Wonder Worker of The Coming Years

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Civil engineering, three generations ago, was summed up in surveying, road making, masonry building and designing heavy machinery, and its masters could be conversant with the whole recorded horizon of the profession. Now it is divided into recognized fields, each of which requires a lifetime of study and concentration. There is mechanical, electrical, mining, naval, railroad, geodetical, hydraulic, structural, municipal and sanitary engineering. The scope of the first four is too elaborate and technical for present consideration. Geodetical engineering includes the most accurate and extensive surveys. Structural engineering may here be considered as chiefly the building of steel, masonry and timber bridges, buildings, and foundations, thus including the essentials of modern architecture, and the other great branches deal with the specific works their names imply, the different ones overlapping each other on all sides.

The geodetical engineer measures on the Atlantic coast a base line a few thousand feet long with an accuracy of one-five-millionth part of its length. From it he triangulates more than 2,000 miles to the Pacific coast and measures the total distance with an error less than 100 feet. His lines are corrected for the earth's curvature and for the refraction of the atmosphere. His levels are carried over mountains, chasms and deserts so perfectly that the differences between the tides of the Atlantic and Pacific oceans are accurately measured, and long canals are planned and built with a perfect control of the water level and flow. He extends his maps to delineate the deep bottoms of rivers, lakes and seas. By his plats and charts, curved, crooked and sloping tunnels are driven under land and sea so accurately that they can be started simultaneously from many intermediate points and meet almost as perfectly as the tubes of a telescope. In this field of engineering a perfection sufficient for present requirements has been attained, and few radical changes may be anticipated.

The railroad engineer has already brought his train speeds up to a possible rate of 100 miles an hour for short distances. Beyond this the limit of safe endurance of his materials is not far distant. The dangers to life and property are so much multiplied and the expense so disproportionate for further increase that the maximum speed will hardly become notably higher. A great advance will be made in the ordinary speeds, the perfection of service and the safety of trains. There will be far less proportionate construction of new railroads in the United States and far more in Africa, Asia, South America and in some parts of Europe. Asia will be traversed by the thousands of miles of the great Siberian railroad, now being built. The Soudan is already reached by a military railroad that may be the entering wedge for the development of the Sahara and the Intercontinental railroad across the Andes has already been surveyed. Wherever commerce or travel justify it the tallest mountains and the widest waters will be crossed by railroads. In many places the steam locomotive will give way to cheaper, more agreeable and more efficient motors. The terminals in the great cities will be combined in great union depots.

In hydraulic engineering, the development of water powers, construction of irrigation works, canal, river and harbor improvement and the water supplies of cities include the principal classes of work. Until within a half score of years the development of water powers has been limited by the wants of adjacent manufacturers and the difficulty of handling, so that many of the best power sites were unavailable. Now power can be transformed to electricity and can be so advantageously applied and transferred that numerous large water powers are being utilized. The most notable instance of this is at Niagara Falls. Millions of dollars have been spent to convert less than the fiftieth part of the potential energy of the falls into commercial horse power. Water from above the cataract is taken down deep shafts and through an immense tunnel blasted out of the living rock and discharged 200 feet down at the surface of the river, a mile below the falls. Great turbines are floated in the water at the bottoms of the shafts and drive huge dynamos in the power house above, from which the electric current is transmitted many miles to furnish light and power for a great city.

In California shafts and tunnels have been driven in a granite mountainside and in them a charge of 24,000 pounds of nitroglycerine was fired to shatter the rock for the building of a great dam. In the center, like a gigantic sheet of paper, is a diaphragm of riveted thin steel plates bedded in a narrow concrete jacket and set in a groove cut in the sides and bottom of the rock valley. On both sides are heaped enormous slopes of loose stone. The steel gives tightness, the stone solidity and the dam thus formed will impound the waters of the valley and furnish a great power. Hydraulic constructions like these may not increase greatly in size, but they will be built in more and more remote wildernesses as the transportation of the power by electricity becomes cheaper and its accumulation and preservation in storage batteries is perfected. Eventually no great stream will be allowed to waste its energies. Its forces will be transmuted by turbines to power, heat, light and motion for factories, cities and railroads hundreds of miles away.

Vast Artificial Waterways.

Costly dams and conduits to store rain and flood waters for the irrigation of arid plains and transform them into fertile gardens have reclaimed millions of dollars' worth of land in the United States. Nearly $9,000,000 is now being spent on such constructions to regulate the Nile and irrigate Egypt. Careful surveys indicate that a channel could be cut to admit the sea to the Desert of Sahara, transforming it to an inland ocean and creating there a new climate, as well as a new geography.

Within fifty years canal building has been wholly revolutionized by the use of high explosives, steam shovels and dredges, mechanical systems of handling the excavated materials, and, notably, by machinery for chiseling the vertical rock sides as smooth as a plastered wall. New types of powerful machinery will be perfected, and the work will be done so much more cheaply that greater and greater enterprises will be undertaken and ships will sail across continents instead of around them. Work has already been commenced on a ship canal across Central America, which will change two continents to islands. Able engineers and capitalists propose to reorganize the ill-fated Panama Canal company and complete its great enterprise. Instead of tedious and wasteful lockages, large boats will be lifted, in some cases fifty or 100 feet, in steel tanks by hydraulic pressure.

Mighty Structures of Steel.

In structural engineering the application of timber in this country has reached a maximum, and is fast going out of use for important structures, other than those constantly saturated with water, steel being substituted for it. The general features of bridge design and the methods of construction will not be greatly changed henceforth. The dimensions of the bridges will be increased, even multiplied; materials will be improved and strained much higher than is now allowed. Steel truss bridge spans may reach, but will hardly exceed, 3,000 feet. Suspension bridges can be built longer. Fifty years ago iron had a strength of barely 50,000 pounds per square inch. The latest steel specifications call for 200,000 pounds, and this will be exceeded by metals of still greater strength. While limits may be set to the length of single spans, they cannot for bridges as a whole. The long proposed bridge across the English channel only needs political and financial authorization to be possible. The second largest and much the grandest bridge in the world is well under way to connect the boroughs of Manhattan and Brooklyn. It will have a river span of 1,600 feet, a width of 118 feet, twice as great as an ordinary street, will carry six lines of railroad track and have a total weight of more than 100,000,000 pounds.

Steel buildings are the modifications of bridge work and their sudden appearance, giants at birth, is the most remarkable example of a whole class of great structures coming to perfection without a slow development. The height of the thirty-one-story Park Row building in New York City, which is 424 feet, will hardly again be equaled, unless for mere notoriety, because it is unnecessary and undesirable, but the greatest existing roof span will doubtless be much exceeded and can even be multiplied almost tenfold if any reason should justify such vast expense. Structural freaks, like the 1,000-foot high Eiffel tower and the Ferris wheel, 250 feet in diameter, will be limited only by the range of ingenuity and the strength of materials.

The construction of massive foundations under water for bridge piers and in treacherous soils for tall buildings has developed special designs of steel and concrete and ingenious scientific methods of pile-driving, pneumatic caisson work, etc., which have reached a high degree of perfection, but new forms of substructures will probably, and new methods and appliances will surely, be invented.

Work of Municipal Engineer.

In two or three years Manhattan island's present daily supply of 200,000,000 gallons of water will be increased by the storage of 32,000,000,000 gallons of water in a reservoir fifteen miles long and 157 feet deep. This will be formed by the building of the world's

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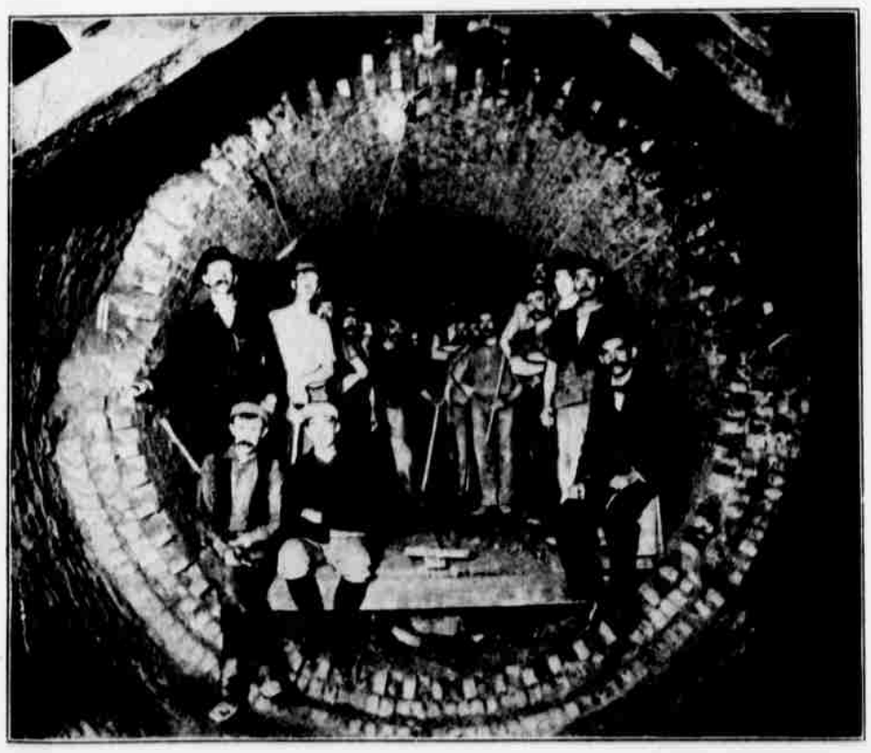
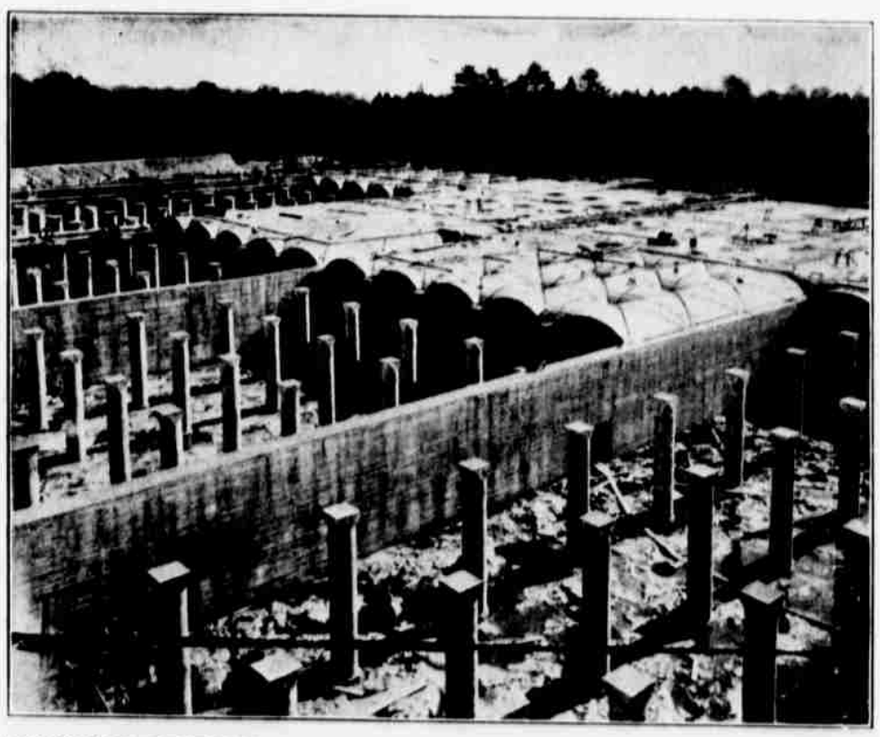
SHEEP FEEDING STATION AT KEARNEY, Neb.



CONDUIT FOR THE WATER SUPPLY OF CHICAGO CONSTRUCTED UNDER LAKE MICHIGAN.



LOUISVILLE RESERVOIR, LARGEST COVERED RESERVOIR EVER BUILT FOR FILTERED WATER.

Celebrated Prize Beauty

Lady Beatrice Butler is the eldest of the two beautiful daughters of the marquis of Ormonde of Kilkenny castle, County Kilkenny, the head of the famous Irish house of Butler. She was born on December 28, 1876, her mother being Lady Elizabeth Harriet Grosvenor, eldest daughter of the late duke of Westminster. Lady Beatrice's sister, Lady Constance Mary Butler, was born on March 26, 1879.

Both daughters have inherited the beauty for which the Butler and the Grosvenor family are famed. Lady Beatrice recalling her grandmother, the first duchess of Westminster, while Lady Constance has the fair beauty which has become the birthright of the ladies Butler. Lady Beatrice and Lady Constance have spent much of their youth at Kilkenny castle, but as children they were also frequently at Eaton hall, and even as quite young girls they accompanied their parents to Cowes, where each year Lord Ormonde, who is a prominent member of the Royal Yacht squadron, has always taken a keen interest in yachting.

General Pole-Carew's bride-elect is one of the few Irish girls who have had the privilege of often meeting the German emperor and empress. His imperial majesty is, indeed, said to have observed that Lady Beatrice Butler was a perfect type of the high-born "English" damsel. The two daughters of Lord and Lady Ormonde are naturally very popular in Kilkenny, the more so that they are both keen sportswomen—a fact that naturally endears them to their neighbors. Lady Beatrice has often helped her mother to entertain royalty, one of the last occasions being that of the visit of the duke and duchess of York to Kilkenny castle, the duchess having been specially delighted with the lovely old place.

It is hoped in Ireland that the wedding will take place from Kilkenny, but it is far more likely that the ceremony, which is certain to be one of the most brilliant functions of the early spring season, will be celebrated in London, where Lord and Lady Ormonde possess a very charming house in Upper Brook street.

Walking

Detroit Journal: It was not until the baby cried by night that the woman's disillusionment was complete.

For it was thereupon that she bade her husband walk the precious angel, and he confessed that he did not know how.

"This is what comes of marrying a walking encyclopedia!" she cried, chagrined.

After that she affected a certain indifference, but it was plain that the iron had entered her soul.

Needed No Help

Wragson Tatters—Dat's a funny sign yer got up dere, boss.

Mr. Housekeep—What? "Look out for the dog?"

Wragson Tatters—Yes. Dat dog's big enough an' ugly enough ter look out fur hisself.