EXPERIMENTS IN FOOD PRESERVATIVES CONDUCTED BY THE DEPARTMENT OF AGRICULTURE.

BY OUR WASHINGTON CORRESPONDENT.

That the public is entitled to an exact knowledge of the things that it purchases, is becoming more and more a recognized fact, and especially so in regard to food. The addition of an ingredient to a standard food product may or may not have a deleterious effect, depending, for instance, among other things, on the constitution of the individual, and experts have frequently testified, both in published volumes and before courts, to opposite opinions. It was in consequence of this condition of affairs that by Act of Congress, approved on June 3, 1902, funds were provided "to enable the Secretary of Agriculture to investigate the character of proposed food preservatives and coloring matters, to determine their relation to digestion and to health, and to establish the principles which should govern their use." This work was naturally assigned to the Bureau of Chemistry, in the Department of Agriculture, and is now being actively carried on under the direction of its chief, Dr. Harvey W. Wiley.

Early in December of last year a kitchen and dining room were fitted up in the basement of the building occupied by the Bureau of Chemistry, after which application was made to the Civil Service Commission for a cook, and an expert was obtained, whose skill and knowledge were certified to by several of the *bon vivants* of Washington. The selection of young men on whom to experiment was not so easy, for the all-powerful Civil Service Commission was for once impotent, and in consequence volunteers were called for. In time Dr. Wiley succeeded in obtaining a dozen or more young men, chiefly from his own Bureau, who were willing for the cause of science to submit themselves to the experiments.

In order to secure the desired results, it became necessary to determine a series of facts concerning the subjects. Accordingly they were at the outset critically examined by a physician from the Bureau of Public Health and Marine Hospital Service, and then for a period of time were fed on pure food, so as to determine exactly what quantity of food was necessary for their normal diet. That is to say, each man throughout the entire course of the experiments is allowed only the same amount of food, which, however, may vary with the individual, but which amount is determined after experimentation to be just enough to maintain the individual in a normal condition. Charts were prepared for each person, on which the weight is daily recorded, and also a record made each day of the temperature taken before and after dinner. The number of heart beats and the respiration are determined twice daily, the blood corpuscles are counted, and the amount of hemoglobin in the blood measured. Of course it is understood that the subjects were pledged to eat only the food given to them by Dr. Wiley, and to refrain from the use of stimulants, although tobacco is allowed during the experiments in the regular manner in which it had been used.

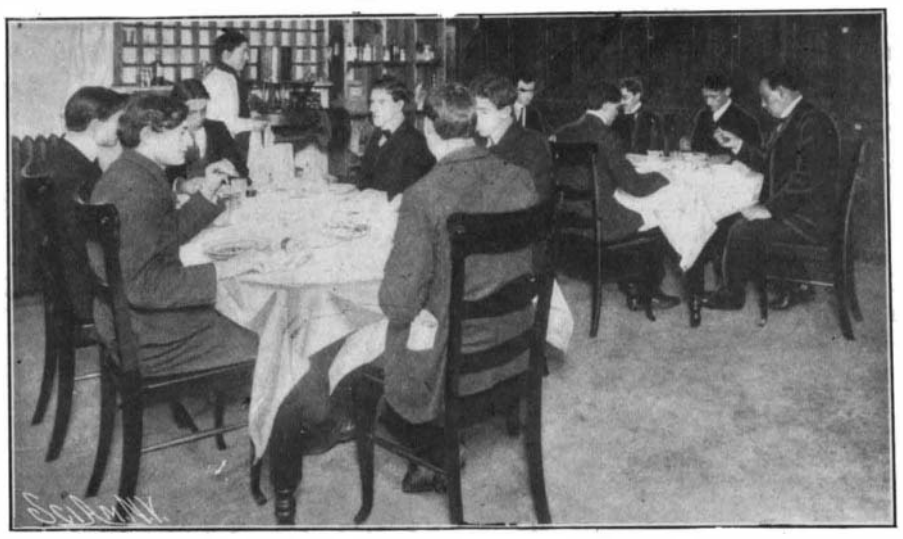

Fig. 1.—Prof. Wiley at Table With His Guests.

The selection of the first substance to be experimented with was considered, and borax was chosen, concerning which it is generally admitted that it is a most excellent preservative, especially for meats and dairy products. A small quantity of borax will act as a preservative just as well as a large quantity of salt. Therefore admitting, for the sake of argument, that borax taken in certain quantities does derange the physiological functions, it is probable that it does not do so to such an extent as does the larger quantity of salt which must be used as its substitute. In the case of meats, if preservatives are really injurious, the injury is a necessary evil, unless the meats are preserved solely by the canning process. In some instances, such as with hams and breakfast bacon, this method would practically destroy the qualities of those meats which are most desired.

The young men having reached a normal condition, that is, possessing a constant weight, and the proper amount of food for each having been determined, they were divided into two sets of six each, and the experiment began. One set was fed with pure food only, and the other set with food to which borax, in increasing amounts, was added, and the effects on metabolism noted. These experiments continued for about four weeks, when the young men changed. That is to say, those who had been eating the food to which borax was added were now fed only on pure food. There was also a special set, consisting of two young men, who were fed continuously on food containing borax. It is understood, of course, that the object of the investigation is to ascertain the changes that occur in the subject, in consequence of the use of the special preservative employed, which in this instance was borax. Therefore, the exact quantity of food required normally by the individual being known, he is given exactly that amount, with the addition of varying proportions of borax. The food is carefully analyzed, so that it may be known exactly how much of each ingredient is given to him, and all that is excreted, both solid and liquid, is carefully weighed and analyzed. By striking a balance, the precise amount assimilated is deter-

Fig. 2.—Dr. Bigelow Examining the Cooked Food in the Hygienic Kitchen

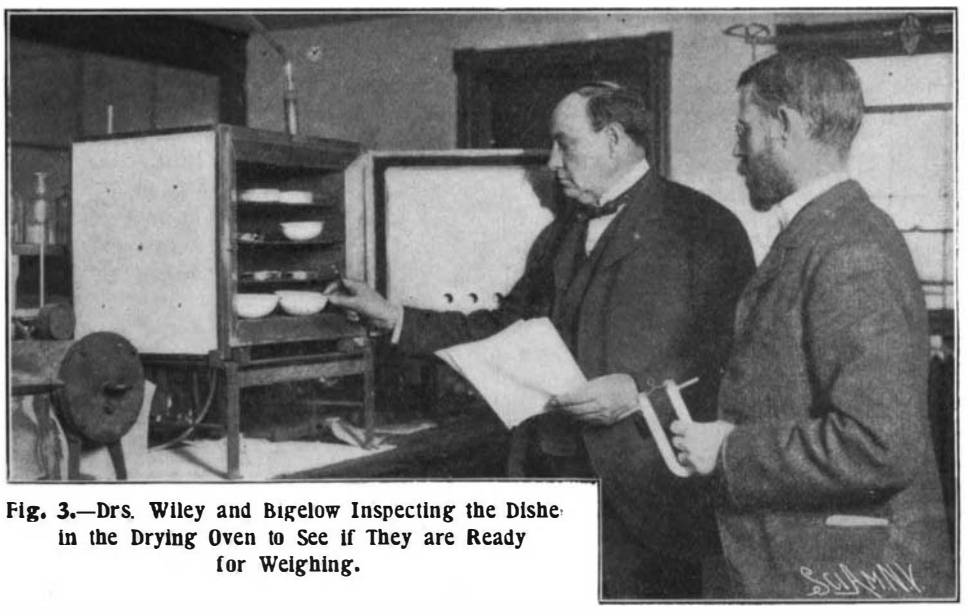

Fig. 3.—Drs. Wiley and Bigelow Inspecting the Dishes in the Drying Oven to See if They are Ready for Weighing.

Fig. 4.—Drs. Wiley and Bigelow Examining the Capsules in Which the Preservative is Administered.

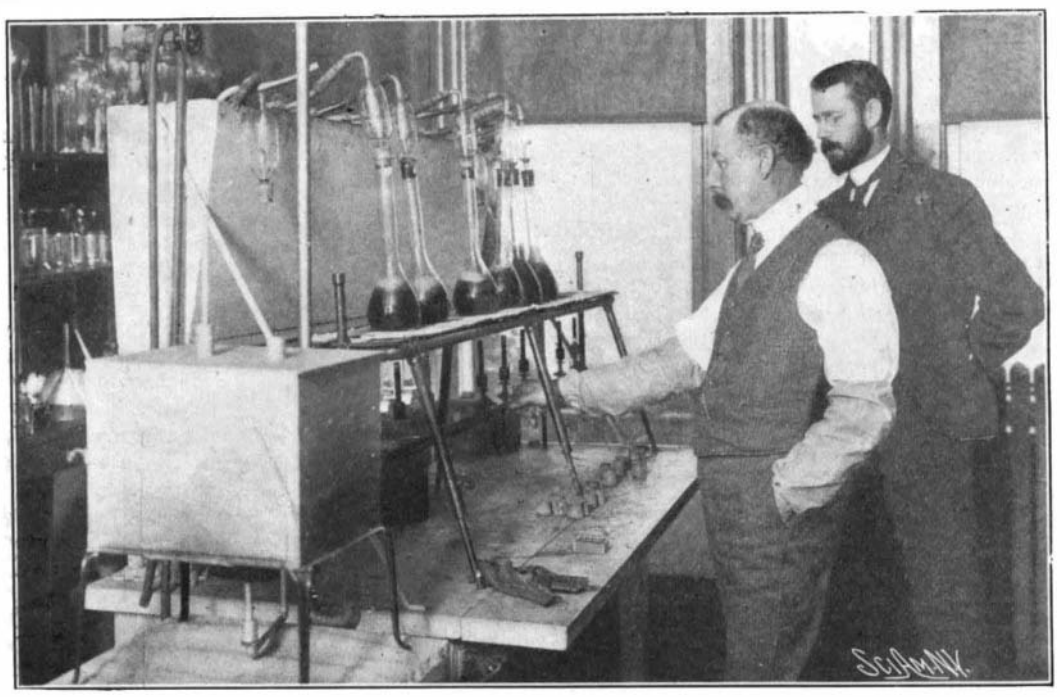

Fig. 5.—The Apparatus Used for the Determination of Nitrogen.

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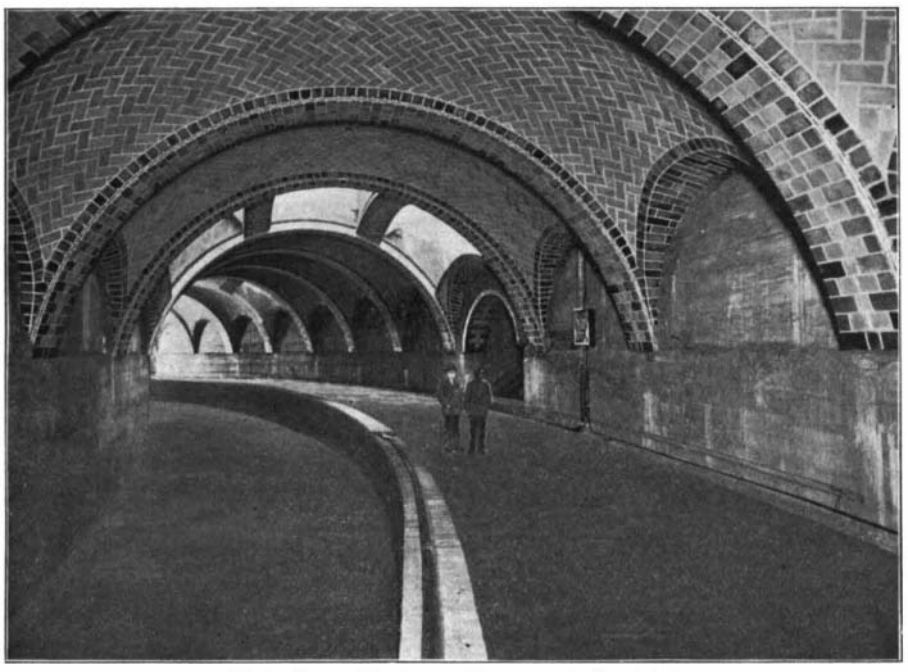
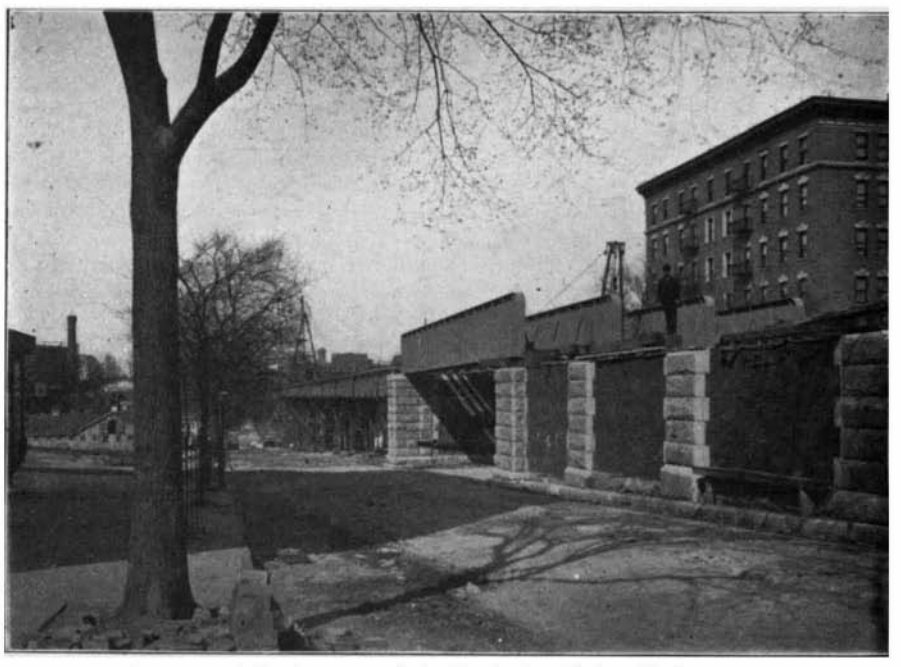
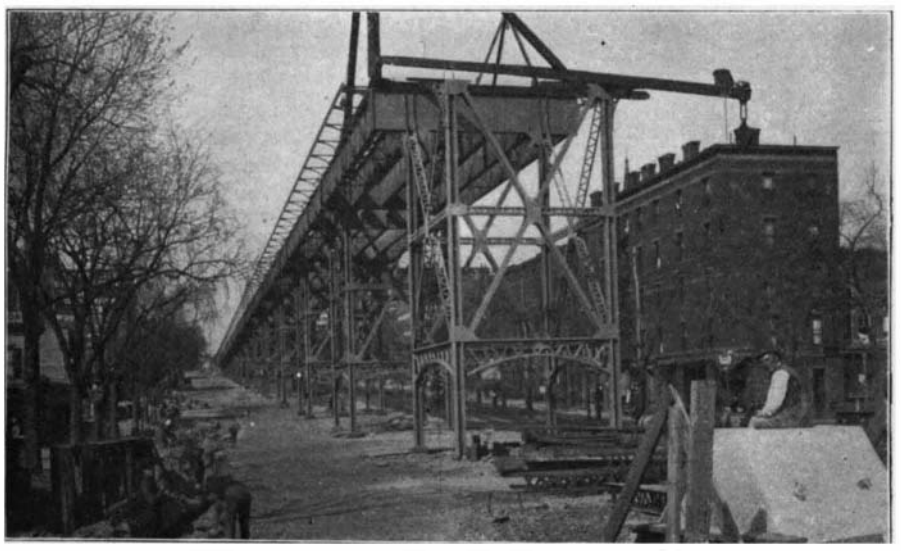


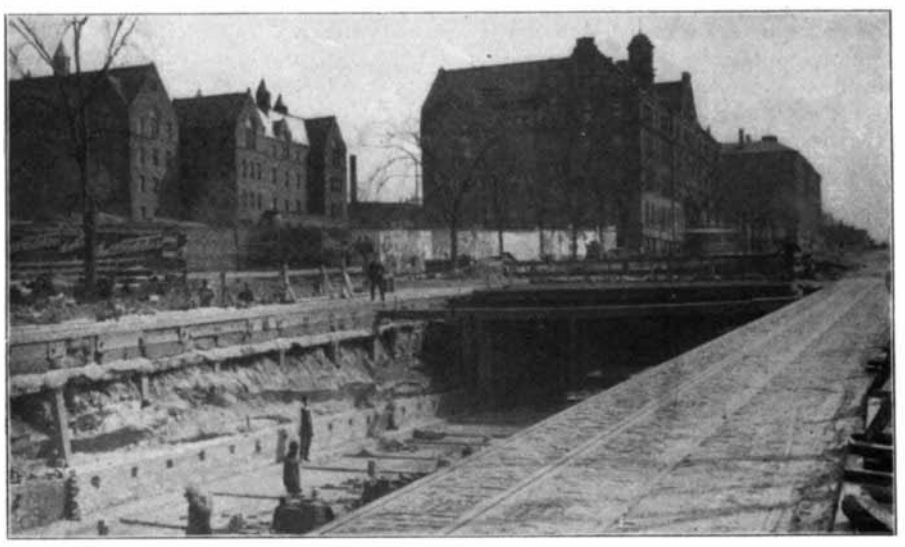
City Hall Loop Station; Concrete Roof, Tile-faced.



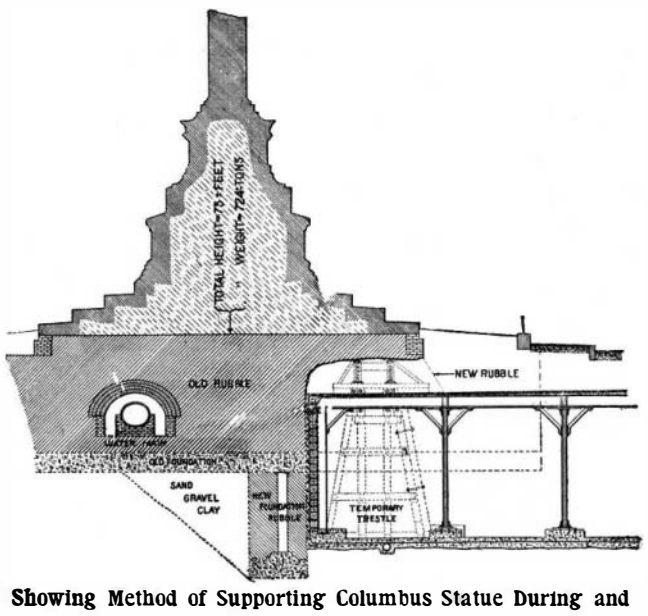
Masonry of North Approach to Manhattan Valley Viaduct.



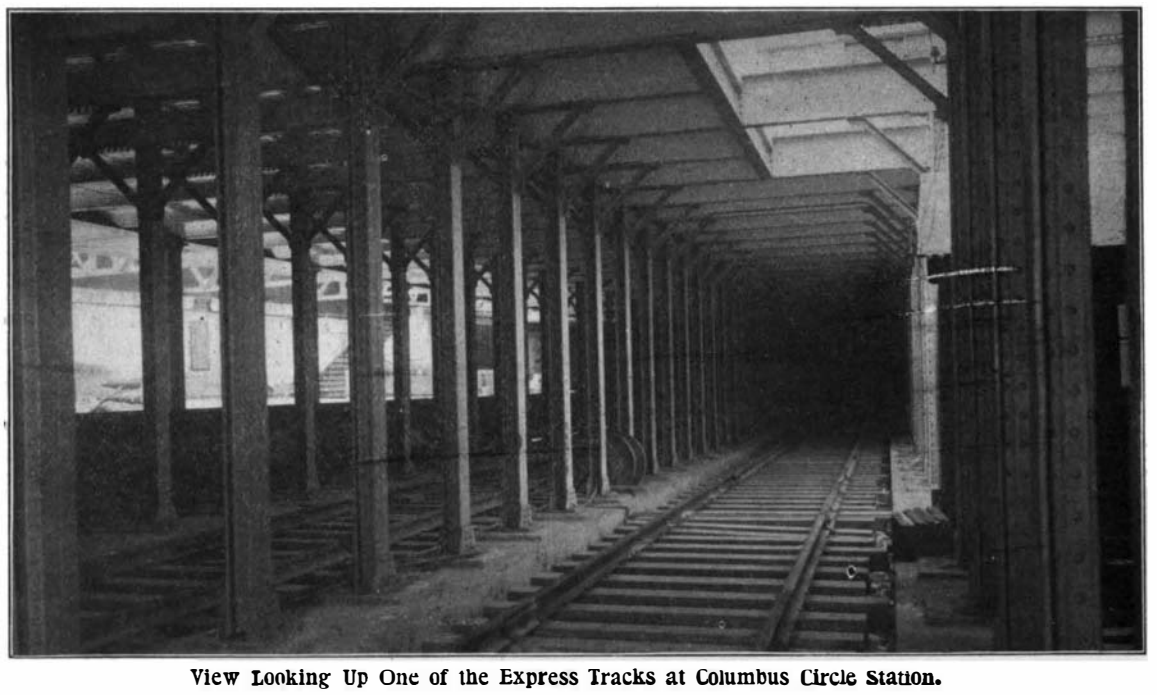
Manhattan Valley Viaduct, Showing Skewbacks for Arch.



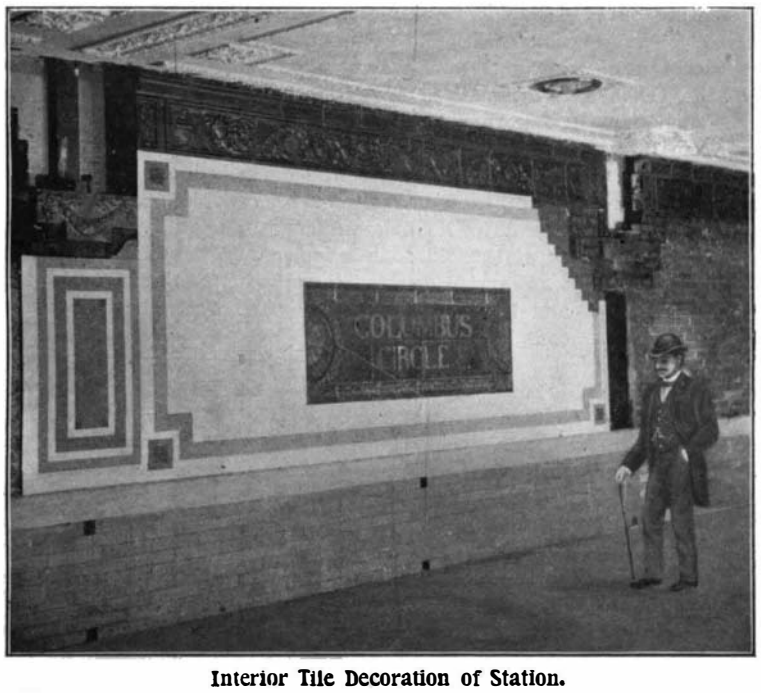
Entrance to Subway from Viaduct Looking South.



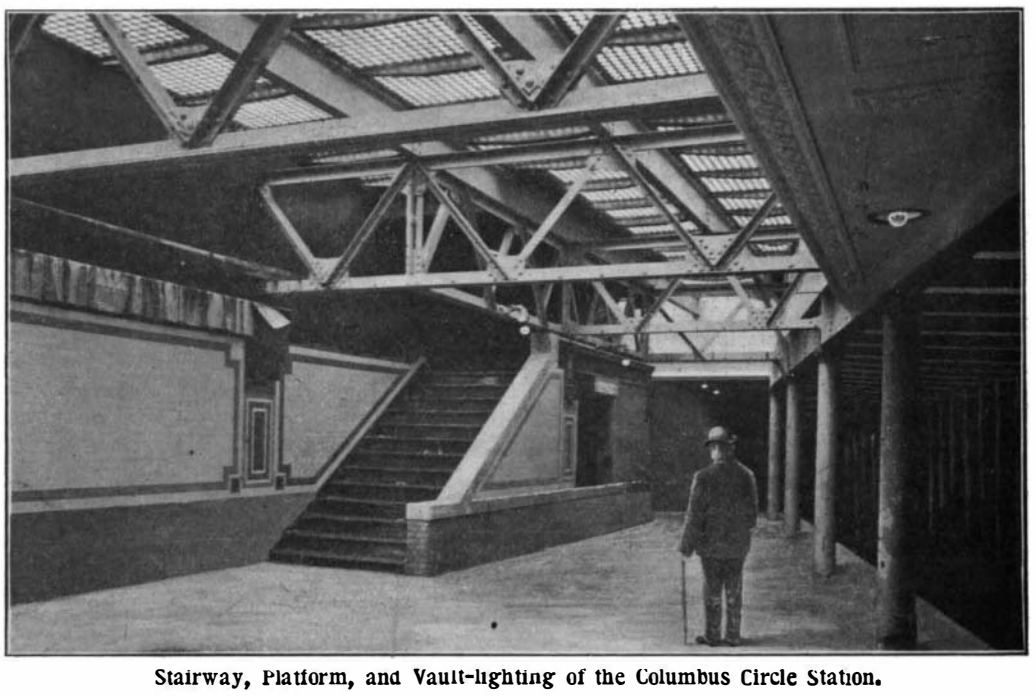
Showing Method of Supporting Columbus Statue During and After Building Subway



View Looking Up One of the Express Tracks at Columbus Circle Station.



Interior Tile Decoration of Station.



Stairway, Platform, and Vault-lighting of the Columbus Circle Station.

Photographs made especially for the Scientific American.

CONDITION OF THE WORK ON THE RAPID TRANSIT SUBWAY.

mined, and the changes in weight or metabolism show the results of the value of the food on the individual. It may be added that the services of some twenty chemists and assistants are required for the various analyses that are essential in this investigation.

A few words about the food may be of interest. The meals are simple, but the best food obtainable is provided, including fruits and vegetables of the season. For breakfast, which is served at 8 o'clock, a cereal, meat with mashed potatoes, bread and butter, and coffee and milk, are furnished. At 12, a luncheon is provided, consisting of soup, bread and butter, fruit and milk. The dinner is more elaborate, and occurs at 5:30 in the afternoon, and a typical meal is the following: Roast beef, mashed potatoes, string beans, bread and butter, milk and sugar, with boiled rice as a dessert, and coffee. In order that the proportion of meat may be constant in its value, and so that a fair sample may be secured for analysis, it is ground up before it is served. The bread is specially prepared on a constant formula. Condiments, such as salt, pepper, and certain spices, are permitted, but the quantity taken by each individual is determined.

Unfortunately, at the beginning of the investigation there was a disposition on the part of some of the newspapers to treat the experiments in a spirit of levity, and stories were told of how, for instance, the coffee of one of the subjects was sweetened with a quinine pill, and the occurrence of slight digestive disorders was magnified into cases of serious poisoning. But these, it is almost unnecessary to say, were due to the desire of the reporter to make "copy." But in consequence of these stories Secretary Wilson, of the Department of Agriculture, than whom no one is more able and progressive, wisely issued an order that no further information should be given to the public. This regulation has also the additional merit of preventing the publication of undigested periodical returns.

It is generally assumed that the experiments with borax will be continued until June, when a further selection from substances, such as benzoic acid. formaldehyde, salicylic acid, sodium benzoate, and sulphurous acid, will probably be made. It is expected that several years will elapse before the entire series of experiments will be completed.

As to the ultimate value of the result to be obtained, it may be said that the information will be of service in shaping intelligent legislation, regulating commerce in food products, securing the removal of unnecessary and unjust restrictions, and making effective those that are necessary and just. It will serve as a basis for international agreement in regard to the composition of preserved foods. At present different nations have widely different laws to protect and regulate the importation and exportation of food products. The experiments will serve also as a basis for rational advice on the part of hygienists and physicians in regard to the foods that should be or should not be used by persons in ordinary health, and they will be especially valuable in the treatment of invalids. The investigation will produce results which will tend to conserve the public health and guard the invalid and the weak person from injurious substances.

The illustrations show the various phases of the work.

In Fig. 1 will be seen the arrangement of the two tables, with Dr. Wiley at the head of the table to the right. Fig. 2 represents Dr. Bigelow examining the cooked food in the hygienic kitchen. Fig. 3 represents the method of conducting the chemical test with the analyses of foods and excretions. Drs. Wiley and Bigelow are inspecting the dishes in the drying oven to see if they are ready for weighing. Fig. 4 shows Drs. Wiley and Bigelow examining the capsules in which the preservative is administered. The nitrogen balance is the most important of the factors determined in controlling metabolism; Fig. 5 shows the apparatus used for the final determination of the nitrogen in the foods and excreta. Dr. Bigelow and Mr. Trescott, the nitrogen expert of the Bureau of Chemistry, are conducting the determination.

CONDITION OF THE WORK ON THE SUBWAY.

In agreement with a practice which we have followed each year since the opening of work on the Rapid Transit Subway, a representative of the Scientific American recently made his annual inspection of the work from the Bronx to City Hall Park. The result was on the whole encouraging, and seems to bear out the statement of the contractor that he will have trains running as far north as 145th Street by the close of the present year. At the same time, it is evident that if this promise is to be fulfilled, the finishing up of those portions of the line that are at present in the most backward state will have to be rushed through with much greater expedition than has been shown during the past year in finishing up some other portions of the work, which twelve months ago were in a very advanced condition. Even if the Subway is completed and the steel laid ready for the trains, there is still the important question to be considered of the erection of the power house and the installation of sufficient plant to operate this portion of the line. Fortunately, the strike on the power house, which threatened to delay the whole Subway, has been amicably settled, and construction is being pushed along at full speed.

Although the prospect of an early completion of the Subway tunnel and tracks is good, and the contractors and engineers are to be congratulated on the fact that they are from six to nine months ahead of the contract, so far as the actual running of trains is concerned, it is impossible to shut one's eyes to the fact that so far as the most important question of restoring the street surfaces along the route of the Subway to their proper uses is concerned, the contractors have been grossly negligent, and have shown an indifference to the rights of the public which cannot be too strongly censured.

The total length of the Subway, including the deep-level tunnels and elevated structure, is about 20 miles, of which about 11 miles have involved the opening up of the streets; about 3½ miles is deep tunnel work that has been carried on without any considerable obstruction of the surface; and about 5½ miles consists of elevated structure. Dealing first with that portion of the Subway that has been built by the cut-and-cover method, in which it must have seemed to the citizens of New York that there was a great deal of cut and very little cover, it may be said that the greater part of it is to be found in Manhattan, between City Hall Park and 145th Street, and on the easterly branch of the road from 104th Street to the Harlem River. As this is the section of the road for which there is the most pressing demand, and because the cut-and-cover system involves the most complete disorganization of city traffic, the public is doubly desirous of seeing it cleaned up, and the street surface restored to its original condition. At the present writing, out of 10.8 miles of the Subway constructed by this method, 6.35 miles have been completed, that is to say, the tunnel has been excavated, the steel framework erected, the concrete roof and brick or terra cotta sidewalls built, the excavation filled in, and the street surface paved or asphalted as the case may be.

There are 1½ miles of the Subway on which the steel work has been erected and the concreting is now going on. The excavation over this portion of the line is, of course, still open and the streets encumbered, but the work is in such an advanced stage that another month or six weeks should see it completed and the street surface restored.

There are other portions of the Subway, aggregating altogether 1.35 miles in length, where the steel structure is only partially completed; but in this case the work of concreting is following close upon the heels of the steel work. Then there are various stretches of the work, making a total of 1.6 miles, on which the work of excavating is still in progress, and as the excavation is mainly in rock, it must necessarily proceed rather slowly. In this case also the work of putting in steel and concreting is following closely upon the excavation.

Of the deep-level tunnels that are being excavated entirely through rock, there are three principal sections. The first of these is the notorious double tunnel, with two tracks in each, extending from 34th Street to 42d Street; notorious because of the unfortunate accidents due to the faulty quality of the rock, which resulted in the collapse of several houses on Park Avenue. This important stretch of tunnel work is completed. The next section of deep tunnel is that which runs under Washington Heights between 145th Street and the station at 160th Street; and here the heading has been cut through and the men are now on bench work, that is to say, they are blasting out the lower half of the tunnel, and some of the concreting has been completed. Between 161st Street and 181st Street the heading has been driven, the bench is being excavated, and some concreting is completed. The most backward portion of the tunnel is from 181st Street to 196th Street, where the heading has not yet been driven through, and the work will not be completed for twelve months or more.

The first portion of the line to be opened will be that from City Hall Park to the great underground storage yards at 145th Street, and on this part of the work there is a stretch of elevated viaduct which carries the tracks across the Manhattan Valley. The viaduct consists of a single-arched span over 125th Street measuring 172 feet between the skewbacks and a trestle approach on either side of it. This approach, of which we present some views, is practically all completed, there being a gap of only about 400 feet to be closed, and of this 172 feet will be taken up by the arched bridge. The connection between the tunnel and the trestle at either end will consist of an open cut and a masonry embankment. The embankment will be faced with stone and brick, and finished with a massive stone parapet of pleasing design, the character of which can be seen from the accompanying illustration. On the rest of the elevated structure, namely, the stretch from 196th Street to Kingsbridge and that which extends from about Third Avenue in the Bronx to Bronx Park, but little work has been accomplished, that which has been done consisting mainly of the foundations for the piers.

The east side branch of the Subway diverges from the main line at 104th Street and Broadway. It includes a tunnel beneath the northwest corner of Central Park, which is practically completed, and can easily be made ready for the passage of trains by the end of the year. The Subway below Lenox Avenue is completed; but the work below the Harlem River and the approaches thereto is still in a backward condition, and there is no possibility of its being ready as early as the main line to 145th Street. Most of the tunnel in the Bronx from the Harlem to Third Avenue is being excavated by the open process, and is in a very incomplete condition, the streets below which it runs being, for much of the distance, in a practically impassable condition.

The question of the opening of the main line at the end of the year is a question of the completion of the work at certain points, where it has been delayed either by legal obstructions or the backwardness of contractors, but chiefly by the former cause. The first break occurs between Worth and Canal Streets, where for some blocks only the easterly half of the tunnel has been completed and the westerly half still remains to be done. The next serious break is at Astor Place, where the work has been held up for a year and a half by the obstruction offered by Wanamaker's store; and if there is any delay in the opening of the line, it looks as though it will be chargeable to this obstruction more than to any other. The building is now being torn down, and the work of constructing a station at this point is being rushed as fast as men can be crowded upon it. The stations at 14th Street, 18th Street, and 23d Street are nearing completion, but the station at 42d Street is still in a very backward condition, quite a large section of the rock excavation opposite the Grand Central Station being still uncompleted. At 42d Street and Broadway also there is an enormous amount of work to be done. Excavation is being carried down at this point for considerable distance below the Subway tracks which here pass through the site which will be occupied by the new Times building. If trains are to be running at the end of the year around this curve, there will have to be some extraordinarily rapid work done both in excavation and steel work.

We present illustrations of two of the most important Subway stations on the whole line, namely, the loop station situated below City Hall Park and just in front of City Hall, and what is known as the Columbus Circle Station at 60th Street. They are representative of two different types of construction, the City Hall Park station being formed of arched concrete construction, while the roof of the Circle station is carried on steel columns and girders with concrete roofing turned in between the girders. In both cases it will be seen that the stations are well lighted by overhead sidewalk vault lights, assisted by a liberal use of incandescent electric lights. The finish of the walls will be in glazed tiling, the colors being chiefly white, green, and Venetian red. The names of the stations will be shown in large glazed tile letters set in the panels of the wall, and they will be clearly distinguishable by the passengers. The loop tunnel will contain a single track, and the station platform, and the whole station indeed, is on a curve of somewhat sharp radius. The Circle station being on the main line will contain four tracks. One of our views of this station shows the platform and one of the stairways, and the other is taken looking up one of the tracks where the line runs on a tangent. An interesting feature of the Circle station is the fact that the structure cuts in underneath the Columbus statue, which is over 75 feet in height and weighs about 724 tons. During excavation a pair of heavy steel girders was placed beneath the corner of the heavy base of the statue and carried on two temporary timber bents. The steel work was then built in place and concreted up, the temporary girders and bents were removed, and the surface restored to its original condition. To prevent sliding in of the old foundation, a new foundation of rubble was carried down at the side of the Subway excavation and left permanently in place when the Subway was completed.

Lord Rayleigh for some time past has been carrying out experiments relative to the surface tension of liquids. This tension is at the maximum in pure water, but by the application of the smallest drop of oil or grease, the tension is reduced considerably. This fact may be easily demonstrated by dropping a small piece of camphor into pure water, and it will rotate very rapidly. But apply a drop of oil to the water, and the rotatory motion ceases immediately. According to Lord Rayleigh, a film of oil on water may be so thin that its thickness is no more than one twenty-five-millionth of an inch—which is computed to be in all probability the size of a molecule of the oil.