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 16s. 5d. 4.00

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 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 5, 1905.

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 LESSON OF THE "BENNINGTON" DISASTER.

The awful tragedy on the gunboat "Bennington," due to the explosion of one of her boilers, has shocked the people of the United States more than any naval disaster since the blowing up of the "Maine" in Havana harbor. The loss of so many lives is rendered doubly painful by the conviction that the accident was entirely preventable. This conviction is based on the fact that the construction, inspection, and care of boilers are now so thoroughly understood, that, if proper precautions are exercised, a boiler explosion is practically impossible. In the exhaustive investigation that will be made by the Navy Department, evidence may be offered that will excuse both the engineering force on the ship and the system under which they worked; but the fact that the motive power of this war vessel was in the sole charge of a young officer, whose age rendered it impossible that he should have had the necessary experience to qualify him for such a great responsibility, suggests that the system may be partly responsible for the disaster.

It is a notorious fact that new ships are being added to our navy faster than adequately trained and experienced officers can be found to man them, and we understand that the scarcity is being felt more severely in the Department of Steam Engineering than in any other branch of the service. One of the first duties of Congress should be to make provisions for a considerable increase in the yearly supply of qualified engineers; and at the same time it should settle on a permanent and satisfactory basis the vexed question of the engineers' official rank.

MECHANICAL STOKERS ON LOCOMOTIVES.

The rapid growth in the size of locomotive boilers has added greatly to the labors of the fireman. Just how great this increase has been, will be understood when it is remembered that in 1893, when the famous express engine No. 999 was exhibited at the World's Fair, with its 1,900 square feet of heating surface, the boiler was considered to be of extreme proportions. Yet today a heating surface of 3,000 square feet is quite common, and there are many express engines that have as much as 3,400 and 3,500 square feet. Now, these figures mean that in the course of a decade and a half the heating surface of locomotives has about doubled; for we must remember that No. 999 was a great advance on contemporary practice, in which from 1,500 to 1,700 square feet was considered to be a generous allowance of heating surface. With the growth of heating capacity there has been a corresponding increase in grate surface, and in the labors of the fireman to keep these huge modern boilers supplied with coal. In a run of 150 miles, except in the very lightest trains, the fireman is never seated. When he is not handling the injector, or peering ahead to catch the first glimpse of a railroad signal, he is steadily loading coal into the firebox. The fireman's labors have increased enormously; for the great length of the firebox, which is necessary to provide the big grate surface, calls for increased physical exertion in throwing the coal forward so as to scatter it evenly over the more remote portions of the grate. The matter has reached a point where the question of employing two firemen has come up for consideration by railroad officials; it is being urged by the labor associations; while in more than one legislature an attempt is being made to regulate the matter by law. The railroad companies object to the presence of a third man, partly on the ground of the expense, and partly because it is thought that for reasons which we fail to grasp the efficiency of the lookout might be impaired thereby.

In this connection the question of the use of the mechanical stoker becomes of considerable importance. One or two types of such stokers have been tested with a fair amount of success, and there can be no doubt that the time has come when the matter should be taken up in the same thorough manner in which the recent locomotive tests were carried out by the Pennsylvania Railroad Company at the St. Louis Fair. The mechanical stoker is such a great success in stationary boiler plants, that it is reasonable to expect that, when its form has been modified to meet the special conditions of locomotive practice, it can be made to yield equally satisfactory results. One important advantage of its installation would be that the fireman could give considerably more attention to signals than is possible in his present overworked condition.

SEAWANHAKA CUP RETURNS TO AMERICA.

There has never been a period in the history of international sport in which this country has been concerned in so many important contests as in the present year. We have but to refer to the Transatlantic cup race, the contest for the Henley cup, the Gordon Bennett cup race, the rifle match between teams of the Seventh Regiment and the Westminster Volunteers, the challenge for the Davis tennis cup, and the challenge for the Seawanhaka cup for small yachts. Of these six international events, the first and last named have been won by the American representatives, and as both of these are yachting events, it will be seen how greatly this country is indebted to the noblest of all sports for its successes in what has been for us, in international contests, a decidedly "off" year.

Of the two yachting events, the winning of the Seawanhaka cup has really, in the eyes of yachtsmen, more significance than the winning of the Transatlantic race; for although the competing yachts for the Kaiser's cup were of the biggest size, they were a rather heterogeneous fleet, varying widely in size and age, some of them being racing yachts pure and simple, and others comfortable old cruisers that were never intended for racing of any kind. The contest just concluded for the Seawanhaka cup was, however, of a very different kind, the competing boats representing a highly-developed racing model, in which the yacht designer and the engineer combined their efforts to secure the single object of high speed. In this respect the Seawanhaka contests are, in the class of small boats, what the "America" cup contests are among the 90-footers.

The Seawanhaka challenge cup was won by a Canadian boat just nine years ago, and in every intervening year since it was captured, various American clubs have challenged, built a fleet of yachts out of which to select a representative, and have gone up to the lakes, and sailed a series of more or less hotly contested races, only to go down to defeat. The credit for the lengthy stay of the cup in Canada is due to a young civil engineer, Mr. Duggan, who approached the problem of building a 21-foot racing craft in exactly the same way in which that other engineer, Mr. Herreshoff, has worked out the same problem in the "America" cup defenders. In each case the process has developed a freak, pure and simple, that is to say, a yacht which, when its work of attack or defense is done, has practically no further usefulness to the yachtsman. Just how freakish the Seawanhaka boats have come to be may be judged from the fact that in one series of races Duggan came to the line with what was practically a double-hulled boat; for along the axis of the boat, where ordinarily the keel would be, the hull was rounded up clear of the waterline. This was done to save wetted surface and give the boat a long, fine, canoe-like hull to sail upon, the windward half of the boat being lifted practically clear of the water in a fresh breeze. The double-hulled boat being mutually barred from future races, the Canadians next brought out a broad, shoal craft, designed to sail upon its bilges and provided with two centerboards and two rudders, set normal to the curve of the bilge and, therefore, standing vertically in the water when the little craft was heeled by the wind. The "Manchester," representing the Manchester Yacht Club, was built on these general lines, and she scored a decisive win by taking the three races that were sailed. Take it all in all, there has never been a series of races that has been characterized by such friendly competition and good, clean sportsmanship as these for the Seawanhaka challenge cup.

WEAR OF CAR WHEELS ON CURVES.

An editorial which appeared in our issue of May 27, on the subject of the wear of wheels of cars when moving over curves, has brought several letters to the Editor's desk, asking whether it is not a fact that the tread of a car wheel is turned with a tapered or coned face, for the purpose of overcoming the slipping of one or other of a pair of wheels in running around a curve. In answer to these correspondents we point out that if the tread of a pair of wheels be formed with a taper corresponding to the sharpness of a given curve, they will move around the curve without any slipping; but if the same pair of wheels be run over other curves of smaller or larger radius, one or other of the wheels must slip. Hence it follows that, in actual practice, where the curves vary so greatly, the coning of the wheels can have only a very limited effect in the prevention of slipping. The theory of the coned wheels is that, in passing around a curve, the centrifugal force causes the train to hug the outside or longer rail, and as the diameter of each wheel at the flange is larger than at the edge opposite the flange, the outer wheel on the curve, or the wheel bearing on the outer and longer rail, is running on a larger diameter tread than is the inner wheel. It can readily be seen that if the taper of the tread has the proper ratio to the curvature of the rails, there will be no slip of either wheel on its rail. This is a condition, however, that occurs but rarely in practice.

PROTECTION AGAINST FIRE DAMP.

The problem of safeguarding the lives of the toilers in our mines is one that lends itself to a great deal of experiment, resulting in processes and instruments of more or less value to science and the world at large.

The recent mine disasters in Pennsylvania, the horrors of which are still fresh in our memories, have resulted in some novel and intensely interesting experiments being made for the purpose of guarding against the dread results of accumulations of fire damp, as methane, or marsh gas, is commonly called.

One of the most interesting of these from a scientific standpoint, and the most successful from a practical point of view, is one that has been installed in a large colliery in Pennsylvania after careful and exhaustive trials that have resulted in a most satisfactory manner. This instrument is called a methanometer, and its successful working is based on the principle of the decomposition of methane in the presence of an excess of ordinary air under the influence of a high temperature. The high temperature is secured through an induction spark or an incandescent platinum wire, and the condensation is shown by a change of height in a column of mercury. The instrument consists of two component parts—the analyzers, which are placed throughout the galleries of the colliery, and the receiver or indicator, which is placed in the office under the eye of the superintendent.

The analyzer transmits each hour to the receiver the exact proportion of fire damp, between one and nine per cent, that is mingled with the air in that part of the mine where each analyzer is placed. Thus, when a dangerous proportion of fire damp is recorded in any part of the mine, the superintendent can issue the necessary orders for the ventilation of that part, and the apparatus will enable him to follow the results of the ventilation as indicated in the receiver.

In the analyzer, the burner, mercury column, and pendulum are attached to one side of a heavy bronze plate, while on the other side is attached the clutching mechanism, the whole being inclosed in a tight-fitting case.

The burner or exploder is a little receiver, with a fine platinum wire across its longest axis, and communicating with the mercury column or manometer. Extending from the side of the exploder are two glass tubes, to which are attached India-rubber tubes, one of which extends through the tight-fitting case to receive the air of the mine, while the other extends to bellows actuated by the movement of the sounding apparatus.

It has been conclusively shown by experiment that the manometric indications are always similar under similar conditions. The height of the barometer has little or no effect on the results obtained; temperature has more, but this varies little in the places where the apparatus is used. Suppose the analyzer to work in a gallery where the temperature varies from 30 deg. to 40 deg. The average is therefore 35 deg., to which the instrument is regulated, and the height of the mercury column is determined for a mixture of five volumes of marsh gas to ninety-five volumes of air. This height divided by five gives the height corresponding to one per cent of marsh gas, and by like experiments the different heights of mercury for volumes of marsh gas from one to nine per cent can be determined, and marked on the sides of the tube. Platinum wires should now be fused into the glass tube at each of the nine marks, and the manometer will be ready to act with its exploding chamber.

The nine platinum wires from the manometer are connected with an equal number of platinum plates insulated in ebonite and arranged in the form of an arc. Just below the center of the arc is attached a ratchet wheel furnished with pawls, and carrying a contact rod which passes from plate to plate as the wheel turns. The mercury of the manometer is in permanent contact with one of the poles of the battery, while the ratchet wheel and arc, through an electro-magnet actuating the pawls, is connected intermittently with the other pole of the battery. When the mercury in the manometer rises as high as the first platinum wire, the current is closed, and passes through the platinum connecting wire to the first plate of the arc, thence through the contact rod into the ratchet wheel and its pawls.

The electro-magnet actuating the ratchet wheel is now magnetized, and turns the wheel until the contact rod rests on the second plate of the arc, thus opening the circuit. When the mercury in the manometer reaches the second platinum wire, the above operation is repeated, and so on, until the contact rod reaches the last plate, where a contact arrangement holds the lever actuated by the electro-magnet until the ratchet wheel and contact rod resume their normal position through the influence of a weight.