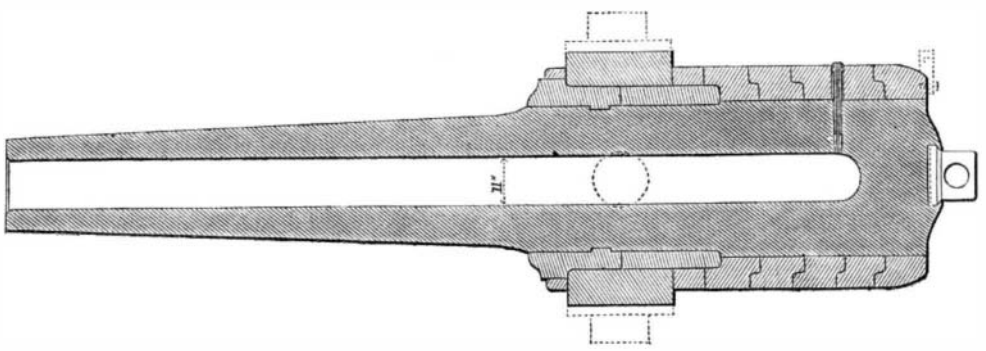
CAST-STEEL ORDNANCE.

We are enabled to lay before our readers a correct representation, made from a working drawing, of one of Krupp's cast-steel guns. These weapons have become celebrated for their strength and endurance; and the translation which we present, extracted from the *Invalid Russe*, organ of the Russian Government, will serve to show the estimation they are held in by that Power. The Russian Government have ordered of Mr. Krupp 220 guns of 8-inch, 9-inch, and 11-inch bore, all rifled muzzle-loaders, together with a number of steel shot and adjusting cylinders for loading. The value of the contract exceeds 4,000,000 thalers, or about $3,000,000—the gun to be delivered at the works in Essen. The 11-inch gun will weigh about 27½ tuns, and costs $30,000 (40,000 Prussian thalers). The extreme length is 17 feet 2 inches; the diameter at the reinforce is 47½ inches. The whole gun is of cast-steel, and the barrel alone will require an ingot of forty tuns in weight, upon which cast-steel rings of a peculiar form are shrunk, as will be seen by the diagram herewith annexed:—

THE OFFICIAL REPORT CONTAINED IN THE "INVALID RUSSE," No. 271, OF DECEMBER 28, 1863, UPON THE TRIALS WITH A 9-INCH CAST-STEEL EXPERIMENTAL GUN :—

"It has been found necessary, since the introduction of iron-cased vessels, to use guns of the greatest possible caliber in order to destroy the iron coating, and also to do this at the highest practicable ranges. To attain this desired object it has been rendered essential to produce guns from a metal possessing a high tensile strength and capability of resisting the enormous strain of large charges of powder. From experience it has been proved that cast-steel is the best metal, and far superior to all others hitherto applied to gunnery, as it combines with strength the important element of toughness; consequently our Government has ordered for the armament of our iron-cased vessels, and sea-coast defenses, a number of 8-inch and 9-inch guns from the well-known and justly renowned works of Mr. Fried. Krupp, of Essen, Rhenish Prussia—the only establishment capable of executing cast-steel guns of such large dimensions.



"All breech-loading guns tried up to the present time have not possessed sufficient strength to resist the forces they are exposed to, as the soft coating of the heavy shells and shot used with such guns has frequently been stripped off; and to obviate this objection our Government has ordered heavy guns to be loaded from the muzzle. To ascertain by experience which class of rifling might be most suitable, and also the kind of shell best adapted for such heavy guns, and moreover to test the effect upon iron plates, a 9-inch gun was ordered from Mr. Krupp to practically solve these questions. It has been proposed by Sir Wm. Armstrong, in order to obtain the greatest possible accuracy for muzzle-loading rifled guns, to use a plan of rifling known as the "shunt" system, and which has proved in practice to be very good, as the shell is compelled to leave the muzzle of the gun without there being any space between the diameter of the bore of the gun in the rifle grooves, and the diameter of the shell as measured across the projecting studs or wings. This system of rifling possesses not only the advantage and accuracy of flight, but also admits a longer durability of the gun, as it is not necessary to cut the rifle grooves obliquely. The pitch of the rifling is also uniform. The strain upon the soft coating of the wings of the shot is also less than in grooves cut obliquely. This Armstrong system of rifling has also been satisfactorily introduced in our brass guns and also in guns of cast iron, for we have not had to report the bursting of guns rifled upon this system; which, however, has happened with guns rifled upon other plans. A 12-pounder cast-steel gun was supplied from the works of Messrs. Krase, Michailow, and rifled upon the Armstrong shunt-principle, having one turn in the length of the bore. This gun was fired with a comparatively heavy shot and with satisfactory accuracy during 800 rounds. The 9-inch cast-steel experimental gun, supplied by Mr. Krupp, was rifled upon the same system, the grooves having likewise the same twist as the 12-pounder. The shot weighed 300 pounds, and the gun was fired with the extraordinary charge of 50 pounds of powder. The guiding projection, or wings on the shot, were made of zinc. The effect of this gun upon armor plates supplied from the best English manufacturer (Brown, of Sheffield), was all that could be desired, for even cast iron shots pierced plates of 4½ inches thick, and one or two rounds were sufficient to destroy the plate. A Lancaster plate of 5½ inches thick was pierced at the first round by a steel-shot. Two 4½-inch plates, laid one upon the other and representing a thickness of 9 inches of metal, were utterly destroyed by five shots from this 9-inch gun. Upon inspecting the shot after being used it was observed that on some of them the projecting studs or wings were cut off, and it was therefore determined to make them of a harder metal than zinc, but in the meantime not to interrupt the experiments against the iron plates, it was resolved to continue with the same shots. At the sixty-sixth round the gun burst. Near the place where the shot first receives motion, the metal between the grooves was partially flattened down and pressed into the grooves, but nearer to the trunnions the metal between the grooves was pressed quite flat. At the muzzle end of the bore the grooves were quite sound and uninjured. On examining the shot that caused this mishap, it was discovered that nearly all the projecting studs were cut off, and the axis of the shot was much bent. There were also three projecting lumps on the front part of the shot. All this proves that the bursting of the gun was caused through the misleading of the shot which left the rifling and became wedged in the bore of the gun; it would be impracticable to make a gun capable of resisting this jamming-in of the shot, and the accident demonstrated the enormous power exerted by the powder.

The fractures of the metal were quite sound, and showed a most excellent and superior quality of the steel with the highest possible tenacity, softness, and homogeneity. A piece of steel from this gun was drawn out under the hammer and afterwards bent cold into a spiral. Grooves or furrows were also found along the bore of the gun and parallel with its axis, proving unmistakably that not only the last shell but several previously had left the rifles and seriously injured the bore, and it can only have resulted from the extreme tenacity of the metal that the gun did not burst before. This bursting serves to us as a guarantee of the strength and excellence of the cast-steel guns supplied by Mr. Krupp. It also explains many circumstances that will arise in testing guns of heavy calibers, but which could not be ascertained with guns of smaller capacity. We learn by this experiment to avoid the jamming-in of the shot by using projections or wings of greater resistance than zinc. In pressing the shot home it must be carefully observed if the axis of the shot is coincident with the axis of the bore of the gun. To diminish the pressure of the wings and to avoid their cutting down the metal of the gun the pitch of the rifling should be decreased for heavy calibers. By now ordering a large number of Krupp's cast-steel guns, which is undoubtedly the best gun material hitherto known, we have surpassed other States, and there is no doubt that these guns, after having corrected some faults in the projectiles, will bring us an immense advantage by the use of such formidable weapons.

THE CHENANGO BOILER EXPLOSION.

We gave an account of this disaster on page 283 of the current volume, and since that time the coroner's inquest has developed the facts which we herewith place before our readers. Mr. Chief Engineer Wood, of the United States Navy, gave it as his opinion that the cause of the disaster arose from the accumulation of a greater pressure within the boiler than the stays and braces could sustain, and that they and also the shell gave way in consequence. Mr. Craig, also an engineer in the navy, and the Government inspector, states that he approved of these boilers and that he reported favorably upon them to the Government, but that he afterwards ascertained that the braces were not put in, in accordance with the specifications. Mr. Miers Coryell, superintendent of the Morgan Iron Works, where the boilers were built, had charge of their construction, and considered them safe at a much greater pressure than that which exploded them. Mr. Henry Mason, foreman of the Morgan Works, testified that he ran the engines during the 96 hours trial, demanded by Government, and that he found great trouble in keeping the water at a proper hight, and that the particular boiler which burst gave much anxiety on that account, and required more than ordinary care and watchfulness. Mr. George B. Riggins, who assisted in driving the engines on the trial, states that he also had great difficulty in keeping the water at a proper and safe hight, and that several times the piston struck quantities of water that had been carried over through the steam-pipe, with great violence; so great that the piston rod was forced one-sixteenth of an inch further into the piston than the fitters had been able to drive it in the shop. Mr. Joseph Belknap, a well-known practical and professional engineer of this city, and a person who has had a great deal of experience with steam engines and boilers, says, in effect, that the braces were defective in so far that they did not distribute the strain properly; he also says that it is possible to damage a boiler by hydraulic pressure, and render it less capable of withstanding steam pressure afterward.

The strain exerted by hydraulic pressure is only borne for a few seconds, and some part may be unduly tried, so that it becomes unsafe. Mr. Belknap says it is his opinion that the boiler-makers who were at work inside the boiler disconnected some of the braces and forgot to reconnect them, and that the explosion resulted from an excessive pressure, which parted the other stays, and subsequently ruptured the shell. He testifies that the iron was good, and that the plan of the boiler is as safe as any other when properly made.

Several naval engineers were also examined; and one—Elbridge Lawton—states that he has been in charge of a great many Martin boilers and considers them perfectly safe when properly managed, and that he never heard of trouble caused by foaming. Mr. De Luce, Chief Engineer of the Brooklyn Navy Yard, testified that the arches gave evidence of having been overheated; in his opinion there had been an unequal strain on the braces; one gave way and the others followed.

Mr. Warren Hill, draftsman and engineer of the Continental Iron Works, Green Point, gave very clear and explicit evidence, the most satisfactory that was elicited on the examination. He confined himself to facts, and stated that the number of stays or braces in the boiler, were, in his opinion, insufficient. Estimating the area of the part to be stayed, the pressure upon it and the number of stays put in to withstand said pressure, he found that the average strain upon each one was 21,600 pounds. This is fully one-fourth the tensile strength of the best iron in carefully-conducted experiments, and proves that what we surmised in our first article was correct, namely, that the rupture in the shell resulted from the breaking of the braces, or what is equivalent to it, their detachment from the parts they were intended

to strengthen. Other engineers, examined on Monday last, gave it as their opinion that the Martin boilers were dangerous, from their liability to foam, and from the incessant care they required to prevent disaster.

It is noticeable that those most interested in the examination, and specially concerned in the verdict, express unbounded confidence in the boilers and plan of construction, and say, with all their experience, they have found little or no trouble with them. These men who thus testify are naval engineers, and it shows they are willing to abide by their testimony and risk their lives in support of their opinion.

It is not plain in the minds of those not immediately engaged in the examination of the witnesses, what decision will be arrived at by the jury, and at the day we go to prass we are unable to procure the verdict, but it would seem from the evidence adduced that the braces gave way in some manner and the roof or shell was torn in consequence. From two indicator-cards found in the engine room, the pressure on the gage was shown to be 34½ pounds; in another portion of the testimony the pressure shown by the gage is stated to be 39½ pounds; but whether this is a misprint or not we cannot say, as we were not present at any of the examinations. The coroner still continues his investigation, and when the verdict is rendered we shall publish it.

THE CLOSE OF THE METROPOLITAN FAIR.

The great Sanitary Fair has closed at last. The huge building in Fourteenth street still stands, but the garlands are gone, the lights are out, the guests have deserted it. There are no fair women passing in and out to enliven it any more, but the memory of their services remains and will never be forgotten. For over three weeks our citizens poured out their money like water for the sake of the sick and wounded soldiers in whose behalf the Sanitary Fairs all over the country have been instituted, and the net proceeds of our Fair, at the present time, reach $1,100,000, and this without counting the goods which remain on hand to be disposed of by auction. No other sensation has been permitted to interfere with the successful prosecution of this magnificent charity; and it will have an immense effect upon the conduct of our soldiers in the coming momentous campaign. The fields lie green around us and in the sunny corners of the valleys the branches of the trees are bursting into bud and bloom; in connection with this luxuriance and lavish generosity of nature the people will long remember the sympathy and devotion to the interests of the soldiers and the love of country shown by our women, as well, also, the sacrifices they have made to perform their duties to the end. The thoughtful visitor at the Fair who looked on the patient attendants sitting behind their counters and remembered that they were delicate, unused to toil, to the thousand-and-one endless questions, the dust, the noise, the heat, the incessant shuffling of feet, the blare of horns, the rattling of drums, the flapping of flags before their eyes, the overpowering odors—we say those who thought of these things fully appreciated the trial and the heroism which endured it meekly to the end. The triumph is theirs; whatever of glory belongs to the deed, let the crown for it fall upon our women; whatever of grace has been shown in their acts and intentions, let the reward of it be given to the women who have so richly earned it. All that is lovely and of good report, men cheerfully and unanimously accord to the ladies who planned and carried out the great Sanitary Fair.

SPECIAL NOTICE.

JOHN E. HEATH, of Berrian County, Mich., has petitioned for the extension of a patent granted to him July 22, 1850, for an improved machine for raking and binding grain.

It is ordered that the said petition be heard at the Patent Office, Washington, on Monday, July 11, 1864.

All persons interested are required to appear and show cause why said petition should not be granted. Persons opposing the extension are required to file their testimony in writing, at least twenty days before the final hearing.

THE arsenal at Springfield, Massachusetts, now contains 224,000 muskets.

Correspondence

The Cause of the High Price of Coal.

MESSRS. EDITORS:—The unusually high price of anthracite coal the past winter has been the subject of several articles which, from time to time, have appeared in the SCIENTIFIC AMERICAN and other journals, the general tenor of which has been to attribute the blame to the coal jobbers and miners, who, by combination or otherwise, have raised the price very much above its actual value. This may be true to a certain extent, but is not in my opinion the principal cause for these high prices. A visit made a few years since to the coal regions of Pennsylvania revealed to me certain facts which I think are not generally known, and which may throw some light on this subject. The mining business I found was no monopoly. It was not confined to those who happened to own coal lands, but was open to any one. Neither did it require a very large capital to carry on the business. Mines already opened could be obtained by paying from ten to twelve cents a tun on the amount of coal got out. All that was required were the necessary tools and an engine in some cases to draw out the coal and break it up. So far all is easy and under the control of those who mine the coal. To get the coal to market they must make use of the railroads and canals which run by the mouth of the mines, and over these they have no control. In fact the railroad and canal companies have entire control of the matter, and with them, I believe, mainly rests the responsibility of the high price of coal. The way they control it is by refusing to take it as freight. They will buy all the coal that is mined, paying their price for it, but refuse to carry it for others at any price. The miner therefore is obliged to sell his coal at the price these companies fix or not at all. What this price may be I know not, but at the time of which I speak it could be bought at the mines for seventy-five cents a tun for nut and one dollar for larger sizes. As late as last September but twenty-five cents a tun had been added to these prices; of course, then, these companies did not pay any more than that, and probably less. They take the coal at their prices, carry it to some seaport and sell it. Whatever price they get over and above the cost at the mines is so much freight. By this course not only the miners but dealers and consumers are completely at the mercy of these companies. The buying and selling prices are fixed by them, and those who mine as well as those who buy the coal are obliged to come to their terms. That this course is still pursued I have proof from a gentleman who visited the coal regions this last winter to buy coal. He found the proprietors of the mines anxious to sell at low rates, but they told him it was impossible to get the coal away except by private conveyance, and he was obliged to leave without purchasing.

Such are the facts, gentlemen, and so long as they exist we must expect to pay for our coal some four or five times as much as it is selling for at the mines. As a remedy for the evil I can suggest but two plans, viz:—1st, rival communications with the mines, and controlled by those who have as much regard for public as for private interests; or, 2d, what is better perhaps, let the Legislatures of the States interested oblige these corporations, by laws, to take coal freights the same as other merchandise is carried. When something of this kind is done we may expect to buy coal within three or four dollars a tun for what it is selling for at the mines, and not till then.

W. S. J.

Providence, R. I., April 21, 1864.

Steam on Canals.

MESSRS. EDITORS.—On page 166, current volume of your journal, I notice a communication under the heading, "Steam on the Tow-path." There is certainly much room for improvement in canal navigation, and I have longed to hear of some movement being made to this end. Hoping that the time for this improvement is near, I would offer my idea, which is neither to favor steam on the tow-path nor propellers, but instead, what I would denominate "pursuers." To understand this, I must explain. Let a hawser or cable be suspended over the middle of a canal for any distance, one or ten miles, properly secured at regular intervals. A boat with an engine of sufficient power is to be placed directly under the cable, and connected to it by machinery. By the operation of this machinery on the cable, the boat is to be moved forward, just as one would move a skiff by pulling along a rope stretched across a stream. A speed of at least 75 miles an hour could be obtained without difficulty, whilst the dangers of railroad travel would be overcome. One boat could be connected to another forming trains as on railroads. On the same plan rivers and coasts could be navigated. Though there are difficulties to this plan, yet greater have been overcome, and the day may not be far distant when traveling by water will leave railroading behind.

W. F. MAPPIN.

Mayslick, Ky., April 13, 1864.

[Seventy-five miles an hour ought to satisfy most persons. Correspondents mistake in making too high estimates, as it gives to many a good idea the appearance of a chimera, and deters sober-minded men from undertaking it.—EDS.

Sizes for Key-seats.

MESSRS. EDITORS.—We noticed, more that a year ago, that you requested some one to send you a list of sizes for key-seats for shafts, but we have waited in vain to hear an answer to your request from some one of more experience than we have. About two years ago we adopted the appended table as our standard sizes for key-seats. We have found it of great convenience to ourselves and certainly to our customers:

Diameter of Shaft. inches.	Key Seat. inches.	Diameter of Shaft. inches.	Key Seat. inches.
1	1-4 by 3-32	3 1-2	3-4 by 1-4
1 1-4	5-16 by 3-32	4	7-8 by 1-4
1 1-2	3-8 by 1-8	4 1-2	1 by 5-16
1 3-4	7-16 by 5-32	5	1 1-16 by 3-8
2	1-2 by 5-32	5 1-2	1 1-8 by 3-8
2 1-2	9-16 by 3-16	6	1 1-4 by 7-16
3	5-8 by 3-16		

We also adopted Nasmyth's standard sizes for shafting and also his taps and dies for screws. We consider the general use of a standard size for screws and also for the outside diameter of nuts to be of great importance. If the Government was to compel all their work to be done to standard sizes, we think its adoption by private manufacturers would soon be general.

SNYDER BROTHERS.

Williamsport, Pa., April 14, 1864.

[It seems to us these sizes are shallow for some metals, such as cast iron for instance; some of the large sizes decidedly so.—EDS.

Terrible Boiler Explosion in Philadelphia.

Another terrible disaster has occurred from the explosion of a steam boiler, in a Philadelphia factory. The *Evening Telegraph* of that city, dated April 25, says:—

"This morning our city was visited by another terrible boiler explosion, as sickening and horrible in its details as the one that recently occurred at the foundry of Messrs. Merrick & Sons, in Washington street. Both of these explosions, like many others of a similar fatal character, occuring on a morning after the boilers had lain idle over Sunday, afford a point which might be investigated in endeavoring to discover the cause of the affair. The yard in the center of the buildings was occupied by the boiler-house, which stood against the north wall, and was a substantial brick building, with an iron roof. There were in the building two tubular boilers, built by Morgan, Orr & Co., of this city, which had been in use about three years. The engineer who had charge of these boilers has been in the employ of Messrs. Cornelius & Baker also about three years, and every confidence was placed in his competency. At twenty-five minutes of eight o'clock, while all the employees of the establishment—about six hundred in number, men and boys—were engaged in various parts of the building, from the fifth story to the basement, the explosion occurred. Two distinct reports were heard, although it is known that only one boiler exploded. The engineer escaped on account of being absent from the boiler-room at the time, and was, it is said, in the office. In order to guard against accident, the firm had taken the precaution to have a steam-gage placed in their private office for their own personal inspection and safety.