actions of alizarine. It is but slightly soluble in water, but soluble in alcohol and ether. Volatilizes between 419° and 464° Fahr. with a yellow vapor, and gives deep red needle-shaped crystals, whose tone of color is very variable. It is not attacked by chlorhydric or concentrated sulphuric acid. It dissolves in caustic and carbonated alkalies with a deep blue purple color. Acids precipitate this solution in deep orange-red flocculi. Like alizarine from madder, it furnishes lakes of the most beautiful colors. It is fixed on stuffs like natural alizarine, and gives similar tints.

Nothing remains but to determine the composition of these two substances comparatively; until that is done their identity cannot be definitely affirmed.—*Cosmos*.

On the Welding of Malleable Iron. By JAMES NASMYTH, Esq., C. E.

From the Lond. Engineer, No. 271.

Of all the processes connected with the working of malleable iron, there is none that has a more intimate relation to the security of life and property than that of "welding," or the process by which we are enabled to unite together, in one mass, the several portions of malleable iron, of which the generality of works in that material are formed.

Every single link in a chain-cable, every wheel tyre in a railway train, directly owes its trustworthiness to the manner in which the process of welding has been performed, in so far as that any imperfection in one single member of the set of cable links or railway wheel tyres may involve a most fearful loss of life, of which, of late years especially, we have had such distressing and melancholy experience.

It is with the most earnest conviction of the vital importance of the process of welding, by reason of its close relation to the security of life and property, that I am anxious to offer a few remarks, based on long and intimate acquaintance with the process in question, and on those conditions that conduce to its perfect performance, which remarks I am fain to think, if read with due care and consideration by those who are more specially concerned with the practice of the process of welding iron, may in no small degree tend to render less frequent those fearful and distressing catastrophes of which recent records of ship and railway disasters furnish such sad evidence.

In order to render more clear the following remarks as to the cause, and most certain means of the prevention of defective welding, it may be as well, at the risk of a little tediousness, to explain the nature of the process of welding iron, which consists in inducing upon malleable iron, by means of a very high heat, a certain degree of adhesiveness, so that any two pieces of malleable iron, when heated to the requisite degree, will, if brought into close contact, adhere or stick together with a greater or less tenacity, according to the amount of force applied to urge them into close contact.

But as malleable iron, when heated to the high temperature requisite to induce the adhesive or weldable condition, is at the same time rendered highly oxidizable, the surface of the iron at the welding hot part becomes enveloped with a coat of vitrified oxide, which adheres

to the metal with great obstinacy; and although this molten oxide can be rendered more fluid, and the further oxidation in some degree restricted, by sprinkling the welding hot surface of the iron with sand, which, combining with the molten oxide, renders it more fluid, and, therefore, more easily removable from the surface of the iron, yet so rapid is the oxidation of the iron when at the high heat requisite for welding, that unless the utmost care be taken and some special means applied for the purpose, more or less of this vitrified oxide is certain to be shut up between the surfaces at the welded part, and a defective junction is the consequence, which defect (as is but too frequently the case), giving no external evidence of its existence, may develop itself in the most unexpected manner, and result in a fearful catastrophe.

It is, therefore, to the means of thoroughly expelling this vitrified oxide from between the surfaces of the iron where the welded junction is to take place that we must direct our attention, for so long as any portion of this adhesive viscid substance is permitted to exist and interpose itself between the surfaces we desire to unite by welding, no sound or trustworthy junction can take place, and once it has made a lodgment no after-heating or hammering, be it ever so severe, will cause its thorough expulsion. It is, therefore, to the thorough expulsion of the vitreous oxide in the first stage of the welding that we must direct the most careful attention, and it would, in no small degree, tend to bring to an end those fearful accidents of which defectively-welded iron-work is so fertile a cause, if all those who are specially and practically concerned with the superintendence of workmen entrusted with the performance of this vitally important process, would see to the use and practice of the truly simple means which I am about to describe.

Fortunately the means of securing a perfectly sound and trustworthy welding are as simple as they are effective, and if those who are entrusted with the superintendence of this vitally important process and of the workmen who perform it, would but give their earnest personal attention to see that the simple and common-sense mode of operation which I am about to describe were in every case attended to, we should bring to an end a fertile source of mischief and disaster.

As I have before said, the chief cause of defective welding arises from portions of the vitreous oxide of the iron being shut up between the surfaces at the part presumed to have been welded, and that besides the impossibility of ascertaining, in the majority of cases after the process of welding has been gone through, whether or not this vitreous oxide has been thoroughly expelled, and the surfaces at the welding brought into perfect metallic union, and that no after-heating or hammering can dislodge the vitreous oxide when once it has effected a lodgment.

Our best and only true security is to form the surfaces of the iron at the part where the welding is desired to take place, so that when applied to each other, when at the welding heat, *their first contact with each other shall be in the centre of each*. Fig. 1 will represent two such surfaces formed in such a manner as to come into contact with each

other in the centre of each, so that when they are urged into close contact by the aid of the hammers, a free escape and means of egress for the interposed matter, vitreous oxide, may be preserved to the last, as indicated in the figures given.

I think it will not require tedious or elaborate description from me to impress on the attention of all who are specially interested in this subject, the practical value of this common-sense and truly valuable, as well as simple, means of effecting the thorough expulsion of the vitreous oxide, as the mode I have pointed out is not only in the highest degree simple and effective, but is also capable of application in every case in which this vitally important process of welding is requisite in the formation of works in malleable iron.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

In order still further to impress on the attention the distinctive characters and value of this simple means of getting quit of the most fertile cause and source of defective welding and its but too frequent fatal consequences, I may as well give a figure of the form of the surfaces of iron-work, as frequently prepared for welding by workmen who are not intelligently alive to the importance of thoroughly dislodging the vitreous oxide from between the surfaces of the parts desired to be welded. Such ignorant or negligent formation of the surfaces is but too frequently made of the nature as indicated in Fig. 5, namely, they are allowed to assume a concave in place of a convex form, and the consequence of such is, that when these surfaces are brought together at a welding heat, and their cohesion aided by the action of the hammers, after the first splash of vitreous oxide is drawn forth by the few first blows of the hammers, the residue remains behind so effectually shut up that no after heating or hammering will ever expel it, and the work resulting will be, in consequence, charged with mischief and fatal disaster, and that all the more dangerously so inasmuch as that the welding of such *concave* surfaces will, from having taken place at the outside part, present all the outward aspect of perfect soundness, as seen in Fig. 6.

Unfortunately, it does happen sometimes that, owing to the simplicity and obviousness of certain improvements in the processes connected with practical matters of the class in question, they do not receive that degree of notice and earnest attention that is given to more elaborate, complex, and "scientific-looking" so-called improvements.

I trust, however, that a consideration of the intimate connexion which the process of welding has with the security of life and property will obtain, for the common-sense means which I have detailed for averting those sad catastrophes which but too often are the direct result of the defective welding of iron, that degree of careful and earnest attention which, I doubt not, every intelligent practical man will give to them.

The Adriatic.

From Mitchell's Steam-Shipping Journal, No. 85.

The steamship *Adriatic*, Captain Jefferson Maury, which arrived here on Sunday morning from New York, and is now the property of the Atlantic Royal Mail Company, was taken to Stokes Bay to-day for an official trial trip before entering on the mail service under the British flag. She made four runs on the measured mile with the following results:—First run, 4 min. 31 sec., equal to 13·284 knots per hour; second, 3 min. 18 sec., or 18·181 knots; third, 4 min. 20 sec., or 13·846 knots; fourth, 3 min. 21 sec., or 17·910 knots; giving a mean speed of 15·908 knots per hour. Revolutions of engines during trial, 17 to 18; pressure of steam, 25 lbs.; vacuum, 25 lbs., with surface condensers. Draft of water, forward, 17 feet 2 ins.; aft, 18 feet 10 ins.; 113 tons of coal on board. The usual authorities of the Admiralty and the Board of Trade were present to witness the trial, together with some of the Company's officials, and a few other scientific gentlemen. The *Adriatic* goes into dry dock to be surveyed, and will leave for Galway in the course of a few days. This fine steamship has excited much attention among nautical men during the time she has been lying in our docks, her beautiful lines, as well as the extent and splendor of her internal arrangements, being much admired by all who have paid her a visit.

SOUTHAMPTON, March 27.

Photo-Sculpture.

M. François Willème proposes the following very ingenious application of the photograph to sculpture:

The model is placed in the centre of a circular platform, around which are arranged at equal heights a number of similar cameras; or around which, one camera can be moved so as to be placed in successive positions at the same distance from the model: in this way a considerable number of photographs are taken. Let us, for the sake of illustration, suppose four: the first, A, presenting the face view; B, the profile from the right; c, the back view; D, the profile from the