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MANUFACTURE OF CAST STEEL AT ESSEN.

IN close proximity to the main route from Cologne to Minden, on the right bank of the Rhine, is situated the little town of Essen, lying within a short distance of that of Ruhrt. Like all small villages and towns originally insignificant in size and population, Essen owes its present importance and increasing development to two causes. One is the presence of natural productions, and the other the skill and enterprise of a few individuals in rendering them subservient to the interest and welfare of mankind. The natural wealth of Essen consists in the possession of the same material which has been a principal means of bringing our own country into its present state of commercial prosperity. It is in the centre of a coal-bearing area, and large revenues are derived from this source, although the price of the coal varies from 7s. to 9s. per ton. A considerable traffic in wool is also carried on between this place and the merchants in Normandy. But the chief cause of the prosperity of the town is to be found in the enterprise and exertions of those who have established manufactories and workshops, and thus enabled these natural endowments to be turned to good account. First in importance, in the number of hands employed, in their tone and *prestige* as a scientific mechanical establishment, in their extent and influence, stand the workshops of M. Krupp. Some idea of their mere size may be arrived at by considering that from first to last they cover an area of 500 acres. On the authority of "Les Grandes Usines," from which we quote, a very considerable difficulty is experienced in obtaining access to the engineering premises of M. Krupp. In fact, this gentleman is sufficiently candid to let it be known very politely, but at the same time very decisively, that one will not be permitted to go over the works, by affixing at their entrance notices, written in English, French, and German, that visitors are requested not to ask for admission, in order to save the proprietor the pain of giving, and themselves the mortification of receiving, a refusal. To us, who are so exceedingly good-natured as to throw open our armouries, and disclose all our warlike implements, and the secrets of their construction and working arrangements, to those who might, perhaps, in a month's time, be turning against us the knowledge so acquired and literally beating us with our weapons, the policy of M. Krupp may appear somewhat too exclusive. There is, however, very little doubt that in the main that gentleman is right, and that independently of the trouble, danger, and inconvenience incurred by the advent of visitors to an establishment of this description, it is but natural that its proprietor should be jealous of exposing to prying eyes all those details of workmanship acquired at the cost of so much time and money, and upon whose union and maintenance depends the prosperity of the concern, and that of the ten thousand hands engaged in it. After forty years of incessant labour, study, and sacrifices, M. Krupp has been rewarded for his toil and patience by being able to produce and work solid masses of steel weighing upwards of thirty-six tons. The magnitude of such an operation will appear when compared with the limit reached in France in similar matters. There it is seldom that a block of cast steel attains to the weight of nine or ten tons, and even when run of that amount it has to be left in the ingot, as there is no machinery suitable for working it up. So far as the production of cast and wrought iron is concerned, the French are not by any means behind the Prussians, but at Essen it is not a question of merely the production of either of these two. The elder M. Krupp had a higher aim in view when starting his works, and he has given all his efforts to the production of steel—that true engineering philosopher's stone of the present age—concerning the chemical composition of which there has been so much dispute, and so many and various opinions have been promulgated, and the physical properties of which have a range so wide, varying from the hardness of the highest tempered chisel to the softness of the finest thread. In addition to the special production alluded to the manufacture of most of the ordinary engineering applications of iron are simultaneously carried on, including axles, tires, wheels, and every description of railway ironwork. The character of the Krupp steel has become so well known that, besides its being used in our own country, it is frequently insisted upon by French, German, and Russian companies in their specifications relating to the employment of that material, notwithstanding the heavy duties existing between the different countries.

Independently of the indomitable perseverance and ability of the originator of the establishment, the coal in its vicinity and even within its boundaries is of the purest kind and well adapted for its intended purpose. The very circumstance, however, of the presence of the required fuel in a proximity so close to the workshops was attended at the commencement with a serious disadvantage, viz., the procuring of hands, as all the available labour was absorbed in working the pits. In order to overcome this drawback and supply the deficiency it was necessary to despatch recruiting agents into all the miner states of Germany to engage labourers, large numbers of whom were obtained from the province of Hesse. The effect of the coal workings in creating a scarcity of labour for any new enterprise may be gathered from the fact that upon one of the many small branch lines constructed for the purpose of the coal traffic more than 100 trains of twenty-five wagons pass daily backwards and forwards. The writer in "Les Grandes Usines" institutes some comparisons between the works at Essen and others of a similar nature in France by no means complimentary to his countrymen. He particularly notices the grave taciturn mode of the German workmen, as opposed to the lively and somewhat boisterous manner of the French, and maintains that 500 of the latter nation would make more noise than as many thousands of the former. In entering the workshops one is immediately convinced of their predominant nationality by the serious demeanour of the men, their long porcelain pipes, which some of them never relinquish, even when carrying the heaviest loads; the elegant contours of the buildings, calling to mind the Gothic style of architecture and the curvilinear outlines of the windows, so different from the harsh straight lines characterising the appearance of these details of construction in French manufactories. We now pass on to the actual production or manufacture of the steel, the preliminary operation consisting of the puddling or partial decarbonisation of the melted mass. The *modus operandi* of puddling is too trite to require comment, although its practical difficulties are not by any means yet conquered. In producing the melted steel a small quantity of iron obtained from a particular ore is put into the melting pot and takes from the puddled steel its excess of carbon, and in so doing carbonises itself; the iron, ordinarily exceedingly difficult to fuse, melts and becomes incorporated with the steel.

The long agitated and still unsettled question of earthenware receptacles for the purposes of fusion now comes before us, and whether it relate to glass makers, gas makers, chemists, or metallurgists, the difficulty is always present. The potter's art has not yet emerged from the clouds of ignorance and uncertainty which have long since been dissipated from the horizon of other manufactures. There are not wanting books supplying abundant information respecting the production of porcelain and china, but the subject of the application of various earths and clays for the purposes of fusing receptacles has never yet been treated in a theoretical or scientific manner. In M. Krupp's establishment, notwithstanding that the greatest possible care and discrimination are used in the selection of the best Scotch bricks for building the furnaces, yet they speedily became attacked and vitrified. It may be readily surmised that when the operation of melting large masses of metal is carried on incessantly on a scale so stupendous the utmost skill and attention are given to the manufacture of the crucibles. The ingredients composing the pottery ware consist of the *débris* of old crucibles, bits of fire-brick, various refractory earths, and ultimately a small amount of graphite or plumbago. The relative proportions of these different ingredients have been arrived at by a long and tedious course of actual experiment. After submitting the materials to the action of cylindrical crushers they are ground to powder between vertical wheels of cast metal. The perfection of the crucible and the success of the after processes of drying and baking depend entirely upon the minute division of all the particles, which should be reduced to an absolutely impalpable powder. Of so much importance is this considered at Essen, that instead of the usual rake for scraping the powder together during the revolution of the wheels the stone, revolving horizontally, carries a stool with it, upon which is seated a workman, whose sole duty is to prevent the smallest particle of the powder escaping from the grinding action of the machinery. When the ingredients are reduced to this state the plumbago, which has also been submitted to a crushing process, is added, and the whole mixture beaten up with pestles by hand labour, in order to thoroughly incorporate the materials and render the whole mass homogeneous. An ordinary compressing machine serves to give solidity and impart a cylindrical shape to the mixture, which is, by a peculiar mechanical movement, thrown out upon a stage. At this juncture a workman stationed for the purpose seizes upon the cylindrical mass and cuts off a certain quantity, which he weighs very accurately, for every crucible of the same capacity ought to be identical in weight, size, and shape. These men become by constant practice so expert that they can cut off at once the exact quantity of material required for a crucible of a certain size. In order to obtain the other conditions necessary to constitute a good crucible, viz., a uniform thickness of envelope and proportion, the following method is put into effect: Between two strong uprights works a bar in a vertical direction, carrying a cast iron cone, which fits concentrically a conical mould containing the material for making the crucible. The solid cone plunges into the mould, causing all the excess of material to overflow. A projecting lip or ring on the solid cone comes down upon the rim of the mould, and stops the material from flowing over at the right time, the intervening space between the exterior surface of the solid cone and the interior of the mould representing the thickness of the crucible. The exact proportioning of these two surfaces was a nice mathematical calculation which many would think unnecessary, but the trouble is repaid by the breakage, in consequence of these delicate precautions, being reduced to a minimum. The entrance of the solid cone into the mould, and the forcing out of the superfluous material, are not performed at one plunge, but by a succession of gentle shocks produced by hand power applied to a double lever. After emerging from the press the crucibles undergo a careful examination, and are despatched to be dried in stoves placed vertically one over the other. The drying process consists in subjecting them slowly to different degrees of temperature, commencing at about 140 deg. Fah., and when properly conducted occupies a period of about two months. The consumption of these crucibles is so great at the manufactory of M. Krupp that there are always about 100,000 of them drying at the same time. They are never allowed to be used more than once, whether damaged or not, but are, immediately after the running, broken up to be reground, and serve for material for new ones. Their capacity or volume varies from 50 lb. to 100 lb., according to the description of steel required to be turned out. Before putting the crucibles to actual work the finishing touches consist in baking them in furnaces specially constructed, and bringing them to an intense heat.—*Mechanics' Magazine.*

LAW INTELLIGENCE.

COURT OF COMMON PLEAS.—JUNE 12TH, 1866.

(*Before the Lord Chief Justice, Mr. Justice* WILLES, *Mr. Justice* BYLES, *and Mr. Justice* SMITH.)

APPLEBY AND ANOTHER *v.* MEYERS.—JUDGMENT.

THE following judgment cannot fail to prove instructive as well as interesting to every mechanical engineer who undertakes a contract. A very few words of explanation will make the case clear. Mr. Meyers resisted a claim for work done in his factory, in Southwark-street, by Messrs. Appleby Brothers, engineers, on the ground that it had been destroyed by fire before contract was wholly completed. The work consisted of steam engine, boiler, hoisting machinery, and steam drying apparatus. There was no exception taken to the quality of Messrs. Appleby's work, or any fault found with the execution of the contract in any respect, and having agreed in a statement of the facts, the case was argued before the judges for their ruling. Messrs. Harrison and Lewis instructed Mr. Macnamara, on Messrs. Appleby's behalf, and Mr. Salaman Mr. Hannan for Mr. Meyers.

"Mr. Justice Smith: In this case the plaintiffs, who are engineers, had contracted, by an agreement in writing, with the defendant to do certain works upon buildings on his premises, namely, to provide and erect upon them a steam engine and machinery connected with it. The works were divided into different parts, and separate prices were fixed upon each of those parts. The plaintiffs agreed to provide and to erect the machinery for those prices. The case finds that the premises were in the occupation and under the entire control of the defendants. That all parts of the work were far advanced towards completion, that some parts were so nearly finished that the defendant had used them for the purposes of his business, but that none of the parts into which the work had been divided were absolutely complete. The works were in this state when an accidental fire broke out on the defendant's premises, and destroyed the defendant's buildings, and the works done upon them by the plaintiffs. The question submitted to us is whether, under the circumstances, the plaintiffs are entitled to recover the whole or any portion of the contract price? It is clear that the plaintiffs cannot recover the whole contract price as specific sum, for that was only to be paid on the completion of the works, an event which has not yet happened. But we think that, under the circumstances, they are entitled, upon an implied contract, to be paid the value of the work done, which value we assume, from the form of the question, the parties are content to estimate upon a due proportion of the contract prices. It was contended, for the defendant, that the fire was a common misfortune, excusing both parties from the performance of the contract, and we were pressed to adopt the principle laid down by the Court of Queen's Bench in the case of Taylor *v.* Caldwell (3rd Best and Smith, 826). In one part of that judgment it is said, no doubt in general terms, 'The principle seems to us to be that in contracts of which performance depends on the continued existence of a given person or thing, a condition is implied that the impossibility of the performance arising from the perishing of the person or thing shall excuse the performance.'

"The Court of Queen's Bench may properly have adopted and applied the principle in the case of the contract before them, but we think it cannot be correctly applied to the present case, where the contract is of a different kind, and appears to us to fall within the qualification of the principle found in the early part of the same judgment, where the court says that 'in the absence of any express or implied warranty that the thing shall exist,' the contract is not to be construed as a positive contract, but subject to an implied condition, that the parties shall be excused by the perishing of the thing before breach.

"By the agreement between the parties the machinery was to be fixed to the buildings of the defendant so that the parts of it were and so fixed would become his property and subject to his dominion, and we think we fulfil the intention of those who entered into the contract by holding that it is an implied term of it—that the defendant should provide the buildings—the subject on which the work was to be done—and keep them in a fit state to enable the plaintiffs to perform their part of the contract. If the defendant had refused to allow the plaintiffs to have the use of the buildings, or by his own act or default had rendered them unfit to receive the work, there can, we apprehend, be no doubt that the plaintiffs might either have sued for a breach of the contract or have treated the contract as rescinded, and recovered the value of the work done on a *quantum valebat* count. These rights of action would accrue to the plaintiffs, not by reason of any express words of agreement, but in virtue of the implied term of the contract to which we have referred. Then is the non-performance of the implied term on the part of the defendant excused by the happening of an accidental fire? We think it is not excused by that count.

"The general rule of law is clear, that when a man contracts to do a thing he is bound to do it or make compensation, notwithstanding he is prevented by inevitable accident. We hold that an implied promise is present in this contract on the part of the defendant to provide and keep up the buildings, and, as a consequence, he must be liable in this case, unless we ought to annex a condition or exception to his promise, exonerating him from the performance of it in the case of fire or other accident.

"When the plaintiffs agreed to expend their materials and labour on buildings of the defendant (of which he was to retain the possession and control) it is reasonable to infer that it was contemplated that the subject on which the work was to be done should be provided and kept at his own risk and peril, and it is unreasonable to suppose that the parties intended that if a fire happened, in no way attributable to the plaintiffs, the defendant should be set free from the obligation under the contract.

"We think that if we were to imply an exception or condition having this effect we should not fulfil, but frustrate, the real intention of the parties. It appears to us that such a fire no more excused the defendant than an eviction of both plaintiffs and defendant from the buildings by title paramount would have done.

"No decision directly in point was cited, but the learned counsel on both sides referred to Story on Bailments, section 426 and following sections, and each relied on certain passages as being in his favour. The application of the maxim "*respérit domino*" to cases of a kind in some respects like the present is discussed by the learned author, but the authorities he has collected appears to leave open the precise question we have decided in this case.

"The judgment of the Court is for the plaintiffs to the extent before indicated."

PROJECTILES FOR SAVING LIFE FROM SHIPWRECK.

By THOMAS GRAY, Esq., H.M.C.S.

MUCH has been written and much has been said about our means and our organisations for destroying our fellow creatures—about our congreve and Hale rockets—our Enfield rifles, and our Armstrong and Whitworth guns—about the discipline and courage of our army and navy—about the steadiness and drill of our 150,000 volunteers ashore, and our 20,000 naval reserve men afloat- all beautifully adapted and trained for the one great purpose of destruction; but far too little is known, and far too little is said and written, about the methods by which, and the extent to which, rifles, rockets, and mortars can be converted into instruments for saving life, and about those unpretentious men who devote moments snatched from their business, their leisure, or their rest to saving their fellow-creatures.

It is now proposed to invite attention to some of the methods by which this end is attained in the case of ships wrecked and stranded on our coasts. When a ship gets close on a lee-shore in heavy weather amongst rocks, or in shallow water, it is obvious that her chances of safety are remote, and that if she strike and break up both property and crew will suffer loss. If, after the ship has struck, the crew attempt to save themselves by jumping overboard, they will in all human probability either be drowned or dashed to death against the rocks or amongst the floating wreck in their endeavours to reach the shore. If they attempt to lower their own boat under the circumstances, she will probably, in nine cases out of ten, be either capsized or stove, if not both. In the same way, if a boat attempt to put off from the shore, she will stand but little chance of working against a head sea, or, if the coast is rocky or strewn with wreck, of escaping destruction amongst the rocks and wreck. The author is not now writing of those cases in which the boats of that noble establishment, the Royal National Lifeboat Institution, are of use, and are used with such marked success. There are cases in which a wreck happens too far from the shore for the rocket apparatus to be of use; then the lifeboat renders her services. But there are again cases in which the wreck happens close on the shore, amongst rocks, where the lifeboat is useless; and here the rocket apparatus comes into service. It is of assistance rendered in these latter cases exclusively that the author is now writing.

It was a consideration of the fearful loss of life happening in ships wrecked on the shore that led one Sergeant Bell, of the Royal Artillery, in 1791, to devise a plan whereby a shot, with a line attached, might be thrown from a ship in distress to the shore. (See "Transactions of the Society of Arts," vol. x.) Sergeant Bell, however, appears to have done little or nothing with his apparatus, and it was not until 1808 that anything noteworthy and practical was effected with the shotted line. It appears from the "Transactions of the Society of Arts" for the year 1808 (vol. xxvi., page 209), and from the evidence accompanying the "Report of the Select Committee on Shipwrecks," 1836 (see Parliamentary Paper 567, page 133), that in 1808 Lieutenant Manby saved the crew of a brig called the Elizabeth, of Plymouth, wrecked on the Norfolk coast, by means of a line thrown over the ship.

When the veteran Manby was in his seventy-first year he was examined by the select committee. His own words will best convey the circumstances that led him to a thoughtful consideration of the subject. He says (p. 133):—"I therefore most respectfully beg leave to state that for four winters after my appointment to the charge of the barracks at the above-named place (Yarmouth, Norfolk), in the year 1803, I witnessed the loss of vessels with all their crews within a few yards from the shore, from the difficulty by manual exertion to throw a rope by hand against a furious wind, and the impracticability of forcing a boat from a beach by the power of oars to effect their preservation; and in the dreadful gale of 18th February, 1807 (when 141 dead bodies were washed up at or near Yarmouth), I witnessed his Majesty's gun brig Snipe stranded within fifty yards of the beach at the back of the pier, having sixty-seven persons on board, who all perished after many hours fruitless attempts, and every effort then known had been tried to save them. On the close of that mournful scene I vowed if providence blessed me with life I would apply myself to produce some effective means by which not only the sufferers might have been rescued, but similar occurrences in future be prevented. It may next be proper for me to state some authenticated facts communicated to me in reference to the coast at and near Yarmouth: that twenty years previously to the occurrence I have just mentioned 200 persons at least had perished in vessels driven on shore at that fatal spot. I should also state that in a gale upwards of thirty vessels were wrecked on the sands off and near Yarmouth, and from their peculiar situation and most dangerous character (being quicksands) they rapidly swallow up every vestige of the ship's hull."

Manby, it is evident, from a perusal of the papers above referred to, made his attempts without any previous knowledge of the proposal of Sergeant Bell. It has been told of him (and this anecdote was printed in the "North British Review" some years ago) that when a youngster he had coveted a nest built by a screech owl in the walls of a church in a Norfolk village, and that after puzzling his brains how to get at it he hit upon the plan of throwing a thin line over the church, and then by that hauling over a thicker one, and so on until he got one sufficiently strong to bear his own weight. He accordingly got a quantity of pewter and cast himself a mortar. With this mortar he was quite successful.

The rude contrivance made by the young Manby to get a bird's nest is to the present time the groundwork of the whole of the apparatus for saving life from shipwreck on our coasts. It is true that the rocket has superseded the mortar, but it is nevertheless true that the principle of throwing *from the shore*, by means of gunpowder, a missile with a thin line attached, and by means of

that getting a thicker and yet a thicker line on board, is the fundamental principle of the whole apparatus.

Manby's apparatus may readily be understood by the aid of the following sketches:—The mortar — an ordinary 5¼in. 24-pounder cohorn —is fixed in a thick solid block of oak, and projects a looped barbed shot, fitted with a plaited hide thong. The barbs were sometimes fitted so that they worked on a pivot, and closed in the shank of the shot when it was in the mortar, and opened when it was out. They were fitted on the supposition that they would catch, like an anchor, in the rigging, ropes, or wreck, and afford a better

Fig. 1.—Mortar.

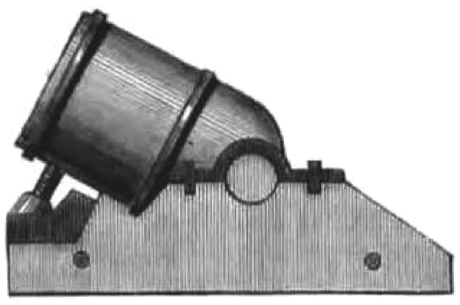
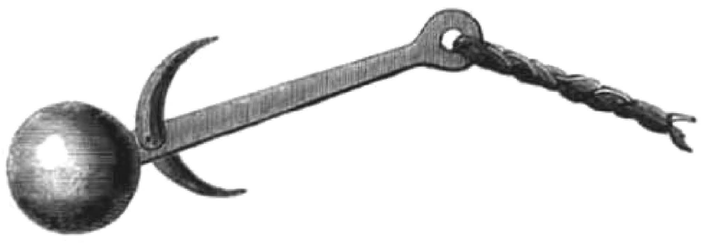


Fig. 2.—Manby's Shot.



chance of securing a communication. This has, in actual practice, not proved to be the case, as the shot is thrown many yards over the ship, and the line is easily secured when once over. Another and a very serious drawback was, that the barbs caught in the rocks, and if the shot missed the ship the line and shot could not be recovered. There was also another disadvantage in the shot used by Manby, and that was that its course could not be traced at night. These defects have recently been overcome by Colonel Boxer, R.A., and now the shot are without barbs, and are made cylindrical, with one hemispherical and one flat end. In the flat end are bored four holes, and in these holes are placed fuses, which throw a good light over the vessel at night.

Fig. 3.—Boxer's Shot.

The plaited hide thong is still retained. About the same time that Manby succeeded in saving the crew of the brig referred to above, a Mr. Henry Trengrouse, on the coast of Cornwall, turned his attention to the subject (see Transactions of the Society of Arts, 1820, vol. xxxviii., p. 161), and also the Parliamentary paper above referred to, p. 249. He thought of three methods: one was a kite, another was a hand lead and line, and the third was a rocket. His plans were completed in 1821. As regards his three plans, it may be remarked that Lieutenant Nares, R.N., has since invented a kite which would sometimes be of much use; but as a ship if stranded is as a rule stranded on a lee shore, and as the kite must therefore be flown from the ship to the shore, it must be carried on board, and kept in order to be of use. And, further, as the chances are much against kites being carried aboard ship, and kept in repair if carried, they may be dismissed from notice at once.

Fig. 4.—Heaving Stick.

Fig. 5.—Sky Rocket.

Fig. 6.—Trengrouse's Rest.

Fig. 7.—Congreve and Carte's Rocket.

The second proposal, the hand lead and line, has been perfected by Captain Ward, R.N., of the Royal National Lifeboat Institution, and the officers of the Board of Trade, in the form of a "heaving stick" and line, as shown in Fig. 4.

A piece of stout cane about 2ft. long is loaded at one end with 2 lb. of lead, and to the other end is attached a thin line. These sticks are whirled round by the arm vertically three times, and then let go. Their range by a practised hand is about fifty yards. They are in fact quite as effective as Trengrouse's small rockets.

The third plan proposed, viz., the rocket, has been improved by Dennett and Colonel Boxer, and is now in general use.

The ordinary sky-rocket or "firework" consists of a cylindrical paper case open at one end, with a quickly and fierce burning composition of sulphur, charcoal, and saltpetre, rammed into it. After the composition is rammed in a part of it is bored out again, leaving a passage longitudinally, as shown in Fig. 5. The shaded part shows the composition, and the dotted part at the head shows the coloured stars that are blown out of the case after the composition has carried it to its height.

Trengrouse used a very small rocket of this description (eight ounces), but without the coloured stars, and he fired it by laying the stick along the barrel of a common musket, and resting the rocket itself on a small metal stage with a bayonet catch at the mouth of the musket, as shown in Fig. 6. On fire being applied at the open end of a rocket it immediately runs up the part bored out and communicates with the whole interior. The fire and gases issue with immense force from the vent against the air and propel the rocket forwards through the whole of its course.

In carrying a line a rocket has a great advantage over a shot. The rocket begins to move slowly, and as it carries its propelling power within itself it gradually attains its maximum speed without any jerk on the line, whereas the shot starts with a jerk which is likely to snap the line attached to it.

The first time that a rocket was ever really used in saving life from shipwreck was at the wreck of the Bainbridge on the southern side of the Isle of Wight. This was in 1832. It appears that a Mr. John Dennett, who had been employed in making war rockets, had by this time matured his plans for saving life. He also appears to have been working without any knowledge of Mr. Trengrouse's proposition. Dennett used a large and really efficient rocket, carrying a stoutish line, and he first showed that the flight of the rocket with a line attached could be depended on.

Having demonstrated in a conclusive manner that the rocket could be used, and having produced a tolerably perfect apparatus, the Board of Customs, in 1834, took the matter in hand. At this time the coastguard under the Board of Customs was supplied with a few sets of Dennett's apparatus, and from this time the serious and effective use of the apparatus dates. But it was not until years later (1855) that the system was completed by uniform rules, a uniform practice, and uniform pattern for stores. Dennett's rockets are, as nearly as possible, similar to the old sky-rocket. The paper case is replaced by an iron case, and the stick of the sky-rocket by a pole 8ft. long. One of Dennett's rockets with the pole attached weighs twenty-three pounds, and is propelled by nine pounds of composition. The practical or working range of Dennett's nine pound rocket, with a line attached, is 250 yards; sometimes 290 yards have been reached.

The next person who turned his attention to the subject was one Mr. Carte, an ordnance storekeeper at Hull. (See Parliamentary report of 1843, 549; appendix, page 84.) The chief difference between Carte's and Dennett's apparatus was that Carte used a congreve rocket instead of a rocket of the ordinary pattern. Carte's apparatus was made about the year 1842. The congreve rockets (Fig. 7) differed from Dennett's in having a central stick instead of a lateral stick. The stick or pole was placed central, and the fire issued from six smaller vents placed in a circle at the base of the rocket, instead of from one large vent, as in the case of Dennett's and other ordinary rockets. The trial range of Carte's congreve rockets were—six-pounders, 238 yards; twelve-pounders, 344 yards. Carte's apparatus appears to have been only an unimportant modification of Dennett's, and it never came into general use.

When the Government took the apparatus really in hand, in 1855, endeavours were made to improve the range of the rocket, to perfect the gear, and to establish a uniform practice throughout the coasts of the United Kingdom, and their endeavours have resulted in marked success.

To increase the range of the rockets Dennett hit upon the expedient of coupling two together, side by side, as shown in Fig. 8. By this means he gets a range of 400 yards, with an elevation of 35 deg., but as it is found in actual practice that there is an amount of uncertainty in getting both to light simultaneously, and as there is danger of the rockets parting, the practice of coupling has been discontinued.

Colonel Boxer's services were called in, and after repeated experiments he hit upon the plan of putting two rockets in one case, and this rocket is likely to supersede all others in saving life from shipwreck. Fig. 9 is a section of same, the dotted head being composed of hard wood, the black parts show the wrought iron case and partitions and the shaded part shows the composition with the longitudinal cavities left white. The effect of this arrangement is that the first rocket carries the case and line to its maximum height, and the next rocket gives the case and line a further impetus forward. It is curious that the range, when the two rockets are placed end on to each other is so much greater than when rockets of the same size and weight are placed side by side, or when the same weight of composition is placed as one rocket in one case; but it is so. It is most marked, and no sooner does the second rocket ignite than its effect is noticeable in the line box by carrying the line out with increased rapidity.

Fig. 10.—Rocket Stand.

The rockets used in saving life from shipwreck are fired from a triangular stand, of which Fig. 10 is a representation. The fire is communicated either by a fuse and port fire, or by a percussion tube. The elevation is determined by a quadrant or pendulum. The elevation for a Dennett's rocket is 32°. It may be well to mention in this place an attempt made by Captain Brown, R.N., the late Registrar-General of Seamen to use a musket barrel with a line attached instead of a rocket. It occurred to him that if the ramrod was fixed and the barrel fired off, a line might be carried when it would not be carried by the shot itself. He had already made some experiments with a musket barrel, weighing two pounds, and had obtained a range of

Fig. 11.—Captain Brown's Proposal.

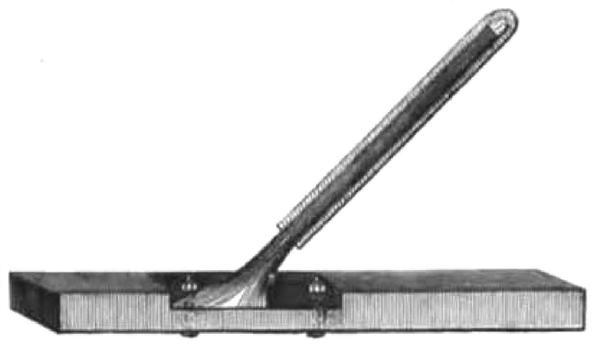


Fig. 8.—Dennett's Coupled Rocket.

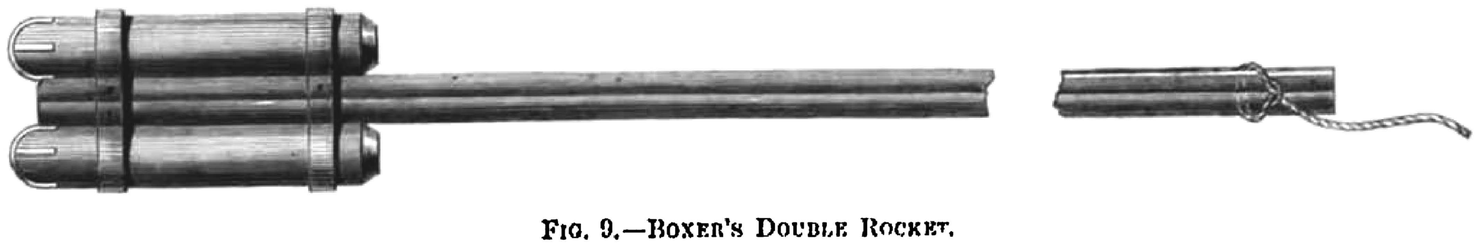


Fig. 9.—Boxer's Double Rocket.

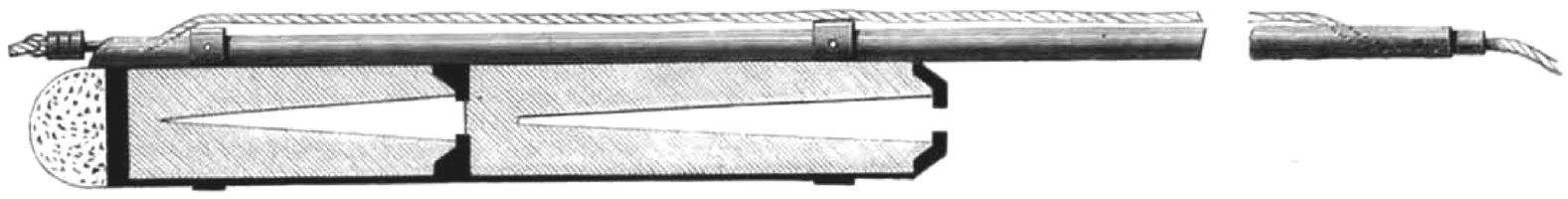
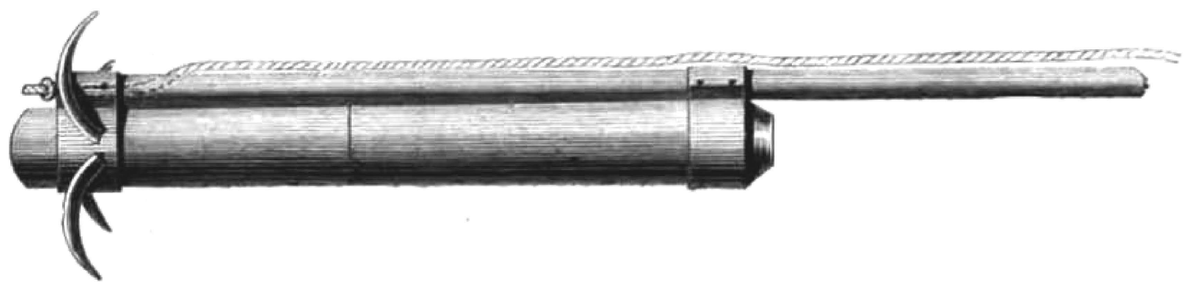


Fig. 12.—Delvigne's Arrow.

Fig. 13.—Tremblay's Anchor Rocket.



285 yards with a charge of 3¾ drachms of powder. Some steel cylinders were made in lieu of the musket barrels, and were arranged on their ramrods or stands as shown in Fig. 11. The black part shows the stand or ramrod; the shaded part the cylinder or barrel; and the dotted part the charge of powder. With a steel cylinder and a rocket line and a 2 oz. charge of powder he got a range of 150 yards; but with 3 oz. the cylinder burst. On further experiment it was ascertained that the plan was not adapted for the life-saving apparatus, and it was abandoned.

Colonel Delvigne, of the French army, also invented a shot to be thrown from a rifled mortar. This shot carried a copper line in it coiled the reverse way of the rifling, but in practice it parted, and was rejected in favour of the simple shot. He has, however made an arrow, to be fired from an ordinary musket or rifle, that is very ingenious, and may be of use in some cases. It is constructed as shown in Fig. 12. It is an ordinary stick of mahogany, something like a billiard cue; the thick end presses in the powder, and the thin end, weighted with lead at the shaded part, and fitted with loops of string, protrudes beyond the muzzle. The line is attached to the loops, and they in their turn are fitted tightly to the thinnest part of the stick. The jerk imparted to the stick at the moment of firing causes the loops to slip down towards the thick end of the stick, and as they cannot slip easily, a gradual motion is imparted to the line, which prevents it from snapping, as it would do if it were fastened rigidly. The arrow weighs 18oz., and the range attained with it and an ordinary mackerel line is 80 yards.

Mons. Tremblay has fitted a large rocket with an anchor-head, as shown in Fig. 13, and proposes to use it in firing from the ship to the shore. It is carried by the Imperial yacht. It is to be hoped that if the yacht should come ashore the people on shore will get as far away as they possibly can. It may be the means of saving some persons on board the ship, but is more likely to be the means of killing people on the shore.

The above is a short sketch of what has been done in the way of projectiles for saving life. It will show in what respects some schemes have failed whilst others have succeeded, and may also be useful as a guide to any person hereafter designing a projectile for carrying a line. In a future number I propose to give an account of the gear and apparatus used, a statement of the expense of working, of the number of lives saved, and of the volunteers and organisations for using the apparatus. T. G.

The Representation of the United States at the Paris Exhibition.—The United States Senate, about three weeks ago, agreed to appropriate 25,000 dollars to the object of representing their country at next year's Paris Universal Exhibition.

The Public Works of Odessa.—The paving of the city with granite progresses slowly in consequence of the scarcity of labour and long winters. During the past year Odessa has been lighted with gas. A railway has been opened between Odessa and Balta, and another between Odessa and Tiraspol. Both these railways have been made by military convicts working under the superintendence of Baron Ungern-Sternburg. A canal is projected between Odessa and the Dnieper, and an endeavour has been made to raise funds in England to carry this project into execution. Telegraphic communication between Odessa and the rest of Europe is now fully established. A message can arrive from London in about four hours. The state of the post-roads is very bad, but posting is cheap and post-horses good; the average rate of travelling in good weather is about ten miles an hour. Sledging over the snow may be done at about twelve miles an hour.

Ex-President Davis on Ironclads and Ordnance.—In a book lately published by the surgeon who attended on the illustrious prisoner in Fortress Monroe a conversation of Mr. Davis is reported in which he expressed his opinion that England's naval supremacy was lost by the introduction of ironclads. He thought that the United States mailed ships of war would be found unequal to sea voyages. "Wooden bottoms with armoured sides and turrets, he could not but think would prove the best. . . Wooden hulls sat more easily in the water, and both avoided chafing and obtained greater speed by their capacity of yielding a little." Between rifled guns and smooth-bores he preferred the latter for general service under present circumstances. "For perfection of elaborate workmanship and detail no guns he had ever seen were superior to some of those received through the blockade from England." Speaking of the fight between the Merrimac and the Federal fleet in Hampton Roads, Mr. Davis asserts that "the Congress had fought gallantly, and that it was in consequence of injuries to the prow of the Merrimac from her shot, and not owing to the attack of the Monitor, that the Merrimac had been compelled to retire. These injuries started a fatal leak, which the weight of armour rendered it impossible to cure; and this was the true cause of the vessel's final failure."