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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.

PRODUCTION AND POPULATION.

We could not ask for stronger evidence of the increasing prosperity of the country than is afforded by the last publication of the Bureau of Statistics, embodying the annual review of the foreign commerce of the United States. It contains figures which show the progress in production and consumption, in the United States, of coal, iron, and petroleum. The increase is really astonishing, particularly when it is borne in mind that it has been far more rapid—five times more rapid, in fact—than the increase of population. Thus, in 1894, the production of coal was 152,447,791 tons; in 1903, it was 319,068,229 tons, an increase of over 100 per cent. In 1894, the production of pig iron was 7,000,000 tons; in 1903, it had risen to 18,000,000 tons, an increase of over 150 per cent. The production of petroleum rose from 2,072,469,672 gallons in 1894 to 4,219,374,154 gallons in 1903, an increase of over 100 per cent. Now, the increase of population in the United States is estimated as not more between the years 1894 and 1903, than 21 per cent, so that the production of these important materials of industry has increased from five to seven times faster than would naturally be called for by the growth of population. It should be noted, moreover, that during this increase, the exports of coal have been nominal, while the exports of petroleum have slightly decreased; showing that the home consumption is growing in a ratio proportionate to the increased production.

GAS TURBINES.

It was inevitable that the success of the steam turbine should lead to an investigation of the problem of the gas turbine; for it is natural to argue broadly that the results obtained with one gas will be obtained with any other, unless indeed some radical difficulties inherent in the gas or in the mechanism employed for its expansion should be found to stand in the way. The prospects for the early development of the gas turbine were discussed recently in a paper read before the British Institute of Mechanical Engineers, and, according to the author, those prospects are not very bright. Of course, one of the chief difficulties is the high temperature of the gas, which necessitates, if the temperature is to be reduced to a degree that is not injurious to the cylinder, the carrying away of a large amount of heat by the cooling water. If it were attempted to dispense with cooling water, or to use only as much as would cause a moderate reduction of the temperature, the rotating parts of the turbine would have to run red hot, and there is no material known to the engineering art to-day that would hold together at such high temperature, if subjected to the great centrifugal forces that would be developed.

POWER OF OCEAN WAVES.

At the International Engineering Congress, recently held at St. Louis, some unusual figures were given on the subject of the height and power of ocean waves, particularly as regards their effect upon harbor works. In the course of a paper dealing with the new Dover harbor, it was stated that since these works have been in progress, no wave of a greater height than 15 feet has been recorded—a fact which will be very surprising to those who have experienced the miseries of the Dover-Calais passage. The fact is the more remarkable because at the entrance to the Tyne, waves from 35 feet to 40 feet high have been measured, and the last-named height has also been observed at Peterhead. In dwelling upon the necessity for what are known as spending-beaches and wave-traps, for dissipating and controlling wave action, it was stated that the depth to which the latter extends is now known to be much greater than was once commonly supposed. Proof of this is shown by the fact that lobster pots placed in from 120 to 180 feet of water, have been found to be filled with sand and shingle after a heavy gale; moreover, sand had been found deposited after a heavy gale in the gallery of the Bishop Rock lighthouse, the latter being 120 feet above the water, and the depth of the water at that point 150 feet. That the water, even at considerable depths, must be moving during a gale with great momentum, is shown by the fact that at the Peterhead breakwater blocks weighing 41 tons and located over 36 feet below spring tide low-water, were displaced during a storm, while a section of the breakwater weighing 3,300 tons was moved bodily for a few inches without the brickwork being dislocated.

ELECTRIC TRACTION FOR TRUNK ROADS.

The successful test of the first of the electric locomotives that are being built for the main line of the New York Central Railroad, marks a definite step toward the day when trunk-line passenger service will be worked by electrical traction. The locomotive did everything that had been expected of it, hauling its test loads with that rate of acceleration which is one of the chief advantages of the electric motor, whether applied to the locomotive or directly to the cars. The success of the New York Central installation, of which no reasonable doubt can be entertained, will be followed by the electrifying of similar stretches of steam roads, on which the traffic is sufficiently dense and heavy to warrant the change. There were special conditions connected with the New York Central service which rendered the use of the electric locomotive desirable; but when such systems as those of the Pennsylvania between New York and Washington or Pittsburg, or of the New Haven road between New York and Boston, come to be electrically equipped, we think it is altogether probable that the Sprague system of multiple control will be adopted, the electric locomotive being dispensed with. This implies a better distribution of the weight and power throughout the train, greater smoothness of running, and, of course, less wear and tear upon the track and bridges.

SUBWAY RESULTS.

The New York Subway has been in operation for a sufficient time to enable the public to realize how far its performance comes up to its high promise. In spite of a pretty liberal bombardment by the crank and the faddist, carried on from the vantage ground of the correspondence columns of the local press, there is little doubt that New York city is greatly pleased with its new system of transportation. The feature that appeals most strongly to the downtown business man and the theater-goer is the system of express trains, in which the operating company has fully redeemed its promise of a fifteen-minute service to Harlem. These trains have hitherto been run under a four-minute headway, but now that the east side branch of the road has been opened, the expresses will be run under a two-minute headway as far as the junction at Ninety-sixth Street, and a four-minute headway upon the two branches of the road from that point to their respective termini. There are two features in particular that mark the road as constructed on the most up-to-date practice in electrical traction. One is the remarkably rapid acceleration, which amounts to 1.25 miles per second, and the other is the splendid condition of the track. The combination of 100-pound rails with a tie-plate on every tie, and broken stone ballast laid on a concrete foundation, provides a remarkably smooth track, in which both surface and alignment are all that could be asked. Another feature that contributes to comfortable riding is that the curves are "spiraled," that is to say, the track runs from the tangent to the maximum curvature in a parabola, the change of direction being so gradual that the jolt which usually accompanies the entrance of a train upon a curve is entirely removed. The express train service is undoubtedly the most valuable feature of the new Subway; and it augurs well for the future service of the system that Mr. Belmont has expressed the conviction that the Subway was intended primarily to provide service of this nature, and that the more completely it is given up to express trains, the more fully will it meet the needs of this great and populous city.

A UNITED STATES WARSHIP ON TRIAL.

In the life of a warship there is no event—always excepting, of course, the day of battle—around which so great interest, both sentimental and practical, centers as her trial trip; for rightly or wrongly, the world has fallen into the habit of placing the speed of a warship as first in value of the many separate elements that go to make up the sum total of her efficiency.

It was, therefore, with no small amount of interest that the editor recently boarded the United States armored cruiser "Pennsylvania" as the guest of her builders, the Cramps, of Philadelphia, to witness the government speed trial on the well-known Cape Ann course off the coast of Massachusetts. Outside of the small party of invited guests and the ship's trial crew of 450 officers and men, the persons on the ship most immediately interested in the trial were the Government Trial Board, composed of eminent officers of the navy, and the officers and representatives of the company that built the ship. To the first named, a speed trial is an event of profound importance, since upon it depends the acceptance by the government of the United States of a vast and complicated machine which, in the completed condition, will represent the expenditure of between five and six million dollars from the national treasury. To the representatives of the firm, the issue is of even more vital importance, since it involves the payment to them of a sum of nearly four million dollars, and what is of even more importance, the prestige of the firm is greatly at stake; for of all misfortunes that may happen to a big shipbuilding firm, there is none that can give more positive chagrin than to know that such and such a great warship constructed by themselves, and designed for 20 or 22 knots an hour, must go down on the official register as having done no better than 19 plus or 21 plus, as the case may be. On the other hand, it is always an object of laudable ambition and keen competition among the respective builders of a class of sister ships to be able, as in the case of the "Pennsylvania," to say that she heads her class in speed and economy of coal consumption.

The performance of the "Pennsylvania" in exceeding the contract speed by 0.43 of a knot, and the contract horse-power by 5,000, is a result that is gratifying both to the government and to the builder. It has always been the policy and tradition of our Bureaus of Construction and Engineering to encourage the hearty co-operation of the leading shipbuilding firms of the country; and in this particular case, the excellent results are directly attributable to certain modifications in the boiler room and engine room, which, as the trials have shown, resulted in greatly improving the speed and efficiency of the ship. The contract for the six vessels of the "Pennsylvania" class called for the development of a speed of 22 knots an hour, with an indicated horse-power of 23,000. The builders of the "Pennsylvania" decided that, by using a different type of water-tube boiler, and making certain modifications in the triple-expansion engines, they could secure a larger indicated horse-power, and thus serve the double purpose of safeguarding their own interests and giving the United States government a better ship. The suggested changes which were allowed by the government were as follows: The battery of thirty Babcock & Wilcox boilers was replaced by a battery of thirty-two modified Niclausse boilers, the modifications being in the direction of larger tubes and drum, and a general simplification of details. The main steam pipe was increased from 13 inches to 15 inches diameter, because it was considered that for a piston speed of nearly 1,100 feet a minute, a pipe of the larger diameter would be a necessity. The boiler pressure was raised from 265 pounds to 300 pounds, and the arrangement of the cylinders was modified, so as to give a more direct flow to the steam; the order in the departmental design being low pressure, high pressure, intermediate, and low pressure, which was changed in the Cramps' design to high pressure, intermediate, low pressure and low pressure. Another radical change was that, instead of the low-pressure cylinders being assisted by introducing live steam from the boilers, this connection was dispensed with, and, instead, the exhaust from the auxiliaries was fed direct to the low-pressure cylinders. It will thus be seen that the changes were thoroughly in touch with the latest marine practice, involving high boiler pressure, ample steam-pipe connections to convey an abundance of steam to the cylinders, and a literal adherence to the principles of triple-compound expansion, by using live steam only in the high-pressure cylinders, and allowing it to develop its full expansive efficiency from throttle to condenser.

The value of these changes is seen in a comparison of the trials of the "West Virginia" with those of the "Pennsylvania," the first-named ship being built strictly to the original designs. On her trial trip the average speed of the "West Virginia" was 22.12 knots with 25,750 horse-power, on a coal consumption of 3.2 pounds per indicated horse-power per hour. The "Pennsylvania" averaged 22.43 knots with an average indication of 27,750 horse-power, on an average coal consumption of 2.2 pounds per horse-power per hour, the temperature in the uptake in the first case being over 1,000 degrees, and in the case of the "Pennsylvania" 650 degrees. We quote these figures not only for their intrinsic interest, but as showing the wisdom of the departmental policy of encouraging the private builders to offer and put in practice their own amendments to departmental designs. The low coal consumption is, perhaps, an even more valuable feature than the higher speed, for it means that if the "West Virginia" and the "Pennsylvania" were both using