

SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico, \$3.00
 One copy, one year, to any foreign country, postage prepaid, £0 10s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845).....\$3.00 a year
 Scientific American Supplement (Established 1876)..... 3.00
 Scientific American Building Monthly (Established 1885)..... 2.50
 Scientific American Export Edition (Established 1878)..... 3.00
 The combined subscription rates and rates to foreign countries will be furnished upon application.
 Remit by postal or express money order, or by bank draft or check.
 MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, MAY 30, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE WAR DEPARTMENT AND NEW YORK CITY DOCKS.

It was a far-sighted and, as events have proved, a pre-eminently successful policy to place the supervision and protection of our natural waterways and harbors in the hands of the War Department. Before a bridge can be thrown across any navigable river, estuary, or strait, before any piers can be run out into a harbor beyond certain bulkhead lines that have been laid down, it is necessary to obtain the permission of the War Department. In safeguarding the interests of river traffic, so far as it is affected by the erection of bridges, it has been the object of the War Department to see that no supporting piers are built in midstream that will materially interfere with navigation, and that bridges are either built at an elevation which will allow shipping to pass without hindrance beneath them, or that they are provided with draw-bridges of sufficient span to allow shipping to pass through without danger of collision. So also with regard to harbor piers and bulkheads, the War Department has exercised a jealous care that certain lines which they have drawn as marking the limits of the harbors are not encroached upon by docks and landing piers. Had it not been for the professional fidelity with which our military officers have performed their duties, incalculable injury would have been wrought to the shipping interests of this country, both inland, river, and deep sea, by the obstruction of waterways and by destructive encroachments upon the deep-water area of our harbors. At the same time, it has occasionally happened that the War Department has allowed its zeal to get the better of its discretion; for it cannot but happen that the best of principles may, at times, be capable of modification to meet some very special case. We think that such an instance may be found in the present ground of contention between the Mayor of this city and the War Department on the question as to whether an important set of piers which are to be built on the North River, southward from West Twenty-third Street, shall be extended beyond the government bulkhead line.

Time was when a pier with a length of 500 or 600 feet was fully adequate to accommodate the longest transatlantic liners. The last important set of piers completed a few years ago on the North River have a maximum length of 800 feet, this being at that time amply sufficient to accommodate such vessels as the "Oceanic" and "Cedric"; but the fact that the Cunard Company is now contemplating the construction of two vessels which will be not less than 750 feet, and may be 800 feet or more in length, proves that the time has come for 1,000-foot docks. The city has requested the War Department to allow an extension of the pierhead line between West Twenty-third Street and Bloomfield Street, 200 feet further into the North River. The application was made by the Dock Commissioners last summer; but the Board of Army Engineers turned in an adverse report to the Secretary of War. The Mayor of this city and the commissioners have been endeavoring to secure a revision of this report, and we sincerely hope that the War Department may be able to look at the matter from the city's standpoint. The objection to the proposed extension is that it will narrow the width of the North River channel; but even if the extension were granted, the channel would still be 2,600 feet in width, which is amply sufficient for a twin-screw vessel to maneuver in and properly make and leave her dock. As a matter of fact, the War Department, to be consistent with itself in the matter of the New York Harbor improvements, should not hesitate to allow this extension; it is already engaged in dredging 40-foot channels through the lower harbor; and vessels of a size that would call for a 40-foot depth of channel will, of necessity, run to 800 or even 900 feet in length. In a letter on the subject written by Vernon H. Brown, one of the veteran trans-

atlantic steamship men of this city, it is pointed out that "adequate piers are as essential to commerce as adequate channels and waterways;" and that all the expense which the government has entered upon in deepening the channels, in response to a strong and popular demand, may be nullified if the steamships for which such channels are constructed cannot be docked after entering port. In conclusion, we repeat that while the jealous care with which the various boards of engineers of the army have safeguarded our harbors and waterways cannot be too highly commended, we think the present is one of those rare cases in which it would be expedient to observe rather the spirit than the strict letter of the law.

RAILWAY HORRORS VS. THE "HORRORS OF WAR."
AN APPALLING RECORD.

In a recent editorial on the subject of the alarming increase of accidents on our railroads, we called attention to the fact that the railroad companies seemed to place a very cheap estimate upon life, as evidenced by the fact that no special measures were being taken to check the rapid growth of fatalities among railroad passengers and employes. We have before us a government publication whose figures present incontestable evidence that the charge of negligence is well founded. According to Accident Bulletin No. 6, published by the Interstate Commerce Commission, the number of passengers killed in train accidents during the months of October, November, and December, 1902, was 266, and of injured, 2,788. Accidents of other kinds, including those sustained by employes while at work and passengers getting on and off cars, etc., bring the total number of casualties up to 12,811. Of these 938 were killed and 11,873 injured; from which we see that at the close of last year our railroads were killing people at the rate of 3,752 per year, and disabling them at the rate of 47,492, a rate of 51,244 deaths and injuries in a single twelve months. Now, these figures are surely sufficiently shocking in themselves; but we can better appreciate their meaning if we compare them with the casualties in some specified instance of the universally-admitted "horrors of war." During the whole of the Boer war, which lasted about three years, the total number of casualties (killed, wounded, died of disease, and invalided home) in the British army was 27,732, of whom 5,727 were killed in action. The Boer losses, if we exclude the number of prisoners taken, were not so numerous as those of the British; but even if we allow that they were approximately equal, we find that the whole number of casualties of British and Boers, throughout the three years, was only about equal to the total number of railroad casualties in the United States, supposing, that is, that the rate shown in the last three months of last year were to prevail for the whole year. Judging from the daily record of accidents during the first three months of 1903, this rate has not only been sustained, but has greatly increased.

What are we going to do about it?

BOILER RIVET HEADS.

Among a series of practical hints on the construction and management of steam boilers that has recently appeared in our esteemed contemporary The Locomotive, we note a discussion of the subject of rivet heads, which is illustrated by cuts of some typical defective rivet heads. These illustrations of themselves are sufficient to prove the necessity for a word of instruction and caution on this most important feature of boiler, tank, bridge, and other kindred work. The specimens presented, which we presume were taken from a steam boiler, show very shallow heads with thin feather edges. They are deficient in strength for any kind of duty, and they would be especially dangerous if they should lie on the furnace side of the plate, where they would be liable to burn off, or to be so impaired by exposure to the furnace heat that leakage and corrosion would probably take place. Although boiler rivets are subject chiefly to shearing stress, there is also a tensile stress in the direction of the axis of the rivet, which acts directly on the rivet head with a tendency to shear it off. Hence the importance of giving such a depth to the head that there shall be sufficient sectional area to prevent longitudinal shearing, and hold the plates in steam-tight contact. In much of the current boiler work the depth is not nearly as great as the heavy duty that falls upon the rivet calls for. This is true in a measure of all riveting, whether it be in tank work, bridge work, or the riveted column and girder work that enters so largely into modern skeleton steel buildings. But in boiler work, as our contemporary points out, it is particularly desirable, because of the complexity of the stresses that occur, that the rivet should be properly proportioned in all of its parts. If it were perfectly certain that the total shearing stress occurring along a certain line of rivets were equally divided among them, we could determine exactly what strain would come upon each individual rivet; but faults of workmanship, and other stresses than those due to the direct pressure of the steam in the boiler, may cause certain rivets to be

strained far more heavily than others. Although we are accustomed to provide factors of safety by placing the working stress which a rivet is designed to carry greatly below the breaking strength of the rivet itself, still it is necessary that every rivet should be perfectly proportioned if we are to get the full benefit of this factor of safety, as allowed. The ideal rivets are those which have the same strength in the heads at both ends, and it is customary to consider them satisfactory when the two heads contain an equal amount of stock and are so shaped as to give a proper bearing against the plates, and a satisfactory strength of body. Since, in driving a rivet, some of the material is used in filling up the hole, which is usually 1-16 of an inch greater in diameter than the rivet, an extra length of shank must be allowed for this purpose. This will vary, of course, with the diameter of the rivet and the thickness of the plates through which it is driven; but under ordinary circumstances, an allowance of 1/8 of an inch in length of the shank will provide sufficient extra material for filling the hole. The chief allowance that must be made is, of course, that for the stock which is necessary for forming up a rivet head; and to make sure of having sufficient steel, it is necessary to allow a length of shank whose volume is equal to the volume of the cone head that is in the rivet as it comes from the maker. On a one-inch rivet a good average proportion would be a diameter of 1 1/4 inches at the base of the head, 15-16 at the top of it, and a depth of 3/8 of an inch. For such proportions it will be found that the extra length of shank necessary to form up a good rivet head must be 1.63 times as long as the diameter of the rivet.

AN AMERICAN OFFICER'S VIEW OF GERMAN INDUSTRIES.

Lieut. Godfrey L. Carden, R. C. S., who was detailed by the government for duty at the World's Fair, St. Louis, has recently returned to the United States after an eight months' period spent among the iron and steel and machinery establishments of Europe. Lieut. Carden went from St. Louis direct to the Krupp works, at Essen, Germany, in July last, and he has been actively employed in the interests of the Machinery Department of the St. Louis Exposition ever since that date.

In a little more than three months' time Lieut. Carden visited more than three hundred of the iron and steel and machinery works of Germany, and his investigations carried him as far north as Stockholm, Sweden, as far south as Legnano, Italy, and included in addition to Sweden, Germany, and Italy, the countries of Switzerland, Belgium, France, and the United Kingdom. In speaking of the conditions in Germany, Lieut. Carden said: "Of all the countries of Europe, Germany has probably made greater advances than any other in the last ten years. The display at the Düsseldorf Exposition was a rude awakening to many of the immense importance of the establishments of the Rhenish Provinces, and plainly indicated that in a matter of sizes the Germans hesitate at nothing. While there was nothing at the Düsseldorf Exposition which could touch, for example, some of the high-speed engine work in the large sizes which one will find in England, still the surprise was that the Germans were so far advanced. This statement applies to the great run of the German establishments, for plants like Krupp, the Bochum houses, Haniel and Lueg, and some others which could be mentioned, have long held a place in the very first rank.

"I doubt if anywhere in the world one will find so many up-to-date plants as exist now in the Rhenish Provinces; and when I say up-to-date I refer to the systems of installation and the general internal facilities. The sanitary arrangements in the various German shops are superb, and in the matter of economics they can teach us on this side of the water very much indeed. In fact, I was almost going to say they can teach us everything.

"Ten years ago one might have traveled up the Rhine, and in practically every shop of any importance one would have found English tools; to-day all this is changed. The small shops of ten years ago have given way to pretentious buildings, arranged and equipped in the most modern fashion; but instead of the English tools of a decade past one now finds, for all general work, German tools, with, however, this addition, that for high-grade work requiring great precision and excellence there is also to be found in nearly all the leading shops a group of American tools—a silent tribute to the remarkable position held in the world to-day by the American machine tool's work.

"After I had visited the first one hundred and fifty iron and steel and machinery houses, I reported that I found but two establishments where English was not spoken. As a matter of fact, the German director almost without exception has a very full knowledge of the English language. I have sat at boards of directors' meetings where no less than seven directors were present, and every German director speaking English almost faultlessly.

"Just now the conditions among the iron and steel