Work for the Engineer.

Civil engineering three generations ago was summed up in surveying road making masonry building and designing heavy machinery. Now it is divided into fields each of which requires a life time of study and concentration. There are mechanical, electrical, mining, naval, railroad, geodetical, hydrulic, 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, 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 of 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. By his plots 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 this 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 be hardly become notably higher.

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 justifies it, the tallest mountains and the widest waters will be crossed by railroads.

In hydraulic engineering the development of water powers, construction of irrigation works, canal, river and harbor improvements, 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 manufactures 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 potiential energy of the Falls into commercial horse power.

In California shafts and tunnels have been driven into a granite mountainside, and in them a charge of 24,000 pounds of nitro-glycerine was fired to shatter the rock for the building of a great dam. In the centre 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 rocky 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 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 hundred of miles away.

Costly dams and condults to store rain and flood water 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 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 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 begun 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 50 or 100 feet in steel tanks by hydraulic pressure.

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 a hundred million 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 equalled, 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 a vast expanse. Structural freaks like the 1,000-feet 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.

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 thirty two billion gallons of water in a reservoir fifteen miles long and 157 feet deep. This will be formed by the building of the world's greatest dam, which will cost $6,000,000. Its vast mass of masonry will rise about 300 feet above its foundations, which have been sunk 130 feet below the bottom of the river which they cross.

In municipal engineering feat such as this there will be vast advances in the years to come. Unpolluted drinking water will be supplied to the public, and if it is not available without, it will be filtered on a great scale. Vile sewage will be filtered chemically precipitated, or made a valuable irrigant. Garbage and solid refuse will not be left to putrefy in the streets, nor burned at an expense, but will be reduced in large plants, whose product will yield a profit.

Heat and cold, light and power, will be disseminated from central stations as water and gas now are. Real rapid transit will be secured by complete tunnel and viaduct systems in great cities, and the trains will be drawn by silent, smokeless, speedy motors. Already the displacement of draught animals in cities by automobiles has begun. Improved methods and economies in generating, transforming and storing power will more and more supplant human labor, as well as multiply automatic vehicles for business and pleasure on land and water.

There is as yet, however, no sign of discoveries revolutionary enough to realize that alluring mirage, aerial navigation. No single invention will accomplish it, and the slow development which leads to great engineering possibilities does not yet predicate for this.

The field of the sanitary engineer has been almost entirely comprehended in that of the municipal engineer. His part will be to aerate, oxidize or filter water supplies; to protect them, sometimes in vast covered reservoirs. He will drain swamps and reclaim poisonous marshes. He will so proportion great sewers that the comparatively clean floods from storms will be safely carried away by them and harmlessly discharged into rivers, while the smaller flow of sewage is taken to the disposal grounds.

Where the city is too low and flat for sewer grades, he will establish wells and pump their contents to its final destination. His will be the task to wash out foul rivers, as in Milwaukee, where the contents of a large tunnel are continually forced by a great pump from the lake to flush out an otherwise stagnant river. In his hands will lie in large measure the health and comfort of millions of people in all cities.

In general the results of engineering will continue to increase in geometrical progression. Improved methods will permit larger and larger scale constructions, most of them will change in quality, rather than in kind, and new discoveries and inventions will bring about developments rather than sudden transformations. Within the limits of scientific and mathematical laws and the strengths of materials almost any great constructions that can be accurately designed may now be built, if unlimited time, money and opportunity be granted. The criterion of what will be done will generally be, 'Is it humanely or politically necessary, or is it financially justified.

Why He Is Mourned.

To fill with conspicuous ability the office of governor of a great state, to leave it, after two terms of service, with untarnished reputation and the confidence and respect of political opponents as well as of political associates, is a noble record; yet a man might accomplish it and still fall far short of winning the place which the late Governor Wolcott occupied in the hearts of the people of Massachusetts.

On the day when the papers announced the news of his death, a man sat in a little Boston, restaurant reading while he waited for his order to be filled. When the meal was brought in and the paper laid aside, the waitress, noticing the head lines, spoke with sincere feeling of the dead governor. 'He was such a good man—so kind!' she said.

'Did you know him?' asked the man with some curiosity.

'No; I never even saw him but once, but I always remembered that time. It was one day when I was coming up Tremont Street, and on the corner by King's Chapel was an awfully ragged, dirty little boy. He had a piece of brown paper with something written on it—an address, I suppose, and he was trying to find the place.

'Then I saw this tall, fine-looking man coming up School street I thought he was the handsomest man I had ever seen, and he was elegantly dressed and carried himself with such an air I couldn't help looking at him.

'When he got to the corner the little boy ran alongside of him, and attracted his attention by pulling at his coat-sleeve. He stopped at looked at the boy and smiled, and said, 'Well, sir, what can I do for you?'

'The boy held up the paper and he read it and said, 'You must go a little farther down, on the other side of the street.' But he saw that the boy didn't seem to understand, so he said, 'Here, I'll show you where it is;' and he took the dirty little chap by the hand and led him off down Tremont street and found the place for him. Then he came back and went on up to the State House, I suppose. I thought it must be the governor, and I stopped and watched him. I had never seen him before but I had seen his picture lots of times. And when he came back' just as he turned the corner, a man met him and touched his hat and said, 'Good morning, governor! So I knew I was right.'

The kindly, helpful spirit displayed in the simple deed which impressed the waitress was characteristic of Governor Wolcott and it was that which made him so universally beloved by the people of the state.

THE BEAR AND THE BANKER.

The Latter's Courage Sank When Bruin Was Sighted.

Mr. Joaquin Miller argues convincingly in his recent book. 'True Bear Stories,' that his heroes and heroines are never cruel, and one of his stories may be quoted as showing the homely, careless kindness—tempered with justifiable resentment—of a grizzly.

With the intention of having some sport with bears, a New York banker chartered a small steamer in San Francisco Bay, and with a party of friends, as well as a great grandson of Daniel Boone for a guide, sailed up the coast to the redwood wilderness of Humboldt. Here he camped on the bank of a small stream in a madrona thicket, and began to hunt for his bear.

He found his bear, an old female with young cubs. As Boone was naturally in advance when the beast was stumbled on, he had to do the fighting, and this gave the banker a chance to scramble up a small madrona tree.

Of course he dropped his gun. Men always drop their guns, by some singularly sad combination of accidents, when they start up a tree with two rows of big teeth in the rear, and it would have been hardly fair to expect this young bear-hunter to prove an exception.

Poor Boone was severely handled by the savage old grizzly in defence of her young. There was a crashing of brush and a crushing of bones, and then all was still.

Suddenly the bear seemed to remember that there was a second party who had been in earnest search for a bear, and looking back down the trail and up in the boughs of a small tree, she saw a pair of boots.

Leaving poor Boone senseless on the ground, she went for those boots. She stood up under the tree and began to claw for the capitalist—who said afterwards that as she stood there she seemed to him to be about fifty feet high.

Then she laid hold of the tree, but with all her strength she could neither bend nor break it. But she kept thrusting up her long nose and longer claws, laying hold of the man's boots, which she pulled off, one after the other, with her teeth. Then with her claws she took hold of one garment after another till he had hardly a shred left, and his legs were streaming with blood.

Fearing that he should faint from loss of blood, he lashed himself to the small trunk of the tree by his belt, and then began to scream with all his might to his friends.

When the bear got weary of clawing up at the dangling legs, she went back and began to turn Boone over to see if he showed any sign of life. Then she went back and clawed a while at the screaming man in the madrona-tree. It was great fun for the bear!

To cut a thrilling story short, the party in camp on the other side of the creek finally came within hail, when the old bear gathered up her babies and made her escape up a gulch.

Boone was so badly bitten and crushed that his life was long despaired of, but he finally got well. The bear showed no disposition to eat him while turning him over with her foot and thrusting her nose into his face to see if he still breathed, from which we may conclude that she considered death a sufficient punishment for his interference with her loved little ones.

Clever Playthings.

Our modern toys are as ingenious as they are varied and pretty, but the young people of Europe and America have no monopoly in this regard. For centuries the children of the far East have delighted themselves with the very queer and interesting contrivances known as expanding water toys.

They come in small wooden boxes similar to the little paint-boxes that are so well known, and they look like dirty shavings, broken matches and dilapidated toothpicks. But throw one of them into water, and the ingenious little toy at once shows itself to be something more than a bit of stick.

The wood has been kiln-dried, and as soon as it touches the water it begins to absorb the same and to expand almost indefinitely.

As it increases in size it separates, and suddenly opens and becomes a very pretty toy. One stick changes into a flower pot containing a rosebush in full bloom, another becomes a fat mandarin carrying an umbrella, a third a sea serpent ferocious in its tiny dimensions. A whale, a tiger, and a lady of fashion taking her daily promenade are all represented.

The figures are colored, and present an astonishing variety in design and treatment.

How they are made and compressed is one of those trade secrets which are kept inviolate by the guild which makes a livelihood by their manufacture.

On rare occasions it is possible to get larger and many artistic figures, historical characters, and portraits of good monarchs, poets and teachers, dwarfed trees, and tiny houses whose doors and windows are full of inmates.

The ordinary kind cost a mere song, but the finer qualities are often very expensive. Expensive or cheap, they have for long years given pleasure to the children of Kyoto and Canton.

A Boar's Gallant Escape.

Bacon says, 'Hog-Hunting is not only more scientific, but is more dangerous sport than tiger-hunting.' The boar is a terrible enemy, and also an alarmingly agile one. Isabel Savory, the author of 'A sportswoman in India,' mentions one evening, when, after a day's pig-sticking, stories of the hunting-field were told, and the 'mighty boar' became their principal theme. Here is one tale of a splendid escape:

A boar, which had been hard pressed, galloped into a nullah, a very sharp, deep cut more like a narrow chasm than a ravine. Down this, along the bottom of it, he raced, followed by a sahib on a swift horse.

The banks on either side, overhanging the pig, were six feet or more in height. Suddenly the creature turned a sharp corner, which hid him from view. Then, by a tremendous effort, he scaled the bank and gained the top.

He turned short round, leaped the entire width of the nullah, and landed safely on the other side, clearing both horse and rider as he jumped, save for the sahib's pith helmet, which he knocked off. He had escaped 'so as by fire.'

Too Smart An Uncle.

To measure all things by the little yardstick of our own experience is a most unsympathetic and sometimes unkind method. Forward tells of a small boy who pronounced judgme[illegible] upon his peculiarity of his elders.

'I caught him all myself, mother, I did!' he cried. 'A big fellow, so long!'

The eager little hands measured an uncertain length, that might have belonged to anything from a minnow to a good-sized trout, and then the boy trotted away to recount his exploit to a neighbor. He came back very quietly.

'What did Uncle Gray say?' the mother asked.

'Oh, he said he'd caught lot's bigger'n that. I guess everything was bigger when he was a boy, but I wish he didn't always 'member it. When I show him my long lessons, he says he used to have longer ones, and when I do lots of work, he tells me how he did more when he was like me. I wish,' said Davy, reflectively, 'he'd left a few big things for me to have all to myself, 'cause, you see, I didn't live when he was a boy!'

Embarrassing.

The ability of the small boy to rouse discomfort in his elder sister's breast has been the theme of more than one story. Ten-year-old Ned had peculiar talents in that direction, and in the month or two before his sister's engagement he made many embarrassing complications between her and the estimable young man who at last succeeded in winning her.

Ned was much interested in the engagement, and very fond of his prospective brother-in-law. One day he was taken by the young man, who was a lawyer, to a court room where a case was on trial. Ned was allowed to remain only a short time, but he had an excellent memory, and sundry phrases remained in his mind and tickled his fancy.

The next day he stood in the window, and saw his future connection pass the corner. Sticking his curly head out, he called in clear, ringing tones, for the benefit of all the neighbors, "George William Snow, come in to court."

Too Far Away.

Chicago is noted, among other peculiarities, for the gigantic policemen that guard the crossings in its down-town district.

Several of these men exceed six feet four inches in height, and one a colossal Irishman usually stationed at the intersection of State and Washington streets, stands six feet seven inches in his stockings and he is well proportioned.

'Why do you let your streets get so awfully dirty?' complained a visitor in the city one windy day rubbing his eyes.

'I think,' replied the friend who was showing him around, 'the reason is that our policemen are so high up above the dirt they never see it.

Puffer—For goodness's sake What's happened to my meerschaum pipe?

Mrs. Puffer—Why, dear, I noticed it was getting awfully brown and discolored, so I put a coat of that white enamel paint on it.