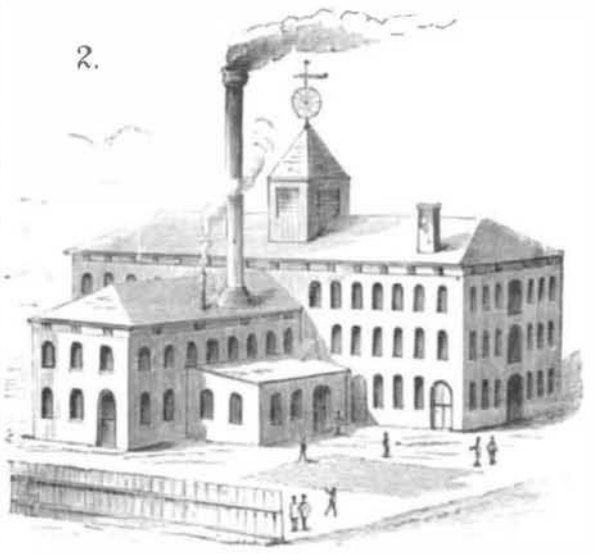


Plan of Dayton Wheel Works.—(C, rear end of boiler. D, girdle of plates. E, front end of boiler. F, boiler No. 1.)

of seventeen years of age, named Mostbaum, was so badly injured that he died soon after the accident. He was eating his dinner in the yard. Peter Aplin, the engineer, formerly a railroad engineer, but in the employ of this firm since 1852, in their old works and their new, was in the engine room oiling his engine and preparing to start up the machinery. He was thrown among the ruins badly bruised and cut about the upper part of his body, but able to dig himself out. A number of others were injured. There were fifty or sixty workmen in the main building.

The plan of the works and the distribution of the parts of the broken boiler are shown in the diagram, Fig. 1. The four story main building and the wings, all of brick, are shown in Fig. 2. Other buildings, including a large dry-house, shown in the foreground of the diagram Fig. 1, are omitted from Fig. 2 for the sake of clearness of illustration.

The one story building (Fig. 2) in the angle was the boiler house, in which were two horizontal tubular boilers, 5 feet diameter by 16 feet long, each containing 46 flues, 4 inches



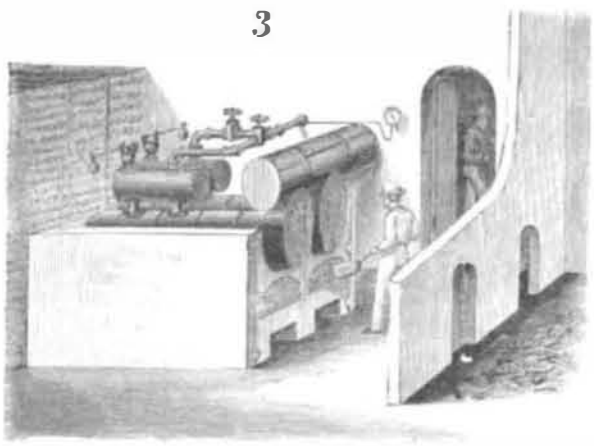
Dayton Wheel Works before explosion.

diameter, full length of the boiler. The steam drums, shown in Fig. 3, were 24 inches diameter by 7 feet long, upon which were attached the safety valves and steam connections, as shown. Each boiler had also a mud drum, 18 inches diameter by about 6 feet long, seen in Fig. 5.

The shells of these boilers had double riveted longitudinal seams, were new less than a year before the explosion, and originally had the appearance of being what they were intended by both makers and users to be—sample pieces of workmanship. The iron was five sixteenths charcoal brand, slightly under thickness, ranging from 0·29 inch to 0·30 inch, and said to have a tensile strength of 55,000 pounds to the square inch; meaning simply that a strip 1 inch wide, 0·29 inch thick, would break, if steadily pulled without shock, torsion, or bending, under a force of (55,000 × 0·29 =) 15,950 pounds acting in a direct line parallel to the plane of the strip, as in a testing machine, for example.

These boilers were provided with the usual attachments, including two steam gauges, one in the fire-room and one in

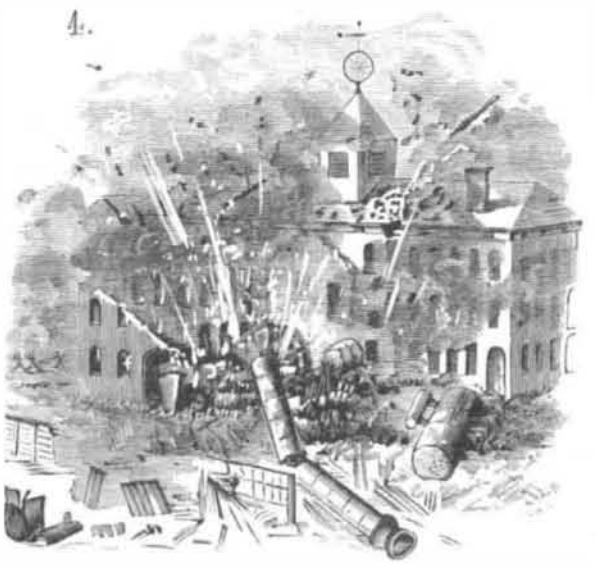
the engine room. They had, however, a common attachment to the boilers, not shown in the engravings. The water was fed into the front ends of the boilers and blown out from the rear end of the mud drums. There were two 4-inch safety valves, each having its own separate stand pipe communicating directly with the steam chamber of each boiler, as it properly should do.



Interior of Boiler House.

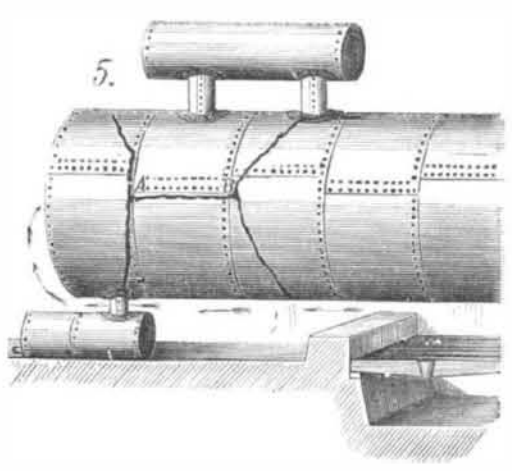
The boilers were tested at a pressure of 140 pounds and put in operation about the beginning of 1881. The fuel used was chips, shavings, and refuse of hard dry timber from the factory, which was stored in the fireproof fuel room, shown at the right of Fig. 3. The steam was distributed at a supposed maximum pressure of 80 to 90 pounds through 6-inch main steam pipes to a 20-inch by 42-inch automatic cut-off engine running at 69 revolutions per minute. Direct steam was also used for the dry-houses and for warming the work rooms. The duty of the engine was to drive a large lot of improved hub, spoke, and felly machinery for making light carriage wheels.

About 12:45 P.M., October 25, the destruction shown in Fig. 4 suddenly took place, caused by the bursting of the shell of right hand or No. 2 boiler. The primary rupture began at the left-hand side, or toward No. 1, on the line A B,



Boiler Explosion at Dayton Wheel Works.

Figs. 5 and 8, just below the overlapping end of the plate at the seam; the secondary rupture, taking the course indicated by the irregular lines in Fig. 5, which extended entirely around the boiler, the force of the expanding water, gushing from this long and suddenly made opening, tore off and flattened out the girdle of plates shown in Fig. 8, and 9,000



Boiler No. 2, showing initial rupture, A B, and secondary lines of rupture running round the boiler.

pounds of water, more or less, practically exploded simultaneously with its release, giving out as much as 100 heat units per pound of water, each unit capable of raising 772 pounds one foot high. The force, then, including the free steam from both boilers, would probably exceed 500 millions of foot-pounds, which may be considered ample when set free in the fraction of a second to produce the observed effects.

Relating to the cause of the initial rupture a quotation from the Dayton *Journal* is admissible, though it should be taken with caution, as there are several obvious errors in the article. That paper reports the engineer as having said:

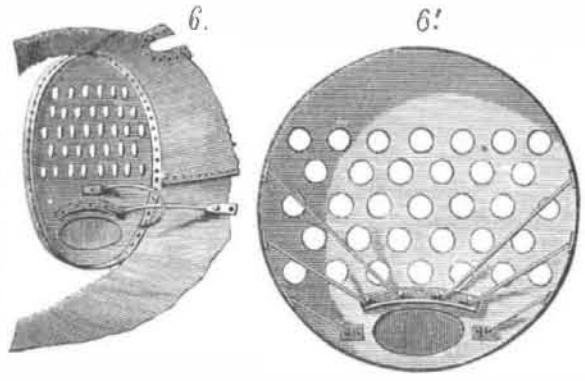
"At 12:25 o'clock he had three full gauges of water, and the steam had run down to 75 pounds. In the morning he had carried 90 pounds."

Again, after he had directed Rokel to put fuel in the furnaces so as to keep the fire from dying out, he is reported as having said he "saw that the engine room gauge showed 80 pounds of steam in the engine room, and Rokel cried out to me in the boiler room that the gauge there indicated 75 pounds."

The engineer continues: "The boiler was scaled pretty thick, and I had tried to get as much of it off as I could, but I think the scales had crystallized (the iron?), and thus caused the explosion. This boiler always leaked at this place, and I felt that it was dangerous, so it was repaired last week. It was placed in the house last December, and appeared strong."

The repairs were, calking a longitudinal seam on the other, right-hand, side of the boiler shell, at I, Fig. 8, near the rear head, which had given warnings of its frail condition, while the seam, A B, might not have leaked before rupture took place.

The fact in the case is that the initial defect was a partial fracture just at the edge of the lap, A B, plainly indicated by the different colors on the fractured edge; old black oxide



Rear end of boiler after explosion. Rear end of boiler before explosion.

extending in places nearly half across the fractured edge, indicating brittle, "cold short" iron. And the same is seen at the seam where the marks of the calking tool plainly indicate the location of the leak spoken of by the engineer as having lately been repaired "because he felt that it was dangerous," I, Fig. 8.

The parts of No. 2 boiler are shown on plan, Fig. 1, C being the rear end in the yard of a dwelling 150 feet from the boiler house, shown on a larger scale, Figs. 6 and 6'. D, Fig. 1, is the position of the girdle of plates, enlarged in Fig. 8. E is the point where the front end lay with the dead Rokel, shown enlarged in Fig. 7. F, Fig. 1, shows the position of No. 1, the unbroken boiler, which turned end for end and tore off the corner of the dry-house in the foreground of the plan.

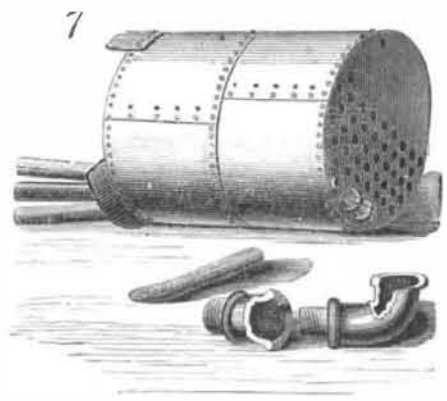
Experts, and especially professional boiler experts, are accustomed to ask steam users to believe that the use of steam can be made safe, and that there is no mystery in boiler explosions; that they are the result of carelessness, ignorance, bad iron, or bad workmanship; but it seems rather discouraging to such as desire to get an idea when they may safely continue to use their boilers, to be put off with such stuff as that contained in the following certificate, which we quote from a local newspaper:

"We, the undersigned, at the request of Messrs. E. H. Brownell & Co., and Messrs. Pinneo & Daniels, have made a thorough examination of their boiler that exploded October 25, 1881, and find the iron in the boiler to be first-class, made by the Licking Rolling Mill Company, and the workmanship good. We are satisfied that Messrs. Pinneo & Daniels took all due pains and spared no expense in having their boiler fitted up in first-class shape, and had provided more than ordinary means for the safety of their boilers, and cannot see that any blame can be attached to Messrs. Brownell & Co. as makers, or Messrs. Pinneo & Daniels. We find that Mr. Peter Aplin bears the name of a careful and experienced engineer, and one of the best in the city. By testing one of the steam gauges, we find it worked correctly. We find no indications of low water. We find it impossible to determine the cause of the explosion.

AID COLLINS,
Of the Hartford Steam Boiler Inspection and Insurance Company.
JOHN L. PEAU,
Of the Swift Iron and Steel Works.
J. H. VAILE,
Of Smith, Vaile & Co.
SIMON SPARKS, M. M.,
With Woodsum Machine Company."

The owners of these new and apparently well made and thoroughly equipped boilers ought not to be told that it is impossible to determine the cause for the explosion. They, in common with most thinking men, no doubt believe that there was a sufficient cause, which somebody ought to be able to explain.

Although a greater pressure than 80 or 90 pounds is not needed to account for this destruction, yet it is not improbable that the pressure, even with two steam gauges themselves in order, and two safety valves of ample size, might have been much above the indications reported. The gauge pipe common to both gauges being accidentally obstructed is all that we require, together with the faulty safety valves, which are illustrated on an enlarged scale in Fig. 9, to fatally

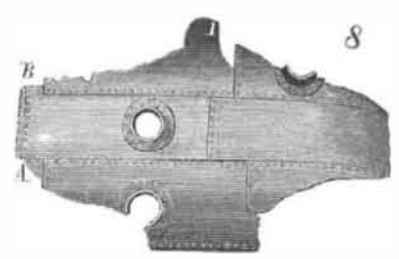


Front end of boiler after explosion.

mislead an observer as to the pressure actually endured by the boilers, both of which were in use at the time of the accident. With perfect safety valves, the boilers being sound and good, the hardest firing would not have dangerously increased the pressure, even though the temporary fireman was densely ignorant of the duties of a boiler attendant.

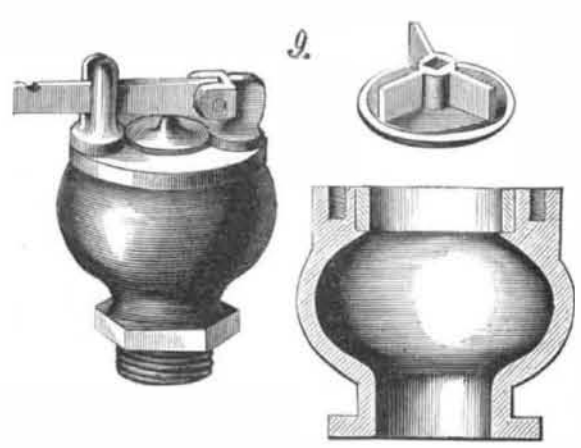
Referring to the cut (Fig. 9) it will be seen that the safety valves were broad disks with three short guide rings and a broad seat. The short blunt stem or teat on which the lever rests is seen to be very close to the lever pivot, barely two inches. These teats were not turned, and might or might not be in the axis of the valve. If the point upon which the lever rests is not central, then a uniform pressure upon the disk below would raise only the side having the larger radius, and "jam" the rings fast in the seat or guide ring. Once in that plight the current of steam toward the crescent-shaped opening would impinge on the rings and tend to increase the difficulty without materially relieving the boilers of pressure. One of these valves bore marks of having been jammed in this way so as to bruise the guide rings.

The SCIENTIFIC AMERICAN has made a careful examination of the exploded boiler of Messrs. Pinneo & Daniels, and



Girdle of plates torn from No. 2 boiler. A B, line of initial rupture. I locality of leak mentioned by the engineer.

finds that the explosion was due to the bad quality of the iron at the line A B; that the plate at this point was brittle; that this brittle iron was subjected to slight hinge-bending motions, caused by variations of pressure on the flattened portion of the boiler at the broad seam; that these motions tended to crack the poor iron; that the plate at the line A B showed the existence of a crack of older date than the explosion; that the steam pressure indicated by the engine



Details of Safety Valve.

room gauge was sufficient to cause the explosion, in view of the cracked and impoverished nature of the iron.

Speed of the Servia.

The new Cunard steamer Servia was tested for speed November 19. The vessel was repeatedly run at the measured mile, and ultimately taken out into the channel and run back between the Cumbrae and Clock lighthouses, a distance of 15¾ statute miles, the result of the day being that she attained the remarkable speed of 20½ statute miles per hour, having on board 2,500 tons of dead weight.