

the grains were composed which blew up the 10-inch gun would not detonate under 100,000 pounds to the square inch, although the rapidity of combustion under that pressure would be very great. To detonate the compound, it must be subjected to a sudden pressure sufficient to force upon the constituent molecules a rearrangement. It is probable that the powder did not detonate in the 10-inch gun in the true sense of the word.

It is probable that had there been placed in the gun, with the charge which exploded it, a piece of powder material of the same size and character as the grains fired, but without any perforations, it would not have been all consumed.

A GLIMPSE OF THE PARIS EXPOSITION OF 1900.

BY CHARLES RICHARDS DODGE.

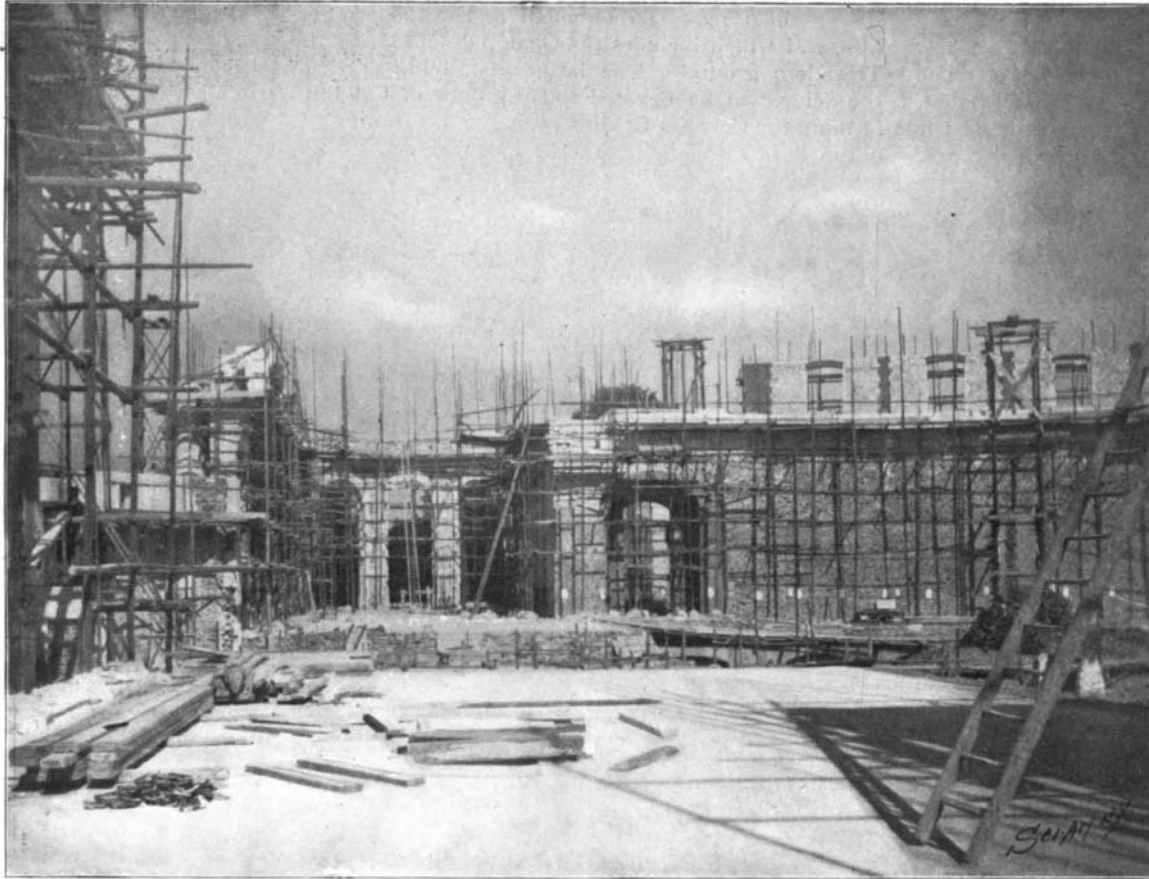
The grounds of the Paris Exposition of 1900, lying within the city, comprise four plots or tracts, two of which, the Champ de Mars and the Esplanade des Invalides, are situated south of the Seine, with two lesser tracts, the Trocadero grounds and the site of the Art Palaces, situated on the north side of the Seine. The main tract, the Champ de Mars, and the Trocadero grounds just across the Seine, are connected by the Pont d'Iéna, and thus form one section. A second section is formed by uniting the Esplanade with the plot taken from the city park system, the two being united by the beautiful Alexander III. bridge, in process of construction. These two sections are connected along the Seine by

near the Place de la Concorde, and, therefore, only a short distance from the garden of the Tuileries. The eastern sections of the grounds nearest to this point are to be connected by a magnificent piece of permanent engineering work over the Seine, to be known as the Alexander III. bridge. Upon the large tract extending along the north bank of the river, which was acquired by using a portion of the park system between Cours de Reine and the Avenue des Champs Elysées, and including the site of the now demolished Palais l'Industrie, two superb palaces of art are in

Seine has been encroached upon, and the embankments extended further out into the stream on either side at large outlay, the surface of the new embankments being at a lower level than those at present existing.

When in Paris recently it was my good fortune to be permitted to go through the ateliers of the Exposition, for the present located in that portion of the old Palais l'Industrie still standing, where are to be seen the plaster models, in exquisite detail, of two palaces of art, models of portions of the bridge structure and its approaches, besides many beautiful models and designs of art work to be used upon the bridge and to enrich façades of Exposition buildings now in process of construction.

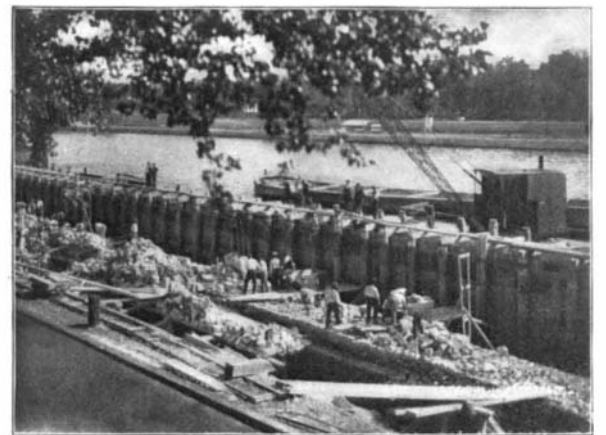
The Grand Palace of Fine Arts, which will house the treasures of sculpture and painting of all nations at the Exposition, is on the west side of the Avenue Nicholas II. and quite near the famous Avenue des Champs Elysées. Prizes to the value of 45,000 francs were offered for designs for this building. The design of M. Louvet was selected from sixty competitors, and the first prize of 15,000 francs was awarded to this architect. The accompanying illustration shows the fine massive proportions of the Grand Palace, which is constructed of cut stone, the same that is used so largely for building purposes in the city of Paris. The palace is provided with two grand staircases, and will have an imposing entrance hall. The first floor will be devoted to a series of superl



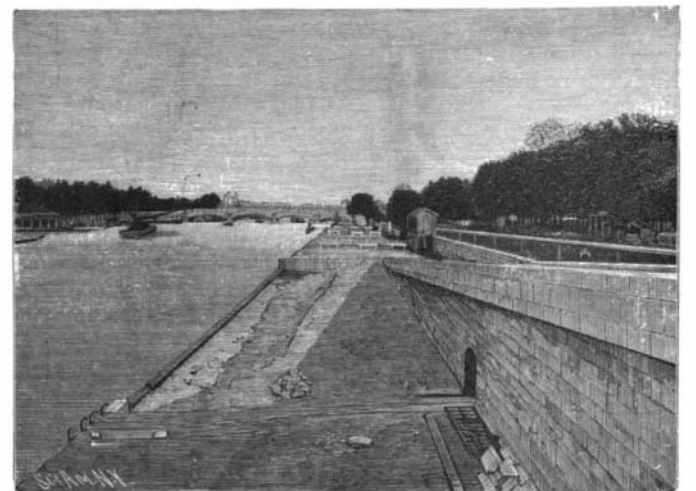
THE 1900 PARIS EXPOSITION—INTERIOR OF THE SMALLER ART PALACE.



THE 1900 PARIS EXPOSITION—EXTERIOR OF THE GRAND ART PALACE.



THE SEINE EMBANKMENT COFFER DAM.



ENLARGED AND COMPLETED SEINE EMBANKMENT.

considerable spaces on either side of the river, formed by the Seine embankments, and, on the south side, by taking in Quai d'Orsay, one of the city streets. While the several sections are almost in the heart of Paris, with blocks of buildings and systems of streets between, it will be possible to fence the grounds into one inclosure, with gates at different points, so that one ticket will admit to all parts of the grounds. It should be mentioned that another section of the Exposition will be located in Parc Vincennes, eight miles distant, though directly connected with the Exposition grounds by rail, with rapid trains running at short intervals.

The main entrance to the Exposition proper will be

process of construction, which are to be permanent. To make room for these immense structures it was necessary to sacrifice the old Palais l'Industrie, and, to make the buildings themselves more imposing, a new thoroughfare is to be established, the Avenue Nicholas II. Starting from the Avenue des Champs Elysées, this thoroughfare will pass between the two Art Palaces, upon which they will front vis-a-vis, and, crossing the Seine by means of the new Alexander III. bridge, will extend the entire length of the Esplanade des Invalides in a straight line, ending at the Exposition building that forms the boundary of the grounds in this direction.

In the effort to secure all available space, even the

exhibition rooms for paintings, and an enormous salon is provided for sculpture. There will also be suites of smaller exhibition rooms, besides a café and other rooms for entertainment or comfort of the Exposition visitors. Ample arrangements have been made for lighting all of these exhibition rooms, the upper ones, of course, being lighted from the roof.

The lesser Palace of Art, an interior view of which is shown, known as the Girault Palace, from the name of the architect whose design was accepted, occupies a position on the east side of the Avenue Nicholas II. It will be a permanent structure, similar to the Grand Palace in materials and general style, and I understand will be devoted to historical treasures, a part of the

grand retrospective exhibit which is the *raison d'être* of the Exhibition of 1900; that is, to show to the world the progress of the past hundred years.

It is the intention of the Exposition authorities to beautify the grounds surrounding the Palaces of Art in such manner that the landscape will connect naturally with existing shrubbery and trees, giving a park-like aspect, which will harmonize with the famous promenade, the Avenue des Champs Elysées, immediately to the north.

Passing from this grand promenade and drive, through the new Avenue Nicholas II., to a point south of the Art Palaces, the visitor comes to the Seine, and to the extensive works now in progress on the new Alexander III. bridge, which will doubtless be one of the architectural features of the Exposition. The corner stone of this structure was laid in October, 1896, by the Czar of Russia. The architects of the bridge are Messieurs Cousin and Cassien-Bernard, while the construction is under the immediate supervision of Messieurs Resal and Alby. It is to be a single span bridge, 110 meters in length over all, with a width of 40 meters. While the main arch, naturally, will be of steel, the foundations will be of granite, though other stone will be used in the structure, even marble, in connection with bronze, with which some very beautiful ornamental effects will be produced. The general style is Louis Quatorze, with many statues and decorations; some of the models for which it was my pleasure to see in the workshops of the Exposition. Among the artists represented are Fremiet, Dalou, Gardet, Cordonnier, and others. During the construction period an iron foot bridge will span the Seine, just beneath which the work will go on. This foot bridge was built in sections and "thrown" or "launched" into position from the north side of the river. One of our illustrations shows its appearance when it had only extended as far as mid-stream. The other small illustration gives an idea of the solidity of the arch springing from the abutment. Beyond are arches to support the esplanade above, and in the distance are the walls of the great Art Palace. One peculiarity of the Alexander III. bridge is that the span is to have a rise of only one foot from ends to center.

The series of palaces on the Esplanade des Invalides will be devoted largely to exhibits in manufactures and the various industries. The United States has secured ground space in this portion of the Exposition, near the Alexander III. bridge, upon which to erect a building which will give about 15,000 square feet of space for various groups of exhibits.

On the Seine embankment, west of the Alexander III. bridge, will be placed some of the most interesting and beautiful structures of the Exposition. On the south embankment, between Pont des Invalides and Pont de l'Alma, will be constructed the Palaces of Nations, in the midst of which our own beautiful national building will have a prominent position. While the plans of this building show a structure worthy of this great nation, it is believed that one or two buildings, to be erected by other nations, will cost more money, as they will be veritable palaces. The United States building, which will house a few exhibits of national interest, will be the headquarters and home of all good Americans at the Exposition. A little further along, likewise on the south side of the river, between Pont de l'Alma and Pont d'Iéna, will be placed the Exposition building, to be devoted to army and navy exhibits, and beyond this the Palace for Commerce and Navigation. The United States will erect an annex near to this building on Quai d'Orsay, in which will be housed exhibits relating to our merchant marine and the United States Weather Bureau. The building has been specially planned with regard to the uses of the United States Weather Bureau, and a novelty in this exhibit will be a working Weather Bureau observatory on the roof, accessible to the general public by an easy flight of stairs leading to a tower, with exit on the roof level. The instruments on the roof are to be connected with those displayed in the exhibit hall below, in order that the public may be able to study every phase of weather observation and forecasting, including preparations for publication and the printing of daily reports.

Another prominent building, just beyond the Merchant Marine, is the Forestry and Fisheries building, almost under the shadow of the Eiffel Tower. On the north bank of the Seine, opposite to the palaces of the foreign powers, will be located the Palace of Horticulture and the Palaces of Social Economy and the city of Paris. The United States will have a very desirable location in the Horticultural building, and extensive arrangements are being made for the exhibits in this special department.

The work upon the new Seine embankments, upon which the buildings bordering the Seine will be constructed, has been in progress for many months. The manner in which the Seine is being encroached upon in order to give available space for these new buildings is shown in two of the small illustrations from photographs taken in the autumn of 1898 by the writer. Just beyond the proposed limits of the new embankment in the river double lines of piles are driven a few feet

apart and parallel with the shore. The space between is then filled in and a bulkhead is thus formed. Other bulkheads are raised at intervals, running from the main line of piles to the shore, and, after pumping out the water which fills a particular section, the masonry work is begun. The other small illustration shows the appearance of the completed embankment, the incline on the right being the line of the river prior to the improvement. Additional temporary foot bridges are to be built over the Seine to provide ample facilities for crossing the river from one part of the exhibition grounds to the other.

We have now reached the main portion of the Exposition, which may be designated as the Eastern Section, and which includes the Champ de Mars and the Trocadero grounds. The latter plot, lying north of the Seine, will be devoted to the groups of buildings forming the Colonies Exhibits, some thirty in number, not including the Palace of the Trocadero, which was erected for the Exposition of 1878.

By far the larger portion of the Champ de Mars is covered by a series of palaces, practically under one immense roof system, which will house the following groups of exhibits: Agriculture and food products, machinery and electricity, textiles and clothing, mines and metallurgy, chemical industries, civil engineering, education, science and arts, etc. Just north of this series of connected palaces stands the Eiffel Tower, to the left of which is the palace devoted to the monster telescope, illustrated in a recent number of the SCIENTIFIC AMERICAN. Mention should also be made of the Annex to Agriculture, which is to be erected by the American Commission, and which fully doubles the space originally allotted to the agricultural groups.

The old Palace of Machines which was used in 1889 is to be devoted to agriculture and food products, and will be known as the Palace of Agriculture. Nearly one-third of the central portion of the floor space of this structure, on Champ de Mars, is to be given up to the magnificent festival hall of the Exposition.

As previously remarked, the principal entrance, which is located very near the Place de la Concorde, and close to the Seine, will be in the form of a triumphal arch, upon the face of which will be emblazoned the arms of the city of Paris, while it will be surmounted by a colossal statue of Liberty. It is claimed that it will be possible to admit 60,000 persons per hour without difficulty.

Mr. F. E. Drake, Director of Machinery and Electricity for this country, states that the part which machinery and electricity will play in the coming Exposition is a more important one than ever assumed by these two great industries in former expositions. In a general way it may be said that but few important changes or improvements will be shown in the service of the Paris Exposition over the Columbian Exposition of 1893.

The great service power plant of the Exposition will occupy a favorable position in the main group of buildings. It will be installed immediately adjoining the space allotted for the exhibits of electrical and other machinery, and any benefits which might naturally accrue to the builder of machinery installed in the service plant will be accentuated by reason of its being located in close proximity to the exhibits not offered for regular service. The capacity of the boiler plants for the service of the Exposition will be approximately 20,000 horse power.

It is the Palace of Electricity to which all eyes will naturally turn at night, and as its main façade reaches across the entire width of the open plaza in the center of the Champ de Mars, splendid opportunity will be afforded for the attractive treatment of the architectural features of the exterior of this palace.

While the city of Paris will doubtless supply the "Midway" attractions, ad lib., there will be many novelties at the Exposition of 1900. Just across Avenue de Suffren from the Palace of Agriculture, there will be a mammoth wheel, some 25 feet higher than the famous Ferris wheel of Chicago, but built on a somewhat different principle. To the writer it appeared like a pair of mammoth suspension bicycle wheels, with swinging cars hung at intervals around the rims. It will be illuminated at night by electricity.

The Luminous Palace will be another novel feature, as it is said that it will be the greatest piece of glass and stained glass work ever produced. It will be over 100 feet in height. Its staircases are of crystal, and as electricity will be used for the lighting, the effect of a palace in fairyland will be produced.

Another novelty is the panorama of a tour of the world, which will require about 27,500 square feet of canvas. It will include a theater, cafés, etc.; and men and women of the countries represented will give performances in the foreground of the panorama. A history of costume has also been suggested, and "A Street of Paris" will doubtless be a little "Midway" all to itself.

There is no question but what the 1900 Exposition will be superior in its artistic decorations to any previous exposition, and stand as a monument of the remarkable skill and genius of the French nation in that direction.

THE HORNET AND ITS HOME.

In the study of nature we are bewildered by so many wonderful things that the real goes far beyond imagination; and the little insect we are about to look at through the eyes of original investigation presents such notable features of architectural construction in its home building that we can but wonder whence all this knowledge comes; for the hornet's nest is commenced in the early spring time by one lonely female hornet, who has succeeded in passing the winter buried in some old tree stump or rotten trunk, whither she repaired the fall previous, after impregnation, to hibernate until spring shall come.

When the warm rays of the sun succeed in making their presence felt in the hornet's hiding place, she becomes awakened to a sense of her duty, and repairs to a convenient place, be it bush or tree, and selects a site for her and her family's future home.

When a suitable place has been found, she goes to some old weatherbeaten log or rail, and gathers the wood fiber that has been set free by the elements, takes a mouthful, chews it, and mixes it with a peculiar caustic secretion of her mouth, whereby it becomes pasty, applies it to the limb, and thereby forms a nucleus for her home. This she continues to do until she has succeeded in forming twenty-four little cells or cups, which are intended for the depository of her eggs.

When this has been accomplished, she will put a covering over the nest for protection from weather. Then she will place an egg in each cell, and go on improving the home by putting another cover over the one already made, with sufficient space between the two to allow her to move about with freedom.

While these eggs are incubating she proceeds to tear down the first covering and make more cells from that material.

Meanwhile, the former eggs have materialized into tiny worms, which she feeds with small insects until they arrive at the period when the transformation from the worm or larva to the pupa or semi-insect takes place. Then she carefully places in the cell food enough to last the pupa until it matures into an insect, seals it over with a parchment-like substance, beautifully white, evidently understanding the law of the need of light for the development of the mature insect.

When the hornet comes from its cell, it does so as a full-fledged worker, and, without any previous experience, he goes to work straightway, and work of a royal kind he does. When these new-born workers come to the assistance of the lonely worker, she welcomes them by showing them every courtesy that a mother can. She leads them to the places where water and building material for the home construction are to be found.

The nest is of intricate workmanship, made from paper manufactured from wood fiber. It may be stated, in passing, that the hornets were the original discoverers of the fact that paper could be made from such materials, and the study by man of the hornet may have led him to adopt the same material, which discovery has since developed one of the greatest industries of the world, viz., the manufacture of paper from wood fiber.

Mr. T. W. Harris, in his interesting work, "Insects Injurious to Vegetation," published in 1852, says what sounds to our ears curious and interesting, viz.: "The hornets are natural paper makers, who are not obliged to use rags and ropes in the formation of their durable paper combs, but have applied to this purpose fibers of wood—a material that the art of man has not yet been able to manufacture into paper."

The insect has a scissors-like arrangement that protrudes out of the mouth, and the fine fibers that stand up from the surface of the weathered rail or log, like so many fine hairs, are clipped off, and, as before stated, are mixed with a caustic secretion of the mouth, and thereby become a paste.

The hornet, when leaving his home for more material, does so very deliberately, never seeming to be in a hurry. He will take a stroll over the nest and apparently chat with the other workmen, and, when he has loafed long enough, he will take his departure for more fiber. When he returns he reports to the master workman on the inside of the nest, then returns to where he left off and begins to force the pulp from his mouth by placing the edge of the work, already done, between his lips. His mouth opens vertically. He walks backward always in one direction, building up the leaf from the edge, and where he joined the fresh to the other material there is a distinct line, and from this mark you can tell precisely how many trips it took to make a complete nest, and the change in color of the material shows exactly when he changed his base of supplies.

No two insects work at the same portion of the nest, each one reserving a certain portion for himself, and no one dare encroach on his territory.

Different styles of architecture exist among the hornets, and there is a vast difference in the workmanship. Some do the work in a magnificent, workmanlike manner, building compactly and gracefully, while others