

Opening of the World's Longest Tunnel.

AT MIDNIGHT on Thursday of this week, writes John R. Rathen, in the Chicago-Herald, the New subway—one of the greatest transportation projects ever carried to completion by the brain and hand of man—was formally opened to the public. Within 24 hours of the opening it is estimated that over half a million people made use of the subway to get to and from their work. Within a week its capacity of a million a day will be taxed to the utmost.

The triumph of this plan, begun only four years ago, should be of special interest at this time to the people of Chicago. It is true that the problems of the one city are not those of the other, and that the physical obstacles in the way of New York and

mining operations had to be carried on. At the highest parts of the hill, uptown which reaches from One Hundred and Fifty-seventh street to Fort George, the tunnel is 200 feet below the surface, and half a dozen shafts were sunk in different parts of the rocky mass in order to facilitate the work below. A shaft was sunk at One Hundred and Sixty-seventh street and another at One Hundred and Eighty-first street, and from the bottom of each of them tunneling went on in both directions until the workmen joined one another by breaking through the rock between.

In many localities where it was found impossible, on account of the enormous amount of traffic—such as on lower Broadway—to use the cut and cover system in building the subway, the subcontractors were ordered to have their men dig in underneath, like moles, and this was done without a single accident. For seven months lower Broadway, was walked over by millions

From this building thousands of wires and cables reach to the various distributing plants along the route of the underground road.

The lighting and power systems have been kept entirely separate, and ingenious devices prevent the possibility of electric flashes about the cars.

Several hundred inspectors, appointed under civil service rules, scrutinized every ounce of material used in the construction of the subway and audited all the bills. These inspectors, furthermore, in addition to inspecting the material delivered, visited the works of the manufacturers at frequent intervals and examined the material as it was being made. Records of all kinds, including countless photographs, were taken of every bit of material as soon as it was tested, and so perfect was this phase of the work that even down to a bag of cement it was possible to trace its source, its maker's name, the name

LONGEST TUNNELS IN WORLD

	Miles
New York Rapid Transit	13 1/2
Met. Underground, London	13
St. Gothard, Switzerland	12
Paris Underground	8 1/2
Mont. Cenis, Switzerland	7 1/2
Baltimore, B. & O.	7
Arburg, Austria	6
"Tuppenny Tube," London	5 1/2
Hoozee, Massachusetts	4 1/2
Berlin Underground	4 1/2
Liverpool and Birkenhead	4 1/2
Boston Subway	2 1/2
Cascadia, Great Northern R.R.	2 1/2
New York Central	2
Budapest, Austria	2
Bowling, Montana	2
Ivanhoe, Colorado	2
Sarnia, Canada	1

The difficulties in the road of construction might well have staggered any man. More than 2,000,000 yards of earth had to be dug out and 1,000,000 yards of rock blasted and carried away. Nearly 25,000 men, skilled and unskilled, were necessary for the construction of the subway, but through all the doubt the chief contractor never faltered or feared. He has given up every moment of his waking hours to the problems involved, and has personally been many times over every yard of the route.

During all of the four years he has never permitted himself to make a prediction that was not borne out and finally, at the very moment when even Belmont himself was beginning to be anxious, he astounded the directors of the company and the city officials by saying that in four months the system would be opened to the public.

Mr. McDonald is 60 years old, broad shouldered, with magnificent physique and ability to endure all sorts of physical hardships. He was born in Ireland in 1844, and was brought to this country three years later, his father, a hard working peasant, coming to New York as an emigrant seeking work. For years during his younger life the boy earned 75 cents and \$1 a day in the rock cut of the Hudson River railroad, and learned to read and write in a free school that was supported by private benevolence.

There have been attacks without number against the subway project since it was begun, and many times Mr. McDonald has been charged with bad faith and with having the knowledge that he could not possibly complete the work he had undertaken. But he has never replied to a single criticism, and even now, with his splendid triumph fresh on him, he refuses to talk about anything except the future. When he was asked a couple of days ago to break his long silence and say something for publication he replied:

"There is nothing like the New York subway in the world, and I am proud of the work. I don't think I would feel any prouder if I were president of the United States. It may be well to say that had it not been for two years of labor conditions hitherto unknown in this country the subway would have been finished more than a year ago.

"Having shovelled and blasted this four track highway, 54 feet wide, under the most crowded parts of New York, with the foundations of tall buildings on either side of us, and tangled miles of water mains, sewers, steam pipes, gas pipes and all kinds of electric cables and conduits in our way—not to speak of the enormous traffic moving in the streets above us—we have demonstrated that the rapid transit problem of any great city can be completely solved.

"It is now simply a question of more tunnels. As far as New York is concerned, there is not a street in the city which cannot be safely tunneled.

"Of course the subway has occasioned inconvenience to many thousands of people. As far as the cost is concerned, the \$35,000,000 advanced by the city will be paid back with interest, and under the contract New York will own the whole structure at the end of 50 years, and it will have cost the people actually nothing. Better than all, the new rapid transit system, with express cars going nearly a mile a minute, will build up New York's outlying districts, add to her population, enormously increase her property values and make it possible for poor families to have cheap and comfortable homes far in distance from, but near in time to, the working districts.

Asked if he was assured that the future trend of rapid transit in large cities would be underground, Mr. McDonald was very emphatic in declaring that to be the case, and in his reply he made a statement that will be of exceptional interest to Chicago people.

"I do not believe," he said, "that people want any more elevated structures. There must be room on the surface of the street for wagons, carriages and

pedestrians. In New York we have been forced to go underground for new territory, and all new rapid transit systems, in my judgment, to be valuable to the community which constructs them, must be underground. Every time we make a tunnel we add so much valuable area to a city in which ground is increasing in value every day. At the same time, we bring within the reach of the poorest citizen homes in the outlying territory where land is comparatively cheap. But, aside from all other considerations, this underground, mile-a-minute transit idea is a work of humanity. It is a vigorous attack in the war against the miseries of congestion.

The scene in the tunnel strikes one at first sight as being so entirely different from anything he expected to see that it takes a long while to get over the surprise and to realize what the surroundings actually are. The lighting effects are most tasteful and for once

has the chance of accident been reduced to such a minimum as in this subway.

There are not only dispatchers' offices, fully equipped, at every station, but by a novel electrical system the moment an engineer of a running train takes his hand from his lever, for any purpose, or accidentally loses control, the air brakes are applied by automatic pressure and the train comes to a gentle stop. It is impossible for a train to swerve from the rails under any circumstances.

Express trains to Harlem will run at the rate of from 40 to 50 miles an hour and cover the distance to the river in 15 minutes. The cry of "Harlem in 15 minutes," thought only a few years ago to be an idle dream, is now an accomplished fact. Local trains, stopping at the various stations, will make the run in 50 minutes.

Between One Hundred and Sixty-eighth street and the city hall there are

points. In addition, the system has a loop at the city hall and a double loop at the Battery. The cables containing the electricity used for power are built in ducts into the side walls of the subway and run in from the opposite side to that provided for the lighting wires, both systems being entirely separate in operation.

William Bradley Parsons, the chief engineer of the rapid transit railroad, has plans for spending \$100,000,000 in extending rapid transit facilities in Greater New York in the near future. Mr. Parsons, with whose splendid ability Mr. McDonald to accomplish the result has attained, says that he does not believe that even this great sum will provide adequate accommodation for the rapidly increasing demand.

Like Mr. McDonald, he firmly believes

OPENED OCTOBER 27—GREAT EVENT IN AMERICAN TRANSPORTATION



SUBWAY STATION AT BROADWAY and 72nd ST.

The above gives an accurate picture of one of the entrances to the new subway, the opening of which occurred on Oct. 27. The building of this tube is one of the greatest engineering feats in the world, constituting the longest single tunnel in existence.

Chicago subway projects are entirely different in character. But what one metropolis has done the other can do.

New Yorkers are about to reap the reward for their four years of patient waiting. During all of that time most of their main thoroughfares have been rock quarries. Their street cars and sidewalks have been along in the air, their houses undermined. Central park turned into a dumping ground and their ears accustomed perpetually, night and day, to blasts of dynamite. But with the subway completed and old roads replaced everywhere with heavy asphalt paving, there are very few of them who would not go through all the inconvenience and distress over again to secure the same result.

It is hard to know where to begin to give the reader an adequate idea of the immensity of this magnificent engineering work or of the ability and industry with which it has been carried through. Nothing has been overlooked or left to chance. The same care that has been given to every detail of the construction of the subway itself has been used in the preparation of the stations, the building of the street cars, the lighting, the ventilation and the protection of the public in any possible emergency that might arise.

In a task involving an expenditure of not far from \$50,000,000 there has not been the slightest dishonesty of a cent, and the prices at which the work has been done, in every kind of construction known in this country. As far as these last named things are concerned, it will be realized, when the first novelty of the subway has worn off, that a much greater honor and credit to New York than the building of this vast work lies in the sterling business integrity that has characterized every step in its progress.

There has been no skimping, no clinging to the hard and fast lines of the contract made by John B. McDonald with the city. This contract called for 30-pound rails for the operation of the cars and 100-pound rails have been provided throughout. The original estimate for equipment was \$5,000,000, and \$12,000,000 has been already expended on this item alone, which, inclusive of the cost of construction, brings the total cost up to \$17,000,000.

The work, as it now stands completed, covers a distance of 24 miles—12 1/2 miles of subway proper, five and one-half miles of elevated viaducts and five miles of deep tunnels. The main stretch of track from city hall to One Hundred and Fourth street is 6.7 miles long and four-track all the way. Following onto this are a three-track system of 3.4 miles, and a double-track system of 3.6 miles, making a total length of 24 miles. The entire track length is 70 miles. The portion of the subway which is to be opened to the public for traffic next Thursday consists of the four-track route as far north as West Ninety-sixth street.

Unlike a number of other great works called "subways," the greater portion of this New York system is in reality a subway, having been built by the "cut-and-cover" method—the entire street being opened up and dug, and blasted down to the required depth, and afterwards covered over with heavy steel floor, forming the bottom of the roadway above.

The engineering problems overcome in the construction of this subway were stupendous. By far the greatest of them was the building of the tunnel under the Harlem river without resorting to compressed air, but by the entirely novel method of clamping tubes and sinking them to the required depth until they connected with the subway excavations on dry land. Sections of the subway were built in the form of tubes, which were closed at each end with water-tight covers. These were inclosed in a rectangular structure of iron and concrete, sunk to the river bottom and bolted to the advancing tunnel.

In certain parts of the route actual

of people, not one of whom ever had an inkling that almost immediately beneath his feet stretched a great hole, 30 feet deep.

The whole subway passage tube is surrounded by an entirely novel construction designed to obviate the disadvantages attendant on shallow cuts, many of which leak badly. Top, sides and bottom of this subway are constructed of concrete and waterproofing in alternate layers, incased in a framework of steel beams. The roof is supported by steel pillars, not more than five feet apart, and set in parallel rows in the concrete of the top and the bottom. The shallowness of the tube does away entirely with the problem of artificial ventilation. Enough air comes in at the station entrances to keep the tunnel fresh and sweet, and the rush of cars will keep this air constantly in motion.

It is when we get to a survey of the figures of material used in the construction work that we realize something of its immensity. Over 60,000 tons of structural steel have been placed in position, and the specifications calling for an ultimate strength of from 55,000 to 60,000 pounds per square inch have not only been held to, but actually exceeded. There was also a requirement that every bar of this steel should undergo the test of being bent cold and sagged on itself, without sign of fracture on the convex side.

The largest power-house in the world has been erected to supply the motive power for the new system. The building stands between Fifty-eighth and Fifty-ninth streets and Eleventh and Twelfth avenues, and is, in itself, a stupendous work not by any means overshadowed even by the subway. The machinery consists of eleven engines, each of 12,000 horse power, and seventy-two boilers of 200 horse power each.

For the purpose of sustaining the weight of the great building and its enormous plant in safety the foundation was carried down to bedrock.

of the inspector who passed on it and its whole record from the time of its manufacture to its final use.

Every device known to modern science has been used to expedite the work and make it as strong and safe as possible. Electric conveyors, automatic compressed air drills, novel forms of riveting apparatus, electric dump carts, shovels electrically manipulated and dozens of other methods were brought into use. The contract was finished three weeks ahead of time, though until six months ago very few professional men believed it would be possible to complete the work according to contract stipulations.

That it was done, and done so thoroughly, brings us to a consideration of the head and center of the operations, John B. McDonald, the man who built the subway, and to whose individual pluck and genius New York clearly owes the successful completion of the work.

When the plans and specifications were published there were only two bidders. The conditions demanded were hard, and small men were frightened. Mr. McDonald, however, was not one of these. He examined the papers with great care and then came to the front and offered to build the road for \$35,000,000. This bid, being the lowest, was accepted. The figure named astonished every engineer of note in the United States and Europe, and they openly declared that he had made a great error and placed the cost of construction at an impossibly small sum.

A bond of \$5,000,000 was demanded. August Belmont, who knew McDonald and had every confidence in him, organized a company and furnished the money. The city then loaned \$35,000,000 for the work of construction, the amount to be repaid, with interest, and the entire subway to revert to the city gratis, at the end of fifty years, during which time the company is to have the use of it. No such advantageous terms as these were ever before made by a municipality for similar work.

MEN WHO BUILT SUBWAY—CONTRACTOR McDONALD AND HIS ENGINEERS.



JOHN B. McDONALD AND HIS ASSISTANTS.

It is due to these men that the Great New York subway has been carried through to completion. The natural difficulties encountered in the digging of the tunnel were immense, but they have all been overcome.



ENTRANCE SOUTHSIDE DOWN

100th ST. OF 23rd ST.

This picture gives an accurate idea of the appearance of the interiors of the subway stations. The two stations shown above are considered the two banner stations of the subway line.

In a great, practically municipal undertaking beauty has been made an important element in the work.

Every station along the route has an entirely different color scheme, in glazed tiles and marble, and in addition the walls of each hold different devices appropriate, wherever possible, to their name. The Astor station, for instance, is decorated with the beaver in mosaic—the Astor emblem, and at Columbus Circle, the decorations are caravels.

It will not be necessary for a passenger going down or up town to strain his ears so that he may understand what station the conductor is calling. He can look out of the window and see the color scheme of the station he is approaching and know at once where he is. But if this evidence fails him, an ingenious electrical arrangement, suspended from the roof of his car, lights up automatically on approaching the station and shows the name in electric bulbs.

Many of these subway stations are finished in the most artistic manner. Rookwood pottery, Faience and marble are used in many tints and intricate designs. The glass roofs at the stations provide dazzling light, which is diffused from the glazed tiles. The platforms are all built in the most substantial manner, to accommodate great crowds. From one end of the subway to the other the passage is nothing less than a great, broad airy arcade, lit with much brilliancy and broken at short intervals by the ever-changing color schemes of the various stations.

The third-rail system will be used throughout, the rail, however, being protected by a hood for its entire length, making accidental contact impossible. This is only one of the precautions that have been taken by way of safety. On no railroad in the world



PHOTOGRAPHS BY RICH. AROS, N.Y.

TICKET OFFICE 23rd ST. DOWN TOWN SIDE

facilities for running the express trains at even a greater speed than 50 miles, if necessary. There is a fifth track at Forty-second street, one at Fourteenth street and a third at Spring street, so that cars can be switched off at these

that underground systems are the only things possible for large cities that are increasing rapidly in population. There is little doubt that within the next few years New York will be honeycombed from one end to the other with tunnels.

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