SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*
361 Broadway, New York

FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year, for the United States or Mexico.......$3.00
One copy, one year, for Canada.......3.75
One copy, one year, to any foreign country, postage prepaid, £0 18s. 6d. 4.50

THE SCIENTIFIC AMERICAN PUBLICATIONS

Scientific American (Established 1845).......$3.00 a year
Scientific American Supplement (Established 1876).......5.00 "
American Homes and Gardens.......3.00 "
Scientific American Export Edition (Established 1878).......3.00 "

The combined subscription rates and rates to foreign countries, including Canada, 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, AUGUST 10, 1907.

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.

AT LAST A 25-KNOT LINER.

Twenty-five knots an hour has for some time been recognized as the maximum speed which, in the present condition of the shipbuilders' art, it would be possible to secure in a big ocean steamship. Indeed, it was only when the marine steam turbine began to reveal its possibilities, that the creation of a 25-knot liner began to take shape in the mind of the naval architect. Congratulations are due to the Cunard Steamship Company, as being the first to place in service a ship of this maximum speed, particularly when it is borne in mind that to the distinction of being the fastest, the new flyer adds also those of being the largest, the most commodious, and the steadiest ship afloat.

In the "Lucania" and "Campania," now twelve years old, the possibilities of the multiple-expansion reciprocating engine for the development of high speed in ocean liners received a striking illustration, one of these ships having crossed the Atlantic at an average speed of slightly over 22 knots an hour. Then the German companies, with all the valuable data acquired in several years' service of these ships at command, and incorporating such improvements in engines and speed lines as their own undoubted talent suggested, brought out that magnificent quartette of boats, the "Deutschland," "Kaiser Wilhelm I.," "Kaiser Wilhelm II.," and "Kronprinz," the fastest of which added 1½ knots an hour to the transatlantic record,—the "Deutschland" and the "Kaiser Wilhelm II." having averaged 23½ knots an hour for the whole trip across the ocean. In their latest ship, the "Kronprinzessin Cecelie," a sister ship to the "Kaiser Wilhelm II.," the North German Lloyd Company, in spite of the fact that the two new Cunarders were under contract to develop a speed of 25¼ knots, decided, much to the surprise of a large section of the naval architects of the day, to equip their new boat, not with marine turbines, but with quadruple-expansion engines of the same type as those in the "Kaiser Wilhelm II.," of which they are practically a duplicate. The contract speed of the ship is the same as that of its predecessor, and she will be capable of equaling, if not somewhat exceeding, the 23½-knot average ocean speed of the sister ship.

That the "Lusitania" will be a 25-knot boat is now established by telegraphic dispatches from Liverpool, announcing that on the official trial, which lasted forty-eight hours, the ship maintained an average speed of 25¼ knots for a continuous run of 1,200 knots. This is certainly the most severe trial test to which any ship, either in the navy or the merchant marine, has yet been subjected. Considering that the engines are new, and the crew not yet accustomed to the ship, it is reasonable to expect that, after she has made a few voyages, the "Lusitania" will be able to maintain an average speed of 25½ knots under normal conditions of wind and sea. Steaming at 25¼ knots, however, she will bring the transatlantic record for the first time below five days—by just how much remains to be seen.

COLORADO DAM IS PERMANENT.

The sixty-foot dam which last winter was thrown hastily by the engineers of the Southern Pacific Railway across the break in the Colorado River banks, was recently subjected to a prolonged and searching test, through which it has passed most successfully. For over three weeks this work and the levees on either side of it were subjected to the greatest June flood on record, without developing any sign of weakness. The engineers, in spite of the violence of the flood, had no fears for the safety of the dam itself, but they realized that there was a possibility of the water passing around the end of the levee and attacking the canal in the rear. Fortunately, however, the Colorado River itself averted that danger, by deepening its old channel, and swinging it over away from the dam to the Arizona shore. The absolute safety of the dam against overflow was shown by the fact that at the period of highest water, the lowest point of the structure was always seven feet above high-water mark.

In anticipation of emergencies, the Southern Pacific Company, to whose prompt action is due the credit for the successful closing of the river, have built a railroad along the crest, from the head gate to the end of the levee. A telephone runs the entire length, with stations a mile apart. During the time of high water, men patrol the work on gasoline track velocipedes, so that if there is any indication of weakness, they can telephone to the heading, where a trainload of rock stands ready to be rushed to the breach. Although the break of the banks has been thus permanently repaired, water is still flowing into the Salton Sea by way of New River, passing down the Paradones to Volcano Lake, whence a portion of it flows northward through New River to the Salton Sea. This inflow, which is about 1,500 second feet, serves to compensate for the surface evaporation of the sea and causes its level to remain about stationary. The security of the Imperial Valley, with its wonderfully fertile lands and many settlers, is thus assured, and the greatest credit is due to the engineers of the Southern Pacific Railroad for carrying through this hazardous and difficult work in so short a period and with results that will probably stand for all time.

IS RUSTING ELECTROLYTIC?

Among the many valuable contributions to knowledge by the United States Department of Agriculture, one of the most important is that which was made public at the recent meeting of the American Society for Testing Materials, in which were announced the results of an investigation which the society has been carrying on for many years past, to determine the causes of the corrosion of iron. The most radical statement contained in Dr. Cushman's paper is that oxygen is not the primary but merely a secondary cause in the rusting of iron, and that the best protection against rust is the use of chromic acid and its salts for the treatment of the iron—that is to say, one of the most active oxidizing agents known to chemistry will be found to be one of the best preventives of rust. Startling as this assertion is, the experimental work, and the deductions therefrom which have led to this conclusion, have been accepted by the leading specialists in this field of investigation. A notable indorsement of the paper was that by Dr. Charles B. Dudley, who did not hesitate to designate it as the most important contribution of the kind that has been made in the last twenty-five years. The investigation which resulted in this important discovery was undertaken with the object of discovering some method of preventing the corrosion of wire fencing—a subject of most vital interest to the farmers of this country. Hitherto, it has been commonly held that the formation of rust was due to the action of carbonic acid, resulting in the formation of carbonate, which, in its turn, is acted on by water and the oxygen of the air in the formation of rust or red hydroxide, the carbonic acid being set free by this last reaction to carry on again its work of destruction.

According to Dr. Cushman's theory, the first attack on the iron is made by hydrogen in the form of the hydrogen ion, and not, as the text books have taught us, by oxygen. This is in agreement with the modern theory that many substances, when they are dissolved in water, are dissociated into ions, or atoms carrying static electrical charges. Even pure water contains a certain number of these, and the presence of acid impurities multiplies the hydrogen ions and strengthens them in their corrosive effect upon iron. The action is explained as being purely electrolytic, and as involving an exchange of the electrostatic relations between the hydrogen and the iron. Dr. Cushman discovered that active oxidizing agents, such as the chromate and bichromate of potash, prevent rusting by polarizing the iron to the condition of an oxygen electrode, thereby safeguarding it against attack by the hydrogen ion. He found that by immersing the iron in a concentrated solution of bichromate acid, and then washing and wiping it, the metal is rendered passive, so that it becomes capable of resisting electrochemical attack. The action of rusting is completely analogous to that which takes place if iron is placed in a copper salt solution. In this case, copper ions, carrying positive electrostatic charges, are present; iron passes into solution and assumes the electrostatic charge, while the copper plates out and becomes visible. Correspondingly, when rusting takes place, iron passes into solution, while hydrogen plates out. Once in solution, the oxygen of the air oxidizes the iron to the insoluble form of the red hydroxide commonly known as rust. It would be difficult to overestimate the practical value of the discovery here outlined, which will have a most important bearing, not alone upon the structural work of the civil engineer, but also upon many forms of iron and steel construction included in mechanical engineering.

CAUSE AND CURE OF SPLIT RAIL HEADS.

Apropos of our reference to the meeting of the American Society for Testing Materials, mention should be made of the paper of Dr. P. H. Dudley dealing with steel rail sections. Probably there is no one in the United States, if indeed in the world, who speaks with such authority upon this subject. The doctor makes his home in a special car equipped with apparatus for determining the condition of the track over which the car is drawn, and the voluminous records which have been thus obtained are probably the most valuable practical contribution to our knowledge of the action of traffic on track, in existence. Dr. Dudley has ever been an ardent advocate of the use of rails of greater weight and deeper section, and in the paper referred to, he shows how great is the benefit secured from a comparatively slight increase in the height of the rail sections, in the way of giving a better distribution of the concentrated wheel loads. To raise the bearing surface of the rails from ½ to 1½ inches higher above the crossties than that of the earlier sections may seem a small increase, in the sense of dimensions; but when this slight increase is utilized in the design of the sections of rails, with a corresponding increase in the proportions of metal used, the mechanical advantages obtained in the way of enabling the rails to better carry and more broadly distribute the heavier modern wheel loads, represent an increase in the capacity of the rails of from 50 to 200 per cent. The depression of the deeper and stiffer rails, in spite of the increased wheel loads, is only from ⅛ to ⅜ of an inch, as compared with a ⅝ to 1 inch deflection under the earlier light and limber rails. The stiffer rail, moreover, has the advantage of distributing the wheel loads over a wider surface of track. The small bending resistance of the limber rail permitted the effect of the load to pass directly to the tie immediately beneath it, with the result that the crushing down of the tie occurred early in its life. The deep 5 and 6-inch rails, because of their high bending resistance, distribute the wheel loads among several adjoining ties, with a consequent lessening of the cutting action and a prolongation of their life.

Although wheel loads have increased only 100 per cent as against an increase in the stiffness of the rails reaching as high as 200 per cent in some cases, there has been a great increase in the number of breakages of rails in the corresponding period. Dr. Dudley has always attributed, and does so in this paper, the inferior quality of the rails to the hurrying-up, which has taken place in late years, of the process of manufacture, and particularly that part of it which has to do with the "blowing" of the metal in the converters. Sufficient time is not allowed to elapse, after recarburizing the blown metal, for the complete chemical reactions to take place, and for the slag to escape from the body of the metal. The slag, oxides and gases are often entrained instead of being eliminated, the chemical reactions being only partially completed while the steel is setting in the ingot mold. The slag and occluded gases, coupled with the segregated metal, are important factors in causing the heads of rails to split. The split rails develop after shorter or longer periods of service, the life of the rail depending upon the thickness of good metal between the surface of the rail head and the slag and occluded gases contained in the body of the rail. Split heads are not confined entirely to the rails rolled from the top of the ingot, but are found in less numbers in rails which have been formed from the body of the ingot.

Dr. Dudley proves his contention by quoting the composition and processes of manufacture of certain 80-pound and 100-pound section rolled for one of our leading railroads, and giving the excellent results obtained with these rails in service. The composition of these 80-pound rails as rolled for the New York Central was: Carbon 0.55 to 0.60, manganese 1.00 to 1.20, silicon 0.10 to 0.15, phosphorus not to exceed 0.06, sulphur not to exceed 0.07. The copper, which was not specified, averaged in those rails 0.7 to 0.8. The iron was remelted in cupolas, and the temperature of the heat in the converter regulated by 1,800 to 2,000 pounds of scrap, charged before the receipt of the molten iron. The bath was recarburized in the converter and the metal poled in the ladle by thrusting in a green wood pole. It was one or two minutes before teeming of the ingots commenced. The ladle nozzle was 1⅛ inches in diameter, and 6 or 7 minutes was consumed in pouring the 10-ton heat in five ingots, 15 by 15 inches square on the base and of sufficient length for three 30-foot rails. The ingots