# The Engineering of 1906.

(Abridged from *The Scientific American.*)

### CIVIL ENGINEERING.

In the broad field of civil engineering the prevailing activity is nowhere more evident than in the construction of costly works connected with water supply, irrigation, and the opening up of artificial water ways. New York City has witnessed the completion of the great Croton Dam, with its capacity of 32 billion gallons of water. And other works have been begun which will give the city another 25 billion gallons in the Croton valley, 500 million in the Catskill basin, and 773 million in Jerome Park.

The past year will be a notable one in the annals of irrigation, because of the vast system of works instituted by the government for the reclamation of the arid lands of the west. These works contemplate the construction of storage reservoirs which, in the size of their dams and the amount of water to be impounded, will form the most notable structures of their kind in the world. The Shoshone Dam will, be 240 feet in height above the bottom of the reservoir; the Pathfinder 190 feet; and the Roosevelt 230, while the respective storage capacity of the three dams will be 19,863 million, 43,560 million, and 61,000 million cubic feet of water. Across the border in the Province of Alberta, Canada, the Canadian Pacific Railway has completed another huge irrigation project in which a valley 150 miles in length by forty miles in width is being brought under cultivation. This block of irrigated lands alone is estimated to have room for half a million people, and it is a significant fact that ninety per cent of the present settlers in the district are Americans.

### TUNNELS.

The past year has been remarkable for the activity which has been shown in the construction of tunnels and subways. It would seem indeed as though we were witnessing the close of the era of bridges, and the opening of an era of tunnels; for the tunnel is taking the place of the bridge and viaduct, both for the crossing of waterways and in the provision of means of rapid transit in cities and thickly populated districts.

A record in speed of construction was recently made in one of the tubes of the Hudson Company's tunnels where a shield was advanced 72 feet in a single day. The large amount of valuable experience gained by our engineers has resulted in the use of improved methods and better machines. As evidence of this it may be mentioned that the Hudson River tubes are now being driven through the mud by the displacement method, the material being thrust aside by the advancing shield, instead of being taken in through the door of the shield.

### BRIDGES.

The notable fact of the year is that excellent progress has been made in the erection of the great railroad and highway cantilever bridge across the St. Lawrence River near Quebec. Although this structure is by no means the largest bridge in respect of its overall length, it will contain the largest single span ever erected, the main span over the river measuring 1,800 feet between the two towers. The total length from centre to centre of anchorage piers is 2,800 feet, made up of two 500 foot anchor spans and two 562½ feet cantilever arms, extending over the river and carrying between them a central suspended span of 675 feet. The depth of the trusses over the main piers is 350 feet. The floor system will accommodate two steam railroad tracks, two electric car tracks, two highways for vehicles, and two sidewalks. The bridge is more than half erected, and will be completed probably during the present year.

### ARMORED CONCRETE.

The professions of architect and engineer overlap so broadly in these days, that we may be excused for speaking of the progress of armoured concrete under the head of civil engineering. Indeed the development of this material of construction, or combination of materials, is proving to be as fully useful to the civil engineer as it is to the architect In the first place, it has served greatly to broaden the scope of masonry arch construction, the imbedded steel rods serving to give that tensional strength which uneven loading renders necessary in all arches and particularly those of long span. For subway it has taken the place of the steel column and concrete arch for walls and roofs, and when the steel is judiciously distributed it is doing good service, where formerly the massive steel column and the plate girder had come to be the standard construction on pier and viaduct work. The too frequent failures of armoured concrete are always traceable to poor design or careless workmanship, never to any inherent fallacies in the principles of construction.

### PANAMA CANAL.

The past year must always be notable in the history of the Panama Canal, as having witnessed the completion of the era of preparation and the commencement of that of active construction. The year opened under a cloud of many discouragements and uncertainties: but as the months have gone by order has gradually come out of confusion, a definite plan has been outlined, an organisation perfected, experience as to the best methods and probable costs acquired, and the great work has been thrown open to competitive bidding. The two most important events of the year were, the very exhaustive and able Senate investigation covering every possible feature of the enterprise, and the technical investigation by the International Advisory Board. The Isthmian Canal Commission has committed the country to the construction of an 85 foot high-level, lock-and-lake canal, and it is upon this plan that bids are requested. The work will be executed along those well tried lines which have proved so successful in the building of our great railroads and other large engineering works. It will be built by contract on the percentage basis, and under the supervision of the Canal Commission's Chief Engineer, a plan of which the *Scientific American* has always been an earnest advocate.

### NAVAL AND MILITARY.

The most important naval event of the year as affecting naval construction was the series of trials of the battleship *Dreadnought*. The world's attention was riveted upon this vessel mainly because she was the first battleship to be built embodying the lessons of the Russo-Japanese war, and also because the British government had avowed its intention of establishing a record in rapid construction. The *Dreadnought* is notable for the facts—that she was built in less than eighteen months; that she is armed as to her main battery exclusively with 12-inch guns; and that she is driven by turbine engines. The ship developed a speed of 21½ knots, and in her gun trials stood the simultaneous discharge of her 12-inch guns without structural injury. That the turbine engines have given great satisfaction is proved by the official announcement that henceforth all the larger British warships will be driven by this type. Other nations must now follow suit; for even Germany, which has always discredited the turbine, is reported on good authority to have decided upon its adoption. The Japanese have launched their own *Dreadnought* in the *Satsuma*, a 19,200 ton ship, carrying four 12-inch and twelve 10-inch guns in the main battery, and twelve 4·7-inch in broadside for repelling torpedo boat attack. Germany has planned a 19,000 ton vessel, which is to carry fourteen 11-inch 50-calibre guns of high velocity, and a penetrating power approximately equal to that of the 12-inch piece carried by other powers. Our own government contemplates an even larger ship of 20,000 tons displacement, carrying ten 12-inch guns, which, being all arranged on the centre line of the ship will be all available on either broadside. In the weight and distribution of her armour, and in the provision of internal bulkhead defences, this vessel will be superior to anything built or planned by other navies.

Progress in the United States has been exceedingly satisfactory during the past year. There have been completed or put in commission all the powerful battleships of the *Connecticut* and *Georgia* classes, and the equally effective cruisers of the *California* class, and in these vessels we possess homogeneous fighting ships, which are equal, if not superior, to the best squadrons that could be brought up against them by foreign navies. If we except the *Dreadnought*, and possibly the ships of the *Lord Nelson* class, the latter, armed with four 12-inch and ten 9·2-inch guns, there is, indeed, no squadron of foreign ships to match the five vessels of the *Georgia* class, and certainly there are no individual ships of the allround excellency of the *Connecticut* and *Louisiana*. Two ships of the new *Dreadnought* type have been commenced, namely, the *South Carolina* and *Michigan*, which on 16,000 tons displacement will carry eight 8-inch guns, all available on either broadside. As things are now tending among the navies, the future types will resolve themselves into battleships of 20,000 tons displacement or over; fast scouts of 3000 tons of 25 knot speed; and torpedo boat destroyers of 25 to 35 knots—the British have a 36-knot turbine driven destroyer now under construction. A notable event of the year was the towing of the large floating drydock *Dewey* from Hampton Roads to Cavite in the Philippine Islands.

There have been no developments in guns and armour during the past year that call for special mention. In the matter of guns the tendency is to reduce the velocities, as reduction has been found to be necessary to pro-