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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.

GROWTH OF AMERICAN UNIVERSITIES.

The safeguard against and corrective of the evils of our vast immigration are to be found in our excellent public school system; and so, on the other hand, we may say that the greatest safeguard against the perils which attend on the increase of the opportunities for accumulating rapid wealth, and the temptations and opportunities to acquire that wealth by devious ways, is to be found in the rapid growth of our universities, and the splendid moral and mental equipment which they offer to the youth of the country. We know of nothing that augurs so well for the future as the fact that the development of our universities is moving forward at an ever-accelerating rate. Indeed, during the past decade they have grown even faster than the population. The record of growth of thirty of our leading universities shows that from 1895 to 1905 the increase in the number of students has been as follows: Harvard attendance has risen from 3,550 to 4,559; Columbia, from 1,942 to 4,056; Michigan, from 2,818 to 3,742; Minnesota, from 2,233 to 3,633; Illinois has made the extraordinary jump from 607 to 3,391; Wisconsin has increased from 1,671 to 3,390; Cornell, from 1,689 to 3,330; California, from 1,787 to 3,200; Yale, from 2,350 to 3,124; Chicago, from 1,524 to 2,901; Northwestern, from 2,413 to 2,481; New York, from 975 to 2,882; Stanford, from 1,100 to 1,552; and Princeton from 1,109 to 1,384. This represents an increase of from 0.28 per cent in the case of the Northwestern University to as high as 459 per cent in the University of Illinois. Now, in the ten years from 1890 to 1900 the increase of the population of the United States was about 22 per cent; while during the same period at thirty universities the attendance increased 65 per cent. Among the many encouraging features in the growth of this country, there is none that carries brighter promise for the future than this ever-widening appreciation of the great educational institutions of the country.

GASOLINE ENGINES AND THE TORPEDO BOAT.

It was only a question of time before the internal-combustion engine would be given a serious trial in the propulsion of torpedo boats. The valuable quality of developing large power in proportion to the weight of the engine, and the wide radius of action for a given weight of fuel which can be secured by the use of gasoline, are qualities which have always commended themselves strongly to the consideration of the naval architect. The first serious attempt to produce a motor-driven torpedo boat of practical size and seagoing ability has recently been made by Yarrow, and he has succeeded in turning out a craft whose success was so pronounced that it has been purchased by the Admiralty, and seems likely to become the nucleus of a fleet of similar boats.

Of late years there has been a tendency to depart from the essential principles upon which torpedo flotillas were built. The original theory was that these flotillas should be made up of a large number of small craft, each of high speed, and presenting, because of its small size, a difficult object to hit, and costing but little to build. In the desire to raise the speed, the designers have been driven to increase the length, until from their original 75 feet torpedo boats have grown to an over-all length of 150 feet. The increase in their cost has necessarily led to a decrease in the number to be built, and consequently torpedo flotillas have lost that most valuable element of bewildering numbers, on which the chance of getting home a successful blow on a warship so largely depended.

In casting about for a type of boat which would accommodate itself to the demand for a restriction of size, it was realized that the motor-driven boat presented the best possibilities, and the matter has been so well worked out that the new motor torpedo boat, although it is only 60 feet long by 9 feet beam, has proved able to make a trial speed of 26.15 knots and sustain 24 continuously on a sea trip of many hours' duration. The economy of weights which has been secured by the adoption of the gasoline motor is shown by a comparison of this vessel with a torpedo boat of similar dimensions driven by steam, which, if it were carrying the same load, would be able to attain only 18 knots an hour as compared with 24. Furthermore, the radius of action of a steam-driven boat for one ton of coal would be only 60 miles, whereas for one ton of oil the motor-torpedo boat would be able to cover 300 miles. The fact that the little craft weighs only 8 tons, and is but 60 feet in length, adds enormously to its mobility in naval operations; for a whole flotilla of them could be loaded on to the cars, and transported to any desired point along the coast with ease and dispatch. The probable method of defense with these vessels would be to arrange a series of special stations, at the mouths of the rivers or harbors, where they could run in for shelter or supplies, and so protect a long stretch of coast line with a continuous chain of torpedo defense, which could be quickly concentrated by rail in large numbers at any point which might be threatened. Although for aggressive operations such craft as these can never in any sense supersede the battleship, it is worthy of note that over three hundred of them could be built for the price of a single "South Carolina" or "Michigan."

NORTH TUBE OF HUDSON RIVER TUNNEL COMPLETED.

It is seldom indeed that an enterprise so vastly important as the construction of the two great railroad tubes by means of which the Pennsylvania Railroad Company is to gain a long sought admission into the city of New York beneath the Hudson River, is forced to its completion with such rapidity and with such little ostentation. Public attention has been centered upon the huge excavation for the terminal on Manhattan Island, and upon the serious difficulties which have attended the driving of the tubes beneath the East River; and since the sinking of the shafts for the Hudson River tubes, practically nothing has been heard of the truly remarkable speed with which the two tubes were being pushed through to a connection beneath the river. Work on the tunnel proper commenced on the New York side on April 18, 1904, and on the Jersey side on September 1 of the same year. The shields of the north tube met on September 12, and at the present average rate of driving the shields of the south tube will meet about the 7th of next month.

The improvements now under way for giving admission to the Pennsylvania Railroad to New York and Long Island will cost altogether about $100,000,000. The North River division of this work, extending from the new terminal at Thirty-third Street and Eighth Avenue to the Hackensack Meadows, west of the Palisades, has a total length of 13,700 feet, and the length of the tunnel proper, lying directly beneath the Hudson River, is 6,100 feet. The tunnels on both sides of the river were driven through rock without the use of shields, to as great a distance as the nature of the material would allow, and in this portion of the work serious and rather puzzling obstructions in the way of piles, cribwork, and riprap, were encountered. As soon as the river mud and silt were entered, the shields were set up and the driving progressed steadily and rapidly and with a remarkable absence, for this kind of work, of fatalities and serious accidents. One miner lost his life by being suddenly submerged in quicksand, and there was one death attributed to the effects of compressed air. It must not be supposed, however, that the success in driving the tunnel was due to the absence of difficulties of a physical nature; for the greatest care had to be exercised in maintaining the pressure at the proper point to prevent a sudden blowout and the inflow of quicksand into the tube. This was particularly the case on the Jersey side, where, at a depth of 85 feet, a freely-flowing quicksand was encountered. On the New York side, moreover, not far beyond the bulkhead wall, the tunnel passed through silt, the surface of which lay dangerously near the bottom of the river. The difficulty at this point was overcome by the well-known expedient of dumping clay and forming a blanket on the river bed, which effectively prevented air-blowing. As the shield progressed, the heavy segmental rings were put in place, and the work advanced so rapidly that on one occasion as much as 12½ feet of distance was made in eight hours. The work remaining to be done consists in driving through the bottom of the tube a row of massive cast-iron screw piles, which will be sunk until they reach the underlying rock. These will be fastened securely to the tube, and will form a series of piers, upon which the structure for carrying the roadbed will be laid. The interior of the tube will be entirely lined with about two feet of concrete, which, in conjunction with the massive cast-iron shell and the heavy screw piles, will render the work so stable as to insure the permanency of these tunnels for all time.

STEEL PASSENGER CARS FOR TRUNK RAILROADS.

It is good news to those of us who realize that the loss of life on steam railroads is altogether too large, to learn that at last one of our great trunk lines has decided to adopt the all-steel passenger car as a standard type for all new equipment. The steel car, as we have often pointed out in the columns of this journal, is the only sure preventive of those two fruitful causes of death and injury in railroad wrecks, namely, telescoping and fire. Telescoping, or the crushing of one car directly into the one adjacent to it, should, more strictly speaking, be known as shearing; for when telescoping takes place, the mischief is due to the massive and enormously strong platform of one car lifting above the one adjacent, and sliding forward upon it, cutting through the light framework of the sides until the body of the telescoped car is cut loose from the under-framing. As the entering platform is forced resistlessly along the surface of the one on which it climbs, its forward edge passes through the car, usually at about the level of the passenger seats, and the passengers are crowded forward, mixed up with the wreckage of the seats, the splinters of the framing, and the fragments of heavy plate-glass windows, with all those resulting horrors with which we are only too familiar. The risk of fire is due to the ignition of the combustible woodwork of the car and its yet more combustible paint and varnish, by the inflammable illuminating gas, or the scattered white-hot coals from the engine firebox.

Obviously, the best preventive of telescoping is to so construct the cars that the end framing of the body and the vestibules will be strong enough to prevent the shearing action of the platforms; and it has at last come to be realized that the only material which presents the proper resisting qualities is the wonderfully tough and elastic mild steel of which we build our skeleton buildings, our bridges, and our steamships.

Great credit is due to the Pennsylvania Railroad Company for its determination to build its future passenger cars of steel. We understand that the first order for the passenger-car equipment to be used in the Hudson River tunnels and the new Manhattan and Long Island stations is to be of steel throughout, and that one thousand of the new cars are to be ready as soon as the tunnels and station are completed. The Pullman Company is now constructing the first all-steel sleeper car, which if it gives satisfaction, will be followed by five hundred Pullmans of similar design. The main feature of the new car platform is a massive central box girder, 24 inches wide by 19 inches deep, which will extend throughout the full length of the car from coupling to coupling. From this backbone, deep steel cantilevers will extend transversely, four on each side, to carry the sides of the car, which will be composed of steel girders of unusual strength. The floor framing will be covered with a continuous flooring of steel plates, strongly riveted to the steel longitudinal girder and the cantilevers of the floor framing; and over this plating will be placed a cement finish in imitation of stone which will be laid while in the plastic condition. Security against telescoping will be obtained by making the steel vestibule end and corner posts of such a form and strength as will present great resistance to transverse shearing; and should the adjoining platform be forced through these, it will bring up against the end door posts, which will be of a very deep section, securely riveted to the main box girder of the platform, and to a horizontal steel strengthening plate at the roof of the car. Inside and out, the lining will consist principally of steel plating, and no wood or inflammable material whatever will be used except for the top of the seat arms, where it has been introduced for the comfort of the passengers. The car is equipped for electric lighting, the current for which is furnished by storage batteries placed beneath the car; and it is to these batteries largely that the great weight of the new car is due; for while the standard wooden coach weighs about 85,000 pounds, the new steel car has a weight of 103,550 pounds. This increased weight, while it will be looked at dubiously by the master mechanic who has to provide the motive power, has the advantage that it greatly reduces vibration and noise and, therefore, adds to the comfort of the passenger.

JAMES DREDGE.

The field of technical journalism has suffered a heavy loss in the recent death of the late James Dredge, editor of our esteemed contemporary Engineering. Among engineers there were few contemporary names more widely known than his; for outside of his editorial work, which extended over a period of thirty-three years, Mr. Dredge was honorably known for the active part which he took in the great international exhibitions. He was identified with the Vienna exhibition of 1873, and later with the Centennial exhibition at Philadelphia of 1876, and the Paris exhibitions of 1878 and 1899. He was a member of the British Commission for the Chicago exhibition of 1893. He held similar official positions with the Antwerp exhibition and that held in Brussels, and he was one