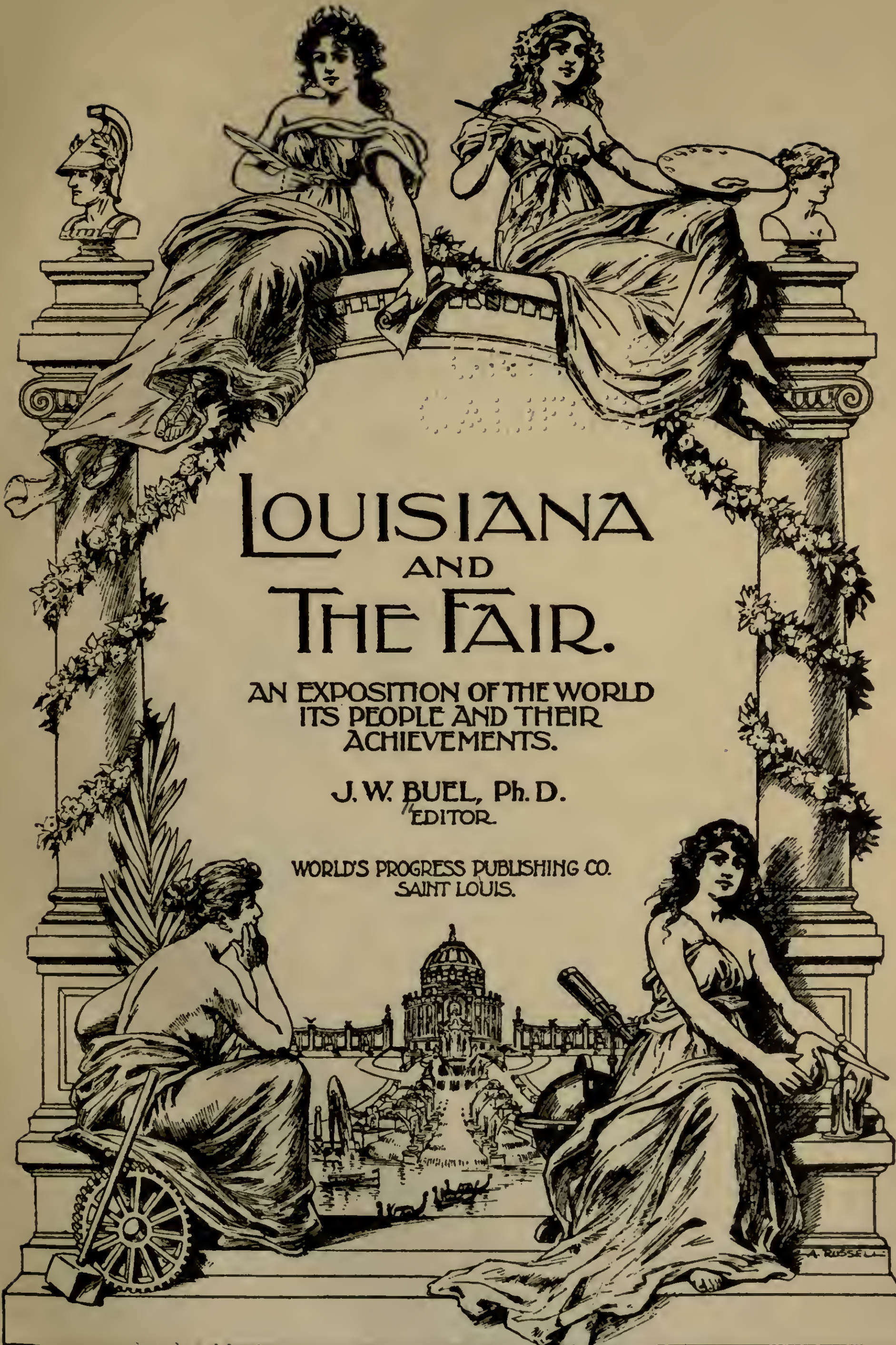
## *A NIGHT SCENE ON THE LAGOON.*

ONE of the most delightful and popular forms of entertainment at the Exposition was provided by electric launches and gondolas. There were several water carnivals and fete days, which brought the scores of crafts into service; but it was during the nights of summer that the boats were most largely patronized, and a more beautiful scene, in a frame of romantic investiture, has never been afforded in America. It was a reproduction of Venice. The splash of oar, song of the gondolier, music softly playing, and laughter of crowds afloat under the glare and dancing reflections of a million lights, composed a picture as exquisite as the surroundings were entrancing.




# LOUISIANA AND THE FAIR.

AN EXPOSITION OF THE WORLD ITS PEOPLE AND THEIR ACHIEVEMENTS.

J. W. BUEL, Ph. D.
EDITOR.

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# INTRODUCTION.

## VOL. IX.

By Frederick J. V. Skiff, Director of Exhibits.

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A MODERN universal exposition is a collection of the wisdom and achievements of the world, for the inspection of the world—for the study of its experts, by which they may make comparisons and deductions and develop plans for future improvements and progress. Such a universal exposition might well be called an encyclopedia of society, as it contains, in highly specialized array, society's words and works. It constitutes a classified, compact, indexed compendium (available for ready reference) of the achievements and ideas of society, in all phases of its activity, extending to the most material as well as the most refined. It offers illustrations covering the full field of social performance, from the production of the shoes on our feet and the pavement beneath them to a presentation of the rarest and most delicate creations of the brains and hands of men in what are classified as the fine arts of civilization.

The Universal Exposition in St. Louis in 1904, in celebration of the acquisition of the Louisiana Territory, was such a social encyclopedia in the most comprehensive and accurate sense. It gave to the world, in revised and complete details, "a living picture of the artistic and industrial development at which mankind has arrived," and actually provided "a new starting point from which all men may direct future exertions." It presented for the inspection of the public and its representatives—particularly for the inspecting and information of specialists in all lines of industrial and social endeavor—an assembly of the best which the world has done and has to show in industry, art, and science; and, what is very important, it offered these achievements of society, these trophies of civilization, in highly selected, accurately classified, effectively illustrated array.

The creators of the St. Louis Exposition had the experience of all previous great expositions by which to plan and effect its high organization. The continuous and repeated burden of the message of experience handed down by all expositions has been more perfect, more effective classification and arrangement of exhibits. Each exposition has left this present for its successor, and the advice has come down in increasing emphasis and with increasing significance to the present, with the result that it is now commensurately heeded. In the St. Louis Exposition everything made way for the most thorough and direct presentation of its assembled treasures.

Too much significance can not be attached to this characterizing feature of this latest Universal Exposition. An encyclopedia is valuable according to the degree in which it possesses two things—full and reliable information, and perfected arrangement and presentation of such information. In the first place, it must contain complete and authentic data on all subjects, and second, this data must be prepared and classified so as to be effectively presented and of easy access—available for thorough and ready reference. There is no need to call attention to the great importance, to the indispensable nature, of this last attribute in an encyclopedia. The same principle applies with even more force to expositions. Indeed, in so colossal a collection as a universal exposition its reference quality is the first important feature to be considered. The highest state of preparation and classification in expositions is absolutely required in order to render them practically available by the investigator. A visitor, to get full value of an exposition, must have the objects of his study so grouped and presented that he may apply himself directly to the examination of them without having to mentally assemble them, himself, from different parts of the exposition, and without having scattered about them objects of a miscellaneous nature which divert and distract the attention instead of furnishing necessary comparisons and resultant information on his subject.

The classification of an exposition, therefore—the method of the disposition and presentation of its exhibits, one of its vital features, which regulates, in fact, the degree of its effectiveness and success—records its value to the public and to society.

The classification of the St. Louis Exposition has been highly complimented by the exposition authorities of the world. It was so prepared as to present a sequential synopsis of man's development, or, rather, of the developments that have marked man's progress. On these bases was assembled the most highly organized and perfected exposition the world has yet seen—possibly the last of the kind to be submitted to the present generation.

The St. Louis classification was divided into 16 departments, 144 groups, and 807 classes. These grand departments in their order recorded what man has accomplished at this time with his faculties, industry, and skill, and the natural resources at his command in the environment in which he has been placed.

At the head of the Exposition classification was placed Education, through which man enters social life. Second, came Art, showing the condition of his culture and development. Liberal Arts and Applied Sciences were placed third,

Effort—*By Lourie.*

Force—*By Lourie.*

to indicate the result of his education and culture, and to illustrate his tastes and demonstrate his inventive genius, scientific attainment, and artistic expression. These three departments equip him for the battle and prepare him for the enjoyments of life. The raw material departments, Agriculture, Horticulture, Mining, and Forestry, showed how man adapts the forces of nature to his uses. The Department of Manufactures exhibited what he has done with them; the Department of Machinery the tools he has used; the Department of Transportation showed how he overcomes distances and secures access to all parts of the world; the Department of Electricity indicated the great forces he has discovered and utilized to convey power and intelligence. And so through the several departments to Anthropology, in which man studies man; and to Social Economy, which illustrated the development of the human race, how it has overcome the difficulties of civilization, and solved the great problems in which society is involved. Last was placed Physical Culture, in which man, his intelligence having reached the supreme point, is able to treat himself as an animal, realizing that his intellectual and moral constitutions require a sound physical body to prompt them to the proper performance of their functions.

Education was the keynote of the Universal Exposition of 1904. It was designed to teach all—but primarily and distinctly, as previously stated, the expert working citizenry of the country and the world—in all lines of human activity. Each department of the world's labor and development was represented at St. Louis, classified and installed in such manner that all engaged in or interested in such branch of activity might come and see, examine, study, and go away advised. Each of the separate sections of the Exposition was an equivalent of, or rather, was in actuality a comprehensive and most effective object lesson in the line of industrial and social achievement and progress which it presents.

In connection with and in addition to this, there was organized a system of universal congresses, which provided a direct academic accompaniment of the Exposition. Under most distinguished control, it held in St. Louis the most remarkable series of meetings that has been assembled for deliberative proceedings. Over 140 stated congresses, conventions and societies, acting upon their own initiative, decided to meet in St. Louis during the Exposition. These alone would insure a remarkable series of gatherings. But it was decided to hold one unprecedented international congress of arts and sciences, under the complete control and patronage of the Exposition. This particular congress, with perhaps one hundred sections, was the crowning feature of the Exposition. In it the great minds of all nations united in fixing the thought of this epoch. When informed of this undertaking, Emperor William spoke of it as a "World's University." While the exhibit of material things established the condition of our productiveness, these congresses

FIGHTING SEALS—*By Roth.*
FIGHTING POLAR BEARS—*By Roth.*

traversed the intellectual courses through which this yield has come, and from these reflexions pointed the way to achievements yet to be recorded. Such a result constituted a fitting appendix, indeed, to the great social encyclopedia represented by the material exhibits of the Exposition.

The occasion for a World's Fair—a presentation of the productiveness of mankind, at certain intervals of time—should not be ascribed to commonplace motives. It is not the act of individuals, nor of communities, nor of sections. It is rather the reflection of an educational revival or uprising influencing some great zone of civilization; individuals and communities being but the agencies employed. It is part of the Great Plan. And just as the glacial flow left the eternal evidence of its tremendous momentum on the imperishable rocks, so these great expositions leave their everlasting impression and vast influence on the progress of the ages and the development of the human race.

Broadly speaking, a universal exposition might be held on a prairie. The large city is important in just the degree that it can contribute to the comforts and convenience of visitors. But the locality of an exposition—a great exposition—is incidental. St. Louis was the locality of the Exposition of 1904, because at this particular point on the firing line of Western progress the forces of civilization found their most potent expression and greatest climax.

The results to the country are reflected in its increasing commerce, its improved international policies, and its higher and keener estimate of its relationship and responsibilities beyond its own domain. The yield to the world is in the universalizing of things, in the realizing of interdependence, in the growing "brotherhood of man and fatherhood of God."

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# DIVISION CXXX.

## Transportation Exhibits at the Fair.

By Willard A. Smith, Chief of the Department.

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The importance of transportation in modern life was first properly recognized by the World's Columbian Exposition of 1893, which established a department devoted to this subject. Since that time the example has been followed by all great expositions.

Transportation is the life of modern civilization. It is the circulatory system, without which it could not have come into existence, and the stoppage of which would cause stagnation and decay.

Modern methods of transportation, which have revolutionized the entire world, had their inception after the event which the Louisiana Purchase Exposition celebrated. The vast territory purchased by the United States in 1803 is now the heart of the republic. That it has become so rich and powerful a seat of empire in our country is due to the railway and steamship and their congeners. In 1803 the means of transportation in the Louisiana Territory were of the crudest kind, principally the flatboat and the pack horse.

To-day the same territory has 65,000 miles of railway, its rivers are traversed by great fleets, and the telegraph, telephone, and trolley wires are weaving a close network over its entire surface. The "unceasing purpose" of progress has had no better exemplification.

The exhibits in the Palace of Transportation showed the most advanced practice of to-day in railway building, equipment, maintenance, operation, and management, and also the history of the railway as developed during the less than a century of its existence, in all parts of the world. In order to give "life" to the exhibits in this department, arrangements were made to have the wheels of the locomotives turned by compressed air. A grand central moving feature was provided, which, being visible from all parts of the building, struck the eyes of the visitor the moment he entered any one of the sixty doors of the vast structure. A steel turn-table, elevated some feet above the level of the surface of the surrounding exhibits, carried a mammoth locomotive weighing over 200,000 pounds. The wheels of the locomotive revolved at great speed, while the turn-table, revolving more slowly by electric power, carried the engine around continuously. This moving trophy, emblematic of the great engineering force of civilization, bore the legend, "The Spirit of the Twentieth Century." Grouped around this central emblem, on the one hand, was a historical presentation by originals and models of the development of the locomotive, the car, and the track,

FIRST STEAM CARRIAGE IN ENGLAND, 1784.
"THE NEWTON" IDEA, 1680.

FIRST STEAM PROPULSION IN AMERICA, 1790.
FIRST STEAM MOVING LAND CARRIAGE, 1769.

from the earliest dream of invention to the wonderful realization of the present day. On the other side appeared the most advanced design and construction—a twentieth century exhibit.

Looking forward to more scientific methods than have yet been adopted anywhere, the Transportation Exhibits Department inaugurated a new departure in exposition work which attracted world-wide interest. This consisted in conducting during the entire term of the Exposition a series of laboratory tests of locomotives, in which all of the most interesting of modern European and American engines were tested for comparative efficiency. The time and place were most fortunate, because foreign and domestic locomotives were available as at no other time, and because the attendance and assistance of the leading mechanical engineers of the world were assured, thus making the tests truly international in character, and, it is believed, an epoch-making event. These tests were made additionally attractive by running a locomotive (or turning its wheels while the locomotive stood still) at the rate of eighty miles an hour, at a certain time each day. This locomotive laboratory constituted a portion of the great exhibit made by the Pennsylvania Railroad System.

The Baltimore & Ohio Railroad Company also made a grand retrospective and contemporaneous exhibit of intense interest and vast educational value. The old locomotives and cars were manned by lay figures of conductors, engineers, and firemen of the early days, affording a most picturesque effect. A very large model of the new passenger station at Washington, D. C., was also one of the features of this magnificent exhibit, which brought into juxtaposition the embryotic ideas of a century ago and the most advanced practice of to-day.

The electrical railway was represented in this department by cars, tracks, etc.; while the electric motors and appliances were exhibited in the Department of Electricity. Along the northern line of the Transportation Exhibits Building, traction systems were shown in operation on a double track, one-quarter of a mile in length.

There were two trains of the finest passenger cars ever built by the Pullman Company, and these were rivaled by those of other great builders in foreign countries. There were more than forty modern locomotives of American, Canadian, French, and German construction, including two of the largest locomotives ever built. Every variety of freight construction and work cars was represented, great prominence being given to the most advanced steel construction. Track and structures, together with all the appurtenances and appliances relating thereto, enabled the tyro or the foreigner to study and understand fully American ideas and methods. The State Railways of Germany used a large out-of-doors space for a track exhibit, showing systems of terminals, switches, signals, etc.

The carriage building industry (with its concomitants, saddlery, etc.) was accorded generous consideration. Automobiles and motor vehicles, which have come into such extensive use since the last World's Fair in this country, and have already given birth to and developed a vast new industry, afforded one of the most novel and popular attractions of the Exposition. The best makers of France, Germany, and Great Britain competed with American builders, occupying a vast space with a magnificent display. While pleasure vehicles naturally occupied a considerable portion of the space, especial attention was given to heavy motor trucks for general commercial purposes, and to independent motor cars for use on railways.

A large and convenient reading-room was provided for exhibitors, which was furnished with a library and also afforded headquarters for the technical press. A beautiful kiosk was used by the railway companies, as a joint ticket office and bureau of information.

Some of the most interesting features of the Department of Transportation Exhibits were in the Marine section. The models of the famous Bureau Veritas of the Louvre Museum, in Paris, which illustrate the development of naval architecture for the past three centuries, were shown for the first time at any exposition; also the magnificent boats which form a part of the Armeria, the well-known museum at Madrid. The British Government made a complete collection of models of steamships, men-of-war, and their exhibits in St. Louis were much more extensive than the ones in Chicago. There was also a complete set of models illustrating the inland transportation of India. The International Mercantile Marine Company occupied a large space, and made a complete exhibit of models of boats of their line as well as other features illustrating the passenger traffic of the Atlantic. One of the most interesting features was Dr. Bircher's War Museum, from Aarau, Switzerland, which illustrated by relief maps the strategy of all American wars, both on land and sea. In the American section of the Marine division there were full-rigged yachts, boats of all descriptions, and a complete historical exhibit of the water transportation of the Mississippi River; also a model of the port of New Orleans. In the German section was exhibited a model of the port of Hamburg, showing the vessels of the North German Lloyd in dock, and one by the German Government of vessels and models which gave an exposition of the development of naval architecture. Among this collection was shown a number of models of old battleships of the line, and the earlier vessels used by the Hanseatic League. The modern methods of transportation in Japan were exhibited in connection with models of her navy yards, docks, men-of-war, and merchant vessels.

Recognizing the progress made toward solving the problem of aerial navigation, and the possibility, if not the probability, of remarkable achievements in the air, the Exposition offered a grand prize of $100,000 to the airship which should make the best record over a prescribed course, marked

"THE SANS PARIEL," 1829.
"THE TREVITHICK," FIRST MOVEMENT ON RAILS, 1803.

"THE ORUKTOR AMPHIBOLUS," 1804.
"THE SEQUIN," 1828.

by captive balloons, at a speed of not less than twenty miles an hour, in addition to which there were other prizes, aggregating $50,000 for balloon races, altitudes attained, and for distances of flights made by aeroplanes.

Several entries were expected, and for several months the hope was great that many kinds of dirigible balloons would be in competition, but while a half dozen balloons were brought upon the grounds, none of the applicants fully qualified under the rules and the results of the contests were disappointing. Successful flights were made, however, by the Baldwin airship, which served to attract immense crowds to the grounds, and while speed and control of the ship showed no improvement over air navigating crafts that have made successful ascensions, in France, particularly, there was the interest of novelty in Baldwin's flights that has greatly stimulated efforts of inventors in this country to devise a commercially practicable, steerable, and safe air-sailing vessel. In this respect the advertised airship contests at the Louisiana Fair may be said to have been highly beneficial, even though disappointing the enthusiasm of the millions who had expected a perfect demonstration.

## DIVISION CXXXI.

### A History of the Art of Transportation.

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We come finally, in the natural sequence of Exposition history, to consideration of the remarkable showings of exhibits that evidence industrial progress of all participating nations, by which both evolution and achievement in all the fields of commercial development are objectively and impressively illustrated.

It has been noted in preceding volumes how man has cultivated the educational faculties; how from a condition of savagery little above that of the beasts, a cave dweller, a superstitious vassal of nature, a shaggy, unkempt, and almost defenseless creature, man advanced gradually, sometimes imperceptibly, along the highway that leads out of the bondage of primitive ignorance and has finally, through growth of apprehension, gained the lofty plateau of present civilization.

Man achieved much when he contrived to fashion a hoe; when he learned to cultivate the soil; when he mitigated the harshness of his environment and thus began the march that ambition inspired with higher ideals pointing the way. But while his first and most substantial victory was obtained

THE "BLUCHER," 1814.
OLD "IRONSIDES," 1832.

THE HEDLEY MODEL TO DEMONSTRATE TRACTION, 1812.
THE "PUFFING BILLY," 1813.

through the invention of means of producing fruits for his subsistence, the greatest step forward towards civilization was, we must believe, discovery and application of the art of navigation and transportation. Without this means man was confined to limitations that not only restricted communication, but isolated families, or clans, and made the efforts of one alien to those of another.

As man learned to decorate his habitation by noticing colors exuding from banks that betrayed the presence of minerals, so he must have received a suggestion of the possibility of navigating streams by seeing logs drifting upon the surface. It may have been awkward to make the first effort to cross a body of water by sitting astride the floating trunk of a tree, and propelling with a pole or improvised paddle, but it was none the less a beneficent discovery, for development follows rapidly when the rudiment is acquired.

In several countries, rushes have been used for making the frame-work of small, tub-like boats, the covering of which was of skins, and mineral pitch was also used for a like purpose by troglodytes along the Red Sea. When Julius Cæsar invaded Britain, 55 B. C., he found the people accustomed to the use of coracles, boats fashioned in the manner described and which, being capable of supporting only a single person, were so light that it was an easy thing for a man to remove one of them from the water and carry it away on his back. Vessels of this kind are still in use among Welsh fishermen, and it is extremely interesting to know that boats of an identical character were very commonly used by North American Indians a hundred years ago. From the fact that figures of coracles are to be seen on some of the oldest pieces of stone sculpture that have been resurrected from the graves of antiquity, belief is very generally shared that this was one of the earliest, if not indeed the first, type of boat built by man.

When fire was discovered, no doubt primitive man employed it in hollowing out logs so as to form a canoe, for he must have very soon ascertained that the buoyancy of a log was very greatly increased by excavating and fashioning it into a manageable craft. Equally natural was it for primitive man, who saw the force of the wind, to employ it as a propelling agency, his first attempt in this direction probably being by fixing a heavy bush in the bow of his canoe, that would catch the breeze, as I have myself done, when a boy, on the Ohio River.

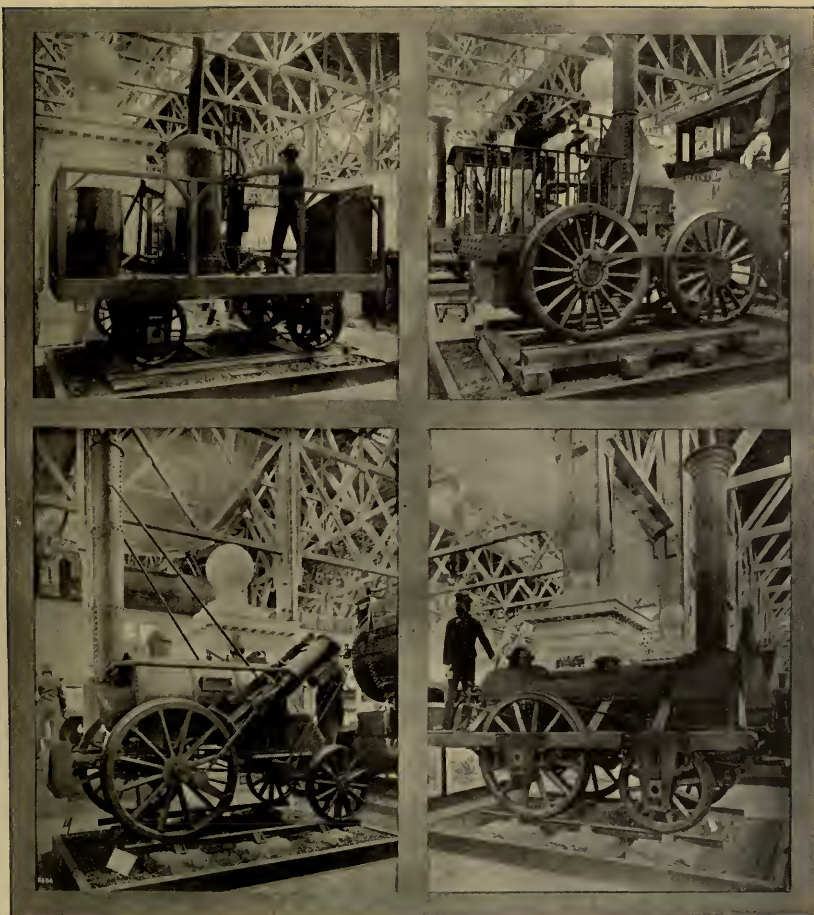
The progressive steps of navigation can not be followed except by inference, but these appear to be plain up to the time at least when men began to build boats for commercial and war purposes. So, passing over the intermediate steps, we arrive at that point in history which affords us more or less certain knowledge of maritime peoples and how they made and propelled vessels.

The ark, though built thousands of years ago, represented the art of boat construction after it had attained to a high degree of excellence, but it is the earliest description of which we have any certain record. Passing from sacred to profane history, we find that the most ancient monuments, paintings, and sculpture of Egypt show boats of large size that were built of sawed lumber, and often highly ornate, especially in the bow and stern, which were propelled by both sails and oars. Such vessels were usually of considerable length and were made to carry at times as many as 1,000 persons, though more commonly their capacity did not exceed fifty or one hundred. The principal means of propulsion was by oars, and in order to provide places for as many rowers as possible the superstructure of the vessels was built in a series of decks, or banks, called galleys (or galleries)—whence the name applied to the boat itself—from each one of which projected rows of long oars so heavy that from two to seven men were required to swing them. These vessels were rated according to the number of oars they carried. Thus a bireme was a ship with two banks of oars, the trireme was one with three banks of oars, the quadrireme had four banks, etc. Again, the trioconter was a vessel of thirty oars, the penteconter, one of fifty oars, etc. It is said, though the statement is not one to be readily believed, that Ptolemy Philopator of Egypt built a vessel of such enormous size that forty banks of oars were needed to drive it through the water, and that it carried an army of 3,000 men, together with horses and provisions. The operating of more than three rows of oars would be a wonder and the carrying of forty banks would not fall short of a miracle.

Galleys were at first used for coast trade purposes, but later they came into service for conducting war on the sea. The Greeks employed them extensively, their war vessels usually being provided with a single line of rowers on a side, aided by one or two square sails made of linen or papyrus. The Romans used triremes, which, being long and narrow, were driven at great speed. After a time it came to be the rule to equip the galleys with iron beaks for ramming, and towers were built in the center from which archers shot their bolts down upon those exposed on the decks of the enemy's vessels.

The labor of rowing was so arduous that it was usually performed by prisoners of war, slaves, and criminals. The practice obtained in some countries of condemning malefactors to the galleys, and when in time of war voluntary labor was difficult to obtain men found guilty of even minor offenses were forced to pay the penalty of their sentence by service as rowers.

The Phœnicians are credited with being the most expert seamen, who as early as 600 B. C. obtained mastery of the Mediterranean and accomplished a circumnavigation of Africa. To them discovery of the art of sailing is also ascribed and it was no doubt in their wars with the Greeks that the latter learned their first lessons in navigation. Their first ships were probably large in size but so badly con-



"THE TOM THUMB," 1829. "THE BEST FRIEND," 1830.
"THE ROCKET," 1829. "THE MERCURY," 1830.

structed that to give them strength to withstand the strain of surging seas their vessels were bound around with heavy ropes, and later chains were substituted. It was also from the Phœnicians that the Romans acquired the art of building sea-going vessels, and by so doing were able at length to obtain mastery of the Mediterranean and to destroy utterly the Phœnicians as a nation.

Notwithstanding, navigation was so well understood by Greeks, Romans, Egyptians, Persians, Norsemen, and Phœnicians, five hundred years before the beginning of the Christian era, that European seas were flecked with numerous crafts used for both war and commercial purposes, and even in the time of Solomon (1,000 B. C.) vessels brought timbers, gold, and marble from Africa for building the temple, the very remarkable fact remains that the art seems to have been practically lost during the next thousand years succeeding. At least it may be said that the first merchant ships using sails were built by the Genoese in the fourteenth century, and thence navigation spread and developed so rapidly that one hundred years later Spain, Portugal, and England were disputing supremacy of the sea and conducting many voyages of discovery. This brings the history of navigation down to modern times and renders it appropriate here to state that the first ocean vessel constructed in America was a two-master named *Virginia,* built at the mouth of the Kennebec River, Maine, in about the year 1612. She was sixty feet long, had eleven feet of beam, and ten feet depth of hold.

Rapid development of navigation was due to the following discoveries and inventions in the order named: The mariner's compass, which is said to have been known to the Chinese 1200 B. C. and brought from Cathay by Marco Polo in the year 1260, though the Italians claim the invention for Flavio Giojo, about 1320; Mercator's chart, 1569; Wright's tables of meridional parts, 1597; Davis' quadrant, 1600; Gunter's application of logarithms to nautical calculations, 1620; introduction of middle latitude sailing, 1623; Norwood's measurement of a degree on the meridian, 1631; Hadley's quadrant, about 1725; Harrison's chronometer, 1764.

Canals were first built for irrigation purposes and afterwards enlarged and used for inland transport, the earliest mentioned in history being of one that connected Babylon with probably Nineveh, 600 B. C. The first canal constructed in America was at South Hadley, Connecticut, around Turner's Falls, 1792. Canals multiplied in the United States and were extensively used for both freight and passenger traffic until they were superseded by the railroad and steamboat.

The first steamship that crossed the ocean was a paddle-wheel named the *Savannah,* which sailed from the City of Savannah with a cargo of cotton for England in 1819 and accomplished the passage in twenty-eight days. The

"THE JAMES," 1832.
"THE CAMPBELL," 1837.

"THE ATLANTIC," 1832.
"THE EXPERIMENT," 1832.

first regular line of steamers (the Cunard) was not established, however, until 1840. A history of steamboating appears in Volume III.

It will be understood without an explanation that an exhaustive history of transportation is neither practicable nor necessary in a work of this character, which should be confined to presenting only salient features that will enable the reader to better understand the steps of progress and to thereby more thoroughly appreciate the efforts that brought forth the examples of finished work displayed at the Exposition.

Having very hastily sketched the beginning and development of navigation, a similarly cursory description of the evolution of the railroad, by which civilization as well as commerce has been powerfully promoted, should follow. Even so short a while as a century ago, which is within the compass of a single exceptionally long life, the world appeared, so far as communication is concerned, as large almost as the planetary system, whereas to-day, by use of the steamship, railroad, cable, wireless telegraphy, and telephone, all the nations have practically been condensed into a neighborhood; space has literally been annihilated and we are kept as well informed respecting events in the antipodes, or wherever the telegraph reaches, as of those transpiring in our immediate surroundings.

The steamship brought nations into a degree of interdependence, by exchanging the products of one country for those of another, but the railroad has essentially developed the potentialities of nations and by so doing has infinitely enlarged the means and the comforts of living. An outline history, therefore, of the application of steam to overland transportation, the inception and improvement of the locomotive, is not only interesting, but should be a part of every intelligent person's education.

Of the many splendid, and often remarkable, exhibits at the St. Louis Exposition there was nothing more instructive, and few things more educational, than a display made by the Baltimore & Ohio Railroad Company of the successive steps, from initial effort, taken in the ambition of inventors to utilize the force of steam for overland transportation. The problem was recognized many years before its solution was attempted; men dreamed of methods as they drove lumbering carts over highways obstructed by deep mire and large stones; many minds were quickened to conceive more facile means than the panniered donkey, the palanquin, the ox team, the human carrier, the pony express, the wagon, but while concepts were numerous, ages passed without producing better ways, and the world's commerce continued to move at the pace of an animal's walk, and if we sought for speed the greatest was found in the sailing vessel. It seems amazing to people of to-day that two months should ever have been required to cross the ocean, or that the same time was spent in traversing the United States from New York to San Francisco. Little wonder that commercial development was slow, since it is compelled always to keep pace with the means of transportation; conversely the world's industry and wealth are now increasing at an astonishing rate because peoples who formerly were separated by great distances are afforded facilities to effect a quick exchange in what may be called a universal market.

While much credit is due the several railroad companies that made expensive displays at the St. Louis Exposition, by which the safety and luxury of modern railway travel were intelligently and almost seductively demonstrated, the largest honor belongs to the Baltimore & Ohio corporation for such an exhibit as the world never before was able to behold. The inspiration that led to such a display, with the enormous expense which it involved, was certainly more ethical than politic, an ambition to create general interest rather than a design to secure public patronage, for one can not readily see the advertising value of a museum of relics, especially to a railroad company, that is usually supposed to be only concerned with practical utilities, looking to the betterment of physical properties and facilities.

So, by natural inference, crediting the B. & O. with a higher purpose than an expectation to realize on the exhibit as an enterprise, the public, and lovers of the historic particularly, have reason to be thankful for the opportunity given to understand, through practical lessons, the steps of evolution, from beginnings, of the railroad industry, to which development of the nation is most largely due.

The B. & O. occupied 62,000 square feet of space in Transportation Building with an exhibit that included examples of nearly every type of machine ever devised for propulsion by steam on land. It cost an almost incredible sum of money to make the collection, but *carte blanche* was given Col. J. G. Pangborn to search the world for old locomotives and to buy the originals whenever possible, or to have duplicates made in every case where the original could not be acquired. In executing this commission Colonel Pangborn spent several years prosecuting his searching investigation and with such excellent results that he accumulated a museum which is more complete and valuable than any other of its kind in the world. In a majority of cases the original, engines, ties, and rails were secured, but when it was necessary to have reproductions these were made with such faithfulness to details as to be in every instance the most exact and perfect counterpart of the original.

Historic accuracy being a prime consideration with the collector, in order to show each machine as it actually appeared in service, lay figures of plaster were prepared, which, being clothed in the dress of the respective country and period, gave a *vrai semblance* to the showing, as of engines being operated by real men. This feature added marked interest to the display as a retrospective object lesson, and the photographs which are reproduced in this volume have a corresponding value, since the picture always presents a clearer understanding than any verbal description can do, and these are all made from the B. & O. display.

If we may rely upon statements that have become a part of history in one country, disregarding what passes for fact in another, credit for the initial effort of applying steam to a road vehicle must be given to Sir Isaac Newton, that very wise man who, through being hit upon the head by a falling apple, discovered and first promulgated the law of gravitation. Every first effort to accomplish a great purpose has about it not merely awkwardness, clumsiness, but most frequently the attempt is positively ludicrous. Nothing, however, in all the concepts of an inventive mind was ever more ridiculously absurd than Sir Isaac's theory of steam propulsion on land. His idea he put into effect in 1680 by constructing a canister, or large carboy-like copper vessel set on wheels, with a fire-box beneath and a spout projecting behind, closed by a valve that was controlled by a driver who sat upon a front seat. The belief—grotesque as it certainly was—that actuated Sir Isaac was that, steam having been generated and allowed to escape through the opened valve, the force of the jet striking against the atmosphere would drive the carriage; upon the principle, perhaps, of a man sitting in a boat and giving it propulsion by working a bellows against the sail. It failed to work.

The first practicable machine ever moved on land by steam was built by a Frenchman, Capt. Nicolas Cugnot, in 1759, who devised a road wagon, which is better understood by the picture than any description can afford. Being a military man, Cugnot's prime purpose was to build a machine for hauling artillery, and thus doing away with horses, which offering a target to the enemy often endanger a battery. The machine was tested in the streets of Paris and moved with so much unexpected celerity that it ran upon the sidewalk and committed such a lot of damage that the unruly monster was condemned and has ever since had a resting-place in a Paris museum.

Every one is supposed to know that James Watt, a mathematical instrument maker, is credited with being the first person to discover and apply the force of steam. This credit is so undeserved that his discovery was quite two thousand years old when Watt was born, for Hero, in his "Pneumatica," certainly as early as 100 B. C., describes a steam turbine, steam boilers, and steam fountains.

But though some experimental applications of steam had been made a long while before the time of Watt, nothing of great practical importance was accomplished, so far as history records. In 1764 he took out a patent for an improved steam engine in which was applied for the first time the means for condensing steam in a separate receptacle, whereas before it was the practice, in building engines, to use the cylinder as a condenser. The effect of introducing a jet of cold water directly into the cylinder was to diminish the steam supply and thus necessitated the use

"THE HERCULES," 1837.
"THE SANDUSKY," 1837.

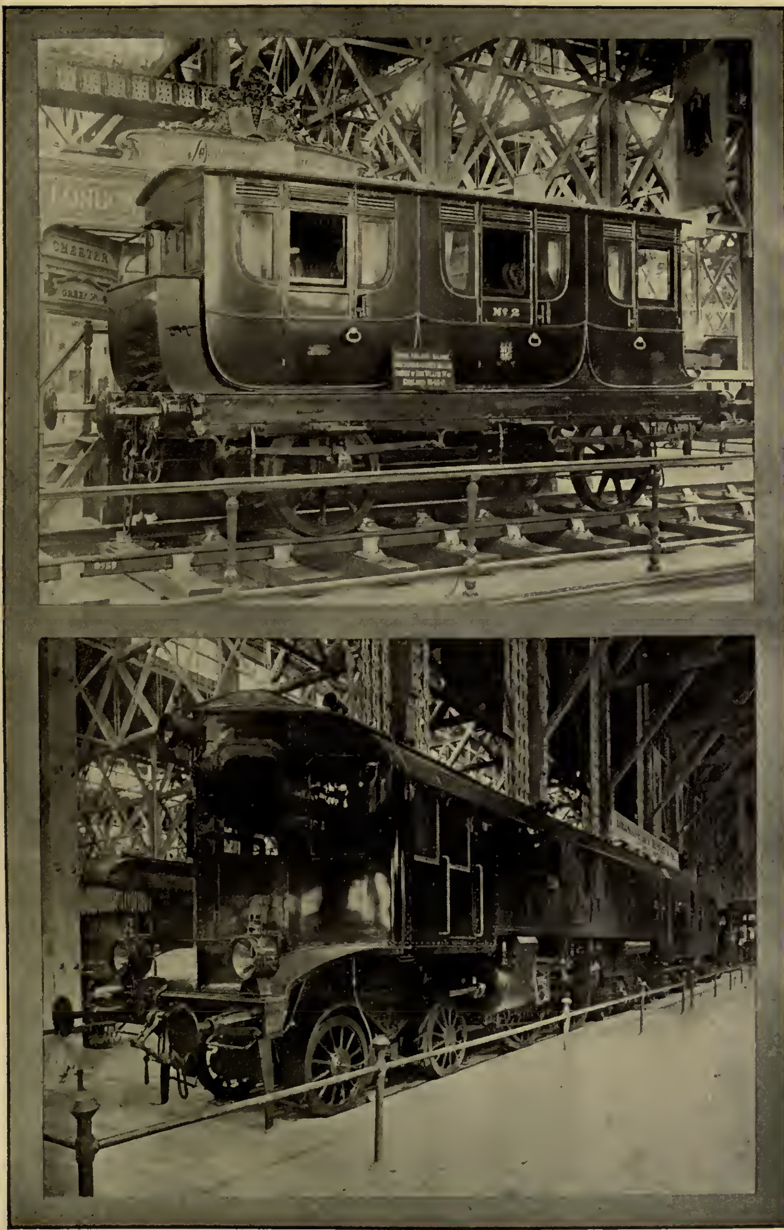
"THE BUFFALO," 1844.
"THE LAFAYETTE," 1837.

of a cylinder of extraordinary size. Watt accordingly devised a boiler to obviate this objection and at the same time to give greater continuous power to the cylinder. Watt afterwards became associated with Matthew Boulton, a Birmingham manufacturer, and made several improvements in steam engines, but though he became a successful manufacturer he was such a stubborn adherent to the theory of low pressure that he regarded all attempts to introduce high pressure as being inspired by criminal recklessness. In pursuance of his ambition, however, to employ steam as a substitute for horses, he devised a steam road-wagon, the boiler of which was constructed of wood and restricted to a pressure of eight pounds to the square inch.

In Watt's employ was an unusually competent and ingenious mechanic named Murdock, who notwithstanding his employer's bitter prejudices, managed, by working at night, to produce a working model of a high pressure engine, which he operated on the highway after dark. On one occasion, the third time, in fact, that the machine was put to actual service, while Murdock's engine was lumbering along the road, spouting sparks and giving other signs of diabolism, he was met by a pious parson, who in the indistinctness of the night seeing the blazing eye and hearing the snorting felt convulsed in soul at what he was certain must be the devil, seeking whom he might devour. With shriek and yell the affrighted parson broke through the brush and thus throwing the evil one off his track soon aroused the neighbors and exhorted them to flee from the wrath that was at hand. It thus came to pass that Murdock's engine was brought into prominence in 1784 and led to the passage of a law by Parliament restrictive of the use of high pressure engines. But the fact remains that Murdock's spitting devil was the first steam locomotive in England.

It is very interesting and no less stimulating to our pride to know that six years after Murdock's disastrous night ride that condemned his vehicle, Nathan Read, of Salem, Mass., built a steam road-wagon that ran with a speed of five or six miles over the very rough highway and was able to climb hills of a five per cent. grade. Even more important is the fact that Read was the first person to use a multi-tubular boiler, an advance step in engine construction of incomputable value. That his machine was a success and contained infinite possibilities there can be no doubt, but instead of prosecuting the advantages that opened before him as an inventor, the popularity which his road-wagon brought him created political ambitions that led to his election to Congress, which closed his career, so far as history discloses.

Oliver Evans was the natural successor of Read, and seems to have seized the opportunity to profit by the experiment of the Yankee by applying the principle and invention of the multi-tubular boiler to a combination road-wagon and steamboat, which he called the *Oruktor Amphibolus*. It was




QUEEN ADELAIDE'S COACH, 1842.
12-WHEEL, 4-COUPLED, TRIPLE CYLINDER GERMAN ENGINE.

in 1804 that he obtained from the Philadelphia Board of Health an order to build a machine for cleaning the Delaware docks. In executing the order he constructed at his works within a few squares of the Schuylkill an awkward scow in which a double-flued boiler was placed, to the fly-wheel of which a crank was attached that was made to serve a two-fold purpose, viz.: to drive four wheels when the scow was on the ground and to operate a stern-wheel when it should be placed in the water. This crude, ungainly hybrid was actually driven through the streets of Philadelphia and into the Schuylkill, where upon being floated it continued under its own motive power to the Delaware and thence up that stream to the foot of Market Street, where it was successfully used for the purpose for which it was intended.

About the time that Evans was building his amphibolus, a Cornishman named Richard Trevithick, despite the rabid opposition of Watt and the restrictive laws of Parliament, built a high pressure engine which he supplied with drive wheels fitted with cogs working upon two others from a fly-wheel, and a piston in front. With this machine he operated a tramway with two cars in South Wales and hauled the first train that was ever drawn by steam on land. The rails were laid on stone sleepers and the success of this initial experiment led directly to the introduction of the railroad for commercial purposes. Trevithick, and not

George Stephenson, must therefore be considered the father of the railway.

But remarkable as Trevithick's locomotive appeared at the time, it was a cumbersome affair that really looked no more awkward than was the means of operating it. The valve-gear consisted of two levers fastened to an arm on the piston rod which reversed the valve at each stroke; therefore, to reverse the wheel motion it was necessary for the engineer to climb down from his perch and reverse the position of the valve-rod by hand from the ground. The wheels, too, were flat, and therefore to prevent the locomotive from leaving the track the rails were deeply flanged on the outside.

Trevithick's tramway worked very well on a level track, hauling a light load, but there was universal doubt as to its practicability for heavy traffic, belief being general that smooth wheels would slip on a smooth rail. William Hadley was one Englishman who held to the opinion that there would be sufficient adhesion in a heavy locomotive to pull almost any required load, and to demonstrate his belief in 1812 he constructed a large flat car with four wheels, to each one of which he attached a crank to be operated by hand. Then connecting several loaded cars to the flat car he set four men to the work of turning the cranks, by which experiment he was able to determine the relations between the weight of a locomotive and its train. Having satisfied himself as to the correctness of his theory, Hadley built a locomotive which he called the "Puffing Billy," which was driven from vertical cylinders connecting with gear wheels on each axle, which in turn were driven by a gear wheel in the center of the crank shaft. This engine further demonstrated Hadley's theory of adhesion and was operated for a considerable time.

In 1812 appeared the Brunton engine, a heavy contrivance called the "Mechanical Traveller" or the "Horse Leg Locomotive," which was the first constructed for practical operation, and also the first locomotive provided with flanged wheels that ran on strip rails laid on stone stringers.

Following fast upon the experiments of Hadley and Brunton came George Stephenson with "The Blücher," in 1814, which showed some improvements over its immediate predecessor and was run successfully for several years on a colliery road. The one new feature that distinguished this engine was a cross walking-beam that was continued on all types of locomotives for several years.

So well did Stephenson's locomotive satisfy requirements that no very pronounced improvements were made until about 1820, when there was renewal of efforts to produce an engine that would give greater efficiency, show increased speed, and effect a saving in fuel. Competition became so sharp that in 1829 a public trial was announced, open to all locomotive builders who desired to enter engines for the test. This famous Rains Hill or Liverpool and Manchester Competitive Exposition brought a considerable number of locomotives into the field, including the "Sequin," the first multi-tubular, built in 1827; the "Sans Pareil," built in 1829 by Hockworth to determine the usefulness of the blast pipe, and "The Rocket," which latter was the entry made by George Stephenson, provided with a multi-tubular boiler with an exhaust in the stack. The "Rocket" won the prize.

About the time of the Rains Hill trials, 1829, the first locomotive that ever appeared in America was imported from England, and was called the "Stourbridge Lion." It ran for a while on a coal tramway at Honesdale, Pa., doing very good service, but, weighing five tons, was too heavy for the strap iron rails. In the following year Peter Cooper built the "Tom Thumb," which was the first locomotive constructed in America and which performed the then almost incredible feat of drawing a car filled with directors of the B. & O. R. R. from Baltimore to Ellicott City, a distance of thirteen miles, in one hour twelve minutes, against a grade of eighteen feet per mile. The return trip occupied fifty-seven minutes.

The second locomotive built in America was the "Best Friend," constructed at the West Point foundry, 1830, for the South Carolina railroad. It exploded, but was rebuilt in 1831 and called the "Phœnix," and was run for several years.

Thereafter building of locomotives in America became a distinct industry, necessary to meet the demands of railroads that now began to multiply in the East. "Old Ironsides" represents the first product of M. W. Baldwin,

"THE PEPPER-SAUCE," MOUNTAIN CLIMBER, 1863.

FATHER OF THE CAMEL TYPE, 1848.

"THE PERKINS," FIRST TEN-WHEEL PASSENGER, 1863.

FIRST ENGINE IN CUMBERLAND VALLEY, 1851.

founder of the Baldwin Locomotive Works, and this famous old engine, made in 1832 and run for twenty years, is still in existence, capable of service, but is now a curiosity carefully preserved in the B. & O. Museum.

"The James," which had upright cylinders, was made in 1832, the first engine equipped with the link motion for reversing. In the same year was built the "Atlantic," which holds the record as the oldest original locomotive in the B. & O. collection, and hence the most aged in America. This remarkable engine was in continuous service on the Pennsylvania road for more than sixty years, and was not retired until placed on exhibition at the Chicago Exposition. That it might appear true to conditions as they existed at the time of its building, the engine rests upon rails bolted to blocks of stone.

In 1832 was also built the "South Carolina," which had the distinction of being the first eight-wheel locomotive, and the first double-ender, which avoided the need of a turntable, for the engine was capable of moving with equal speed and safety in either direction. In the same year was produced the "Experiment," which was the first locomotive provided with a bogie, or forward truck that turns easily upon its swivel bearings.

The "Campbell" made its initial appearance in 1837 and has come to be known as the father of the American standard type of eight-wheel locomotives. In the same year the "Sandusky" was built for the Sandusky Railroad, the first locomotive ever seen west of the Ohio River. The importance of this engine was so great that by act of the Legislature of Ohio railroads built within the State were required to conform in gauge to that of the "Sandusky."

1837 was a year somewhat famous for departures from the theretofore common types of locomotives, in which very marked improvements were shown. Thus the "Lafayette" was the first six-wheel engine to appear on the B. & O. road, and the first type to be exported, and the "Hercules" was the earliest with equalizing frames and levers, but which retained the tall steamboat smokestack, which was necessary until the forced draft was invented. What was known as the "Rogers First," also built in 1837, was the first counterbalance engine.

One year earlier, or in 1836, the first locomotive was seen within the Louisiana Purchase Territory. It was built in England, 1834, and having been imported it was put into service on the Natchez & Hamburg, Miss., line. After two years the engine, for some reason, was cast aside and continued in disuse until 1878, when it was overhauled and put to work on the Brookhaven & Natchez line, where it ran until 1890. The "Mississippi," as it was called, was the first locomotive to have a cab.

The "Jefferson" appeared a little earlier, 1835, and was the original of what is known as the grasshopper type and continued in service for a period of fifty-eight years.

The "Pioneer," which was built by Baldwin in 1836, was the first locomotive to enter Chicago. Having been transferred from the East by lake steamer to run on the Galena & Chicago Union railroad, it did not make its first trip over this line until October, 1848, and the 10th day of that month and year is accordingly a memorable date in the history of that now great metropolis.

The "De Witt Clinton," of 1831, is one of the best-known locomotives, having figured much in history as the first locomotive to draw a train of cars in the State of New York. The cars were, in fact, identical in size and appearance with horse-drawn coaches, such as were in use in England and also for a long time in America for overland travel.

The camel-back type, of 1848, is the pioneer heavy draft locomotive. Its prominent features are eight coupled drivers, large horizontal cylinders connected to a third pair of drivers and a very large dome with a covered platform above the center of the boiler, which latter gives it the name "Camel-back."

The tendency, it will be seen, has been toward greater weight in order to increase the traction power, until there have been evolved engines from 25,000 pounds to leviathans of 240,000 pounds, and a corresponding increase appears in the capacity of cars. In 1853 appeared the Mason type, a trim, neat, symmetrical engine not very different in appearance from the prevailing style of locomotives of to-day but in size it bears comparison with the large engines now in use as a pigmy to a giant. Ten years later an important step was taken by the building of a heavy grade ten-wheeler in Baltimore, called the "Perkins," for not only did it show an enormous increase in size, beyond any attempt previously made, but the locomotive preserved the graceful outlines of the Mason type. In the same year the "Peppersauce" was produced, which was the first mountain-climbing engine, built especially for a road laid from the foot to the summit of Mt. Washington.

We are now brought down to what most of us, perhaps, are pleased to call modern times, but the changes which mark the styles and capacities of locomotives have been almost as great in the past thirty years as those that distinguish the preceding quarter of a century. As an illustration, that becomes an object lesson to the observer, of how great has been the change, the Baltimore & Ohio exhibited the "600," a mogul passenger engine that created much interest at the Philadelphia Centennial Exposition, where it was shown just before being placed in commission. The "600" was the heaviest passenger engine in the world at that time, weighing probably fifty tons; a wonder in size and noted for remarkable speed, forty miles an hour. Near the famous "600" was the "Director General," shown at the Columbian Exposition, a Vauclain four-cylinder compound locomotive weighing 122,780 pounds, and capable of a speed of nearly sixty miles an hour. People almost held their breath when they first saw this Brobdingnagian greyhound at Chicago, and when it swept by in actual service the very earth felt unstable under the power that shook the ground and left hurricanes in its wake. There was, however, at the Chicago Exposition, a larger engine than the "Director General," but it was designed exclusively for freight service. It was what is known as the "Decapod," or ten-wheeler, and weighed 195,000 pounds, which was considered at the time entirely too heavy for practical service. In comparison with this latter must therefore be placed the largest freight engine exhibited by the A., T. & S. F., which had a total weight of 287,240 pounds, and the wonder-compelling "Mallet Mountain Climber," shown by the B. & O., the greatest engine ever constructed, and which, weighing the astounding total of 334,500 pounds, seems to be the limit of practicability; that no rails could be drawn sufficiently large to withstand the pounding which the rapid moving of such a weight would subject them to, and that no road-bed could be laid strong enough to prevent unequal settling under so great a strain. This amazing body of articulated steel, of flexible joints, of ponderous size and personified power, was supplied with a boiler, the largest ever constructed, provided with tubes which, if laid lengthwise, would reach a distance of nearly two miles, carried a steam pressure of 235 pounds to the square inch, and had injectors with a capacity of 5,000 gallons per hour. Yet despite weight, size, and complicated structure, so perfect was the distribution and adjustment of parts that the locomotive was as easily handled as a switch engine, and in no instance on the journey westward was any difficulty experienced, whether as to track, crossing, switches, or bridges.

But even more wonderful, though somewhat smaller, was Locomotive "3000" placed on exhibition at the Exposition by the N. Y. C. & H. R. Railway. The Mallet type shown by the B. & O. was a freight engine designed for pushing principally on the heavy mountain grades of Maryland and West Virginia, whereas the "3000" was a passenger locomotive built to draw the Empire Express, said to be the fastest train in the world. The weight of engine and tender is 321,000 pounds. It is a four-cylinder balanced compound type, capable of a sustained speed on a level track of eighty miles per hour, and which under special conditions is able to increase this rate to 110 miles per hour. To better appreciate the development of passenger service engines it will be helpful to recall an historic incident with which all should be familiar, and which is told in the following language:

As long ago as 1811 Chancellor Livingston, who was associated with Robert Fulton in the invention of the steamboat, received a letter from some "wild, harebrained individual," asking his opinion of the practicability of railroads. After giving the matter due consideration the worthy chancellor replied that, besides being too dangerous, it would be impossible to build rails that would "sustain so heavy a weight as you propose moving at the rate of four miles an hour on wheels."

It was twenty years later that steam travel by rail be-


B. & O. "600," EXHIBITED AT THE PHILADELPHIA EXPOSITION, 1876.
AMERICAN COMPOUND TYPE, EXHIBITED AT CHICAGO, 1893, WEIGHT 102 TONS.

came a reality in New York, but Mr. Livingston, unfortunately, did not live to see his prophecy overturned.

On a warm morning in August, 1831, the "De Witt Clinton" train, which had been tested for a month, puffed proudly out of the Albany station on its first regular trip over the Mohawk & Hudson Railroad. In spite of the discomforts, in the shape of cinders, sparks, and smoke, which they were obliged to endure, fourteen passengers made the round trip from Albany to Schenectady on the "flyer." It is reported that the sparks from the little wood-burning locomotive were so thick that the passengers were compelled to raise their umbrellas. Naturally the cloth coverings soon caught fire and the enthusiastic travelers were nearly incinerated before the journey ended.

Soon after the first trip, which was considered highly successful, the Mohawk & Hudson Railroad established a schedule or time-table, and undertook to make the run from Albany to Schenectady at a rate of about fifteen miles an hour.

The phenomenal speed which the "Clinton" sustained created much more wonder and comment at that time than does the sixty to eighty mile an hour gait of the modern express train to-day.

Of the several exceptional, remarkable locomotives shown at the Exposition, the strangest, in the matter of appearance, was one built by Henschel & Son of Cassel, Germany, which may be described as a twelve-wheel, four-coupled, triple-cylinder express engine, capable of hauling a load of 180 tons at a speed of ninety-three miles per hour, and which when in working order has a weight of 189,200 pounds. This locomotive was built especially for speed and besides being provided with a double set of driving wheels, eighty-six and five-eighths inches in diameter, the largest, I believe, that have ever been used, the construction was designed with a view to reducing atmosphere resistance to the minimum. To accomplish this purpose the boiler is placed in the rear of the engineer's cab, so that a clear view ahead may always be had, and the end, which is properly the cab, is brought to a sharp cutting edge, so that in running the engine literally cleaves the air. The total length of engine and tender is nearly eighty-seven feet, and the whole is enclosed so as to appear like a coach. The fireman's place is near the rear, but communication with the engineer is provided by means of a speaking tube, and every known safety appliance is used, including Westinghouse brakes, automatic low pressure cylinders, smoke consumer, spark arrester, speed indicator, and a slotted bar that makes it impossible for the fireman to open the throttle, though he may close it.

The improvements made in track construction have kept pace with that of locomotive building. Originally tramways were laid with wooden rails resting on round ties as they were cut from trees. When heavier traffic was attempted strap iron rails were substituted that rested more or less firmly on wooden stringers. The next improvement was the laying of flanged iron rails three feet in length on ties three feet apart, which was succeeded by flat rails fastened by chairs and bolted to square blocks of stone. This brought the flanged wheel into service, and in a little while blocks of stone were superseded by stone stringers which furnished the foundation for strap rails of bar iron two and one-half inches wide and five-eighths of an inch in thickness. The track of the B. & O. road was originally constructed in this manner. The labor and expense of building a road of bar iron laid on quarried stone stringers were probably two or three times more than that involved by present methods, while the difficulty of keeping the roadbed in good condition was correspondingly greater. Then the T rail was introduced, laid on ties, but the construction was light, the ties being small and the rails of a weight of thirty pounds to the yard. These were increased from year to year until to-day the best roads use rails of ninety and one hundred pounds, laid on five by seven ties, which, in turn, have a foundation of stone ballast twelve and in some cases fourteen inches thick. The chair that formerly joined the rails has given place to the fish-plate that completely surrounds the joint, thus providing what is practically a continuous rail.

## DIVISION CXXXII.

### Electric Railways and Luxury on Wheels.

Electricity, the most subtle and least understood fluid, has been bridled by the inventive genius of man and harnessed to wagon, car, and boat, furnishing a force which is rapidly superseding steam, giving greater efficiency, is more easily distributed, and has the very great merit of being applicable to a variety of purposes for which steam, and especially the means of its production, is not so readily adaptable. The objection to steam lies in the requirement of its use near the fire that produces it, which, of course, includes the coal that is the primal agency. While electricity is also the product of coal, through a process, it may be stored, or conducted long distances from the furnace, thus removing it from the dirt, grime, and heat that are inseparable from a steam engine.

The evolution of the street car, which we have now come to associate with electrically propelled cars, was shown at the Exposition by a display made by the St. Louis Car Company. The exhibit was not comparable in extent with that made by the B. & O. R. R., but neither was the occasion nor opportunity so great, for the locomotive has not only the dignity of precedence but the importance of infinitely larger use. Considered for relative consequence, the St. Louis Car Company's showing was of equal interest and particularly the exhibit as a showing of the development of urban transportation in the Louisiana Territory since about 1860. Standing at the head of the historic collection was a famous stage coach that for several years was in overland service, carrying passengers over the Rocky Mountains. Next in position and in evolution was a bob-tail street car, with which the older generation is acquainted, as a carrier at times and off the track at others, but which for all the vagaries of car and mule was highly esteemed because no better or so cheap a means of conveyance was in use. That many countries have not even yet progressed beyond the bob-tail state was evidenced by the fact that new cars of the same character were exhibited which had been made upon export orders for South American cities.

The horse car was finally superseded by the cable, which was first operated in San Francisco in 1873, the prime object of introduction being to render accessible, for residence purposes, Knob Hill, which very soon became the most desirable and exclusive residential district in that city. The first horse-drawn street car was built and operated on Fourth Avenue, New York, in 1832, and accordingly continued without a successor for a period of forty years, while the cable car, though such a pronounced success that it was soon introduced in many large cities, retained its pre-eminence for less than twenty years.

In 1888 Frank J. Sprague, whose name is identified with the electric motor, built an electric car which was successfully run on one of the Richmond, Va., lines, and in the following year the Atlantic City, N. J., Street Railway adopted the Sprague trolley system with great success, and thereafter the use of electricity as a propulsive force for street cars increased so rapidly that by 1900 it had completely displaced both horse and cable-drawn cars in every city in America and also in many cities of Europe.

There has been more or less dispute as to the date and place where electricity was first successfully employed for street car service, and while encyclopedias generally give 1888 as the time, and Richmond the place, the St. Louis Car Company exhibited at the Exposition a trolley car which it is maintained was run continuously by the Topeka, Kan., Railway Company from 1887 until 1904. It was thus that exhibits made at the Exposition in many cases served to correct mistakes of written history, and to topple credit from its long usurpation. The display by the St. Louis Car Company served practically the same purposes that were designed by the B. & O., for all the successive steps of improvement in street car service, both as to cars and equipment, were shown, and also the various types of cars used in nearly all countries. And in the exhibit there were not a few curious as well as elegant vehicles, ranging from the

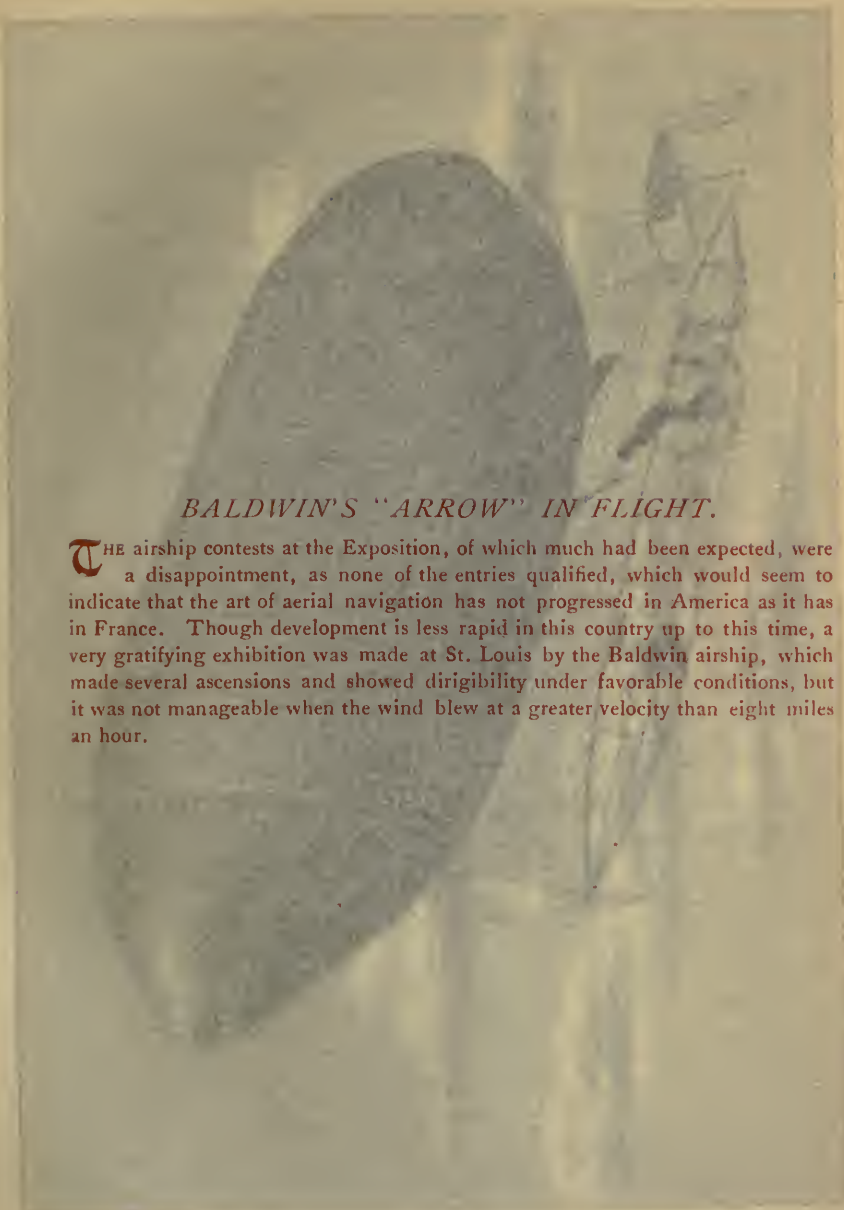
BRAZIL'S TRANSPORTATION EXHIBIT.
JAPAN'S TRANSPORTATION EXHIBIT.

"dinkey-bob," so to speak, the diminutive pony-drawn car used on South American plantations, to the copper-bed interborough and the palatial interurban coach, which latter in point of elegance and convenience rivals the finest product of the Pullman Company. For development of the electric car and equipment has reached a point where luxury appears to be satisfied; where urban travel is not only accommodated, but where the trolley system has brought widely separated cities into rapid and cheap railway communication, and thus made the farm an adjunct of the city in convenience.

As an example of the sumptuousness to which the building of electric cars has reached, the St. Louis Car Company had on exhibition a coach made for John I. Beggs, of the Milwaukee system, which would appear to be the limit of magnificence. The exterior feature was a semi-circular plate glass observation apartment in each end, on the left side of which was the motorman's stand. The observation apartment in both ends was provided with an upper and lower berth, a typewriter desk, and the wood finish was of East India vermilion, with arabesque and marquetry of harmonious and chaste designs. There was a luxurious dining saloon in the center of the car, finished in rich Philippine rosewood with marquetry ornamentation in contrasting wood-color inlays. Furnishings of the saloon consisted of a heavy circular table with leather upholstered chairs to match, a large double compartment refrigerator, one side of which opened into the kitchen, silver mounted lockers, a beautifully carved sideboard, and in the center was a cosy, comfort-inviting fireplace, from which electric heat was radiated. There was a large family compartment and sitting-room, en suite, finished in soft, velvety Hungarian ash and prima vera, furnished with double berths, toilet table, sofa, folding washstand, and a convertible bed, which when not required for sleeping became a cabinet bookcase. There was a splendid toilet-room in striated zebra-wood, fitted out with hot and cold water and flushing closet, besides facilities for bathing. The kitchen, which was finished in polished quartersawed oak, contained an electric range twenty-six by thirty inches, linen lockers, and all the accessories needful for culinary service of the most perfect character for providing either a simple meal or an elaborate banquet.

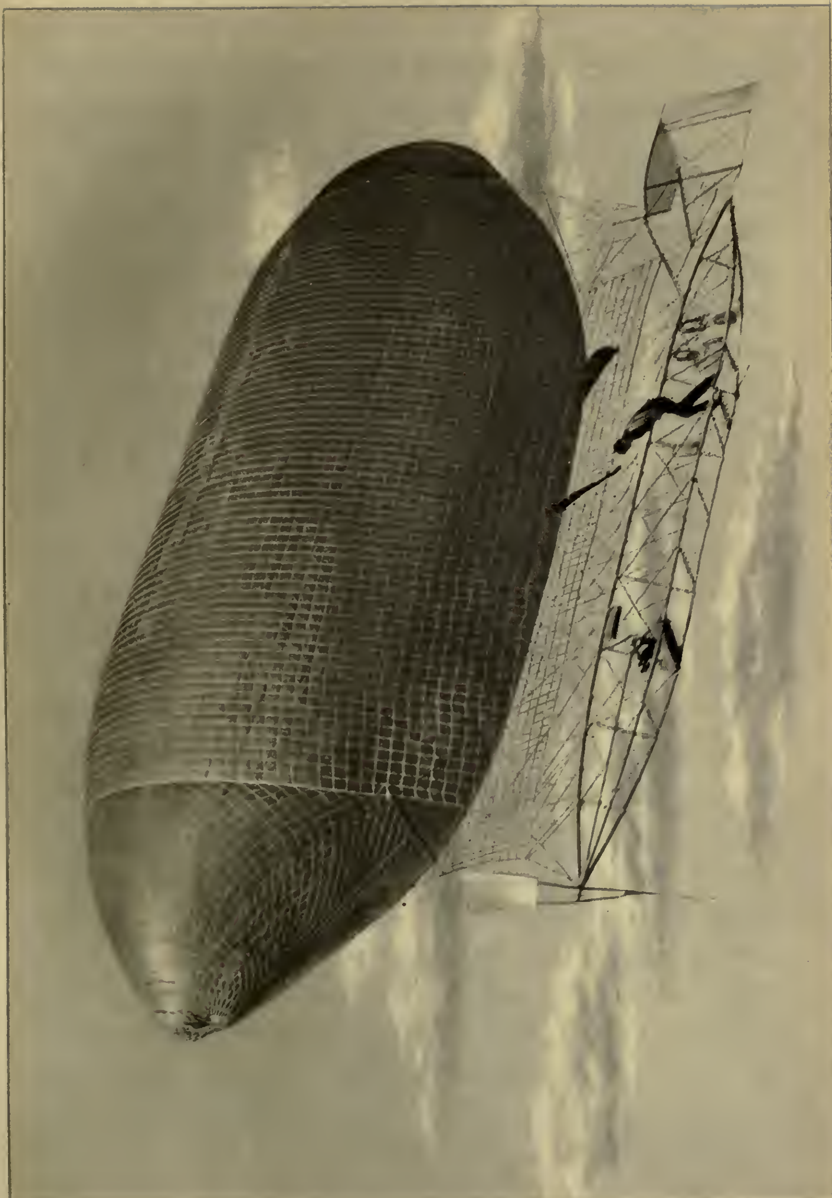
The exquisite beauty of the interior of this electric palace car was accentuated by light softly diffused from incandescent chandeliers and girandoles covered with holophane globes, which gloriously illuminated the vermilioned passageways, the Empire ceilings, and the delicate silk tapestries, draperies, upholstering, and art glass that give a rich yet thoroughly harmonized decorative effect to every compartment.

The luxury which characterized the Milwaukee car illustrated not only the possibilities that are within the range and occupation of the car builder, but it may be accepted as



*BALDWIN'S "ARROW" IN FLIGHT.*

THE airship contests at the Exposition, of which much had been expected, were a disappointment, as none of the entries qualified, which would seem to indicate that the art of aerial navigation has not progressed in America as it has in France. Though development is less rapid in this country up to this time, a very gratifying exhibition was made at St. Louis by the Baldwin airship, which made several ascensions and showed dirigibility under favorable conditions, but it was not manageable when the wind blew at a greater velocity than eight miles an hour.



an immediate precursor of the elegance to which the traveler on interurban electric cars will soon be accustomed.

The improvements which we have seen in the systems of transportation, which represent the development of locomotive and electric motors, have not been greater than the elegances that have been added to the car to render traveling more of a pleasure than a business. It has been less than forty years since the sleeping-car was introduced, and when it first appeared the comfort offered was disproportioned to the expense, but it was nevertheless a long step in advance of the head rest which railway passengers had theretofore been compelled to accept as the best that had been devised. But we must not forget that when the first train started out of Albany in 1831 passengers on the outside seats had to raise umbrellas to keep the engine sparks from setting them on fire. It is not said, however, that they had provided themselves with sheet iron umbrellas.

Originally train coaches were fashioned after the stage coach—from which fact the name is still applied—and the comforts of one did not exceed those of the other. In the old country, and in England especially, the style of car has not even yet materially changed, so tenacious are the English of customs said to have been good enough for their fathers. At the Exposition, therefore, was exhibited a salon car which was built for Queen Adelaide (William IV.) in 1842, which marks the first period in the development from the stage coach to railway transportation, and yet it is almost identical in appearance and size with the passenger cars still operated on English roads. The dimensions of this triple compartment car are twenty-one feet nine inches in length, eleven feet high from the track, and six feet across the body. This royal coach is framed in English oak, the panels are mahogany and the interior woodwork is polished white hornbeam. Having been built for the use of a queen, the upholstering was the finest possible at the time, being of tuffed brocaded silk in a light gray tint. The car was not supposed to be reversible, so the front compartment was fitted with a glass front and sides to afford observation, and a flat car was placed ahead of it so that an unobstructed view from the compartment might be had. The rear compartment was fitted up as a bedroom for the Queen, and the middle compartment was for her entourage. At this time there was the prejudice born of fear against traveling by railway, so the use of a coach by the Queen was designed to dispel public timidity, which it helped very much to do.

This royal car was considered very fine in its day, nor do the royal coaches used in Europe even now very greatly excel it in mere sumptuousness of furnishings, but in America the tendency has been constantly toward magnificence and luxury until many cars now in use are veritable palaces, combining all the comforts to be found at the most expensive hotels.

It is a long way between the coaches in general use even thirty years ago and those that form the rolling stock of the best equipped roads of the new century. This improvement extends to every kind of car in use until we now have not only the sleeper superbly finished in most highly polished woods and supplied with the most decorative embellishments in upholstery, art glass, candelabra, and lavatory fittings, but there have been added bath-room, barber-shop, library, dining salon, Davenport lounges, smoking room, observation rotunda, compartments en suite, and indeed all the accessional luxuries of a club house. And these luxuries of modern travel are not wholly reserved for the rich, for elegance of equipment also distinguishes cars for the masses, for occupying which no extra charge is demanded, such as very fine chair cars, toilet facilities, and smoking compartments, while the tourist coaches, which are really second-class sleepers, are infinitely finer in finish, furnish, and comfort than the first-class sleeping-cars in service on any line twenty-five years ago.

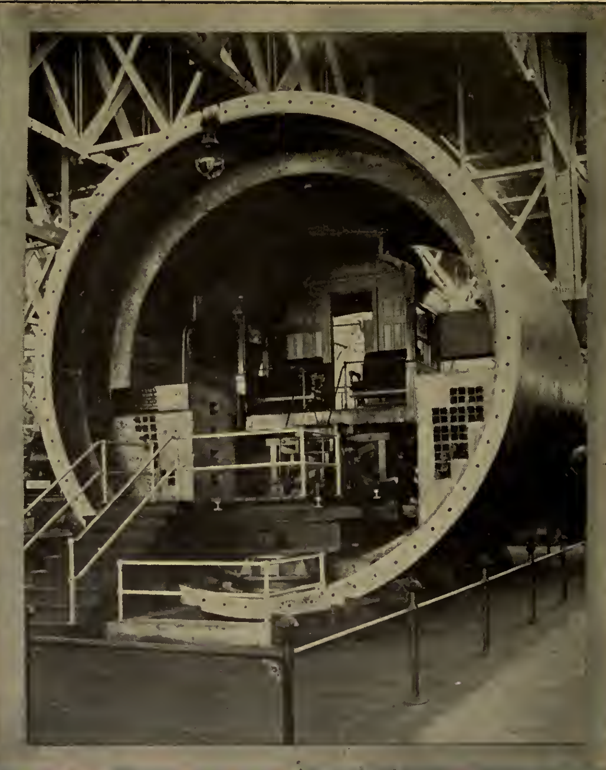
It is in the private car, growing more numerous every day, that the supreme of architectural and decorative magnificence is to be seen. As wealth increases ways for showing it multiply and the private car affords a means for personal exploitation which is at once more picturesque and impressive than any other that has yet been devised. What was heretofore the special prerogative of the railway president is now exercised by rich men in many callings of life. The very successful actor, actress, and prima donna requires the seclusion and exclusiveness of a private car.

Equally insistent is the circus manager, the impresario, the promoter, and the politician, while not infrequently publishers, especially the owners of metropolitan magazines and journals, keep a private car as they do an automobile, for pleasure and business. It is not a practice that is properly a subject of criticism, since there is quite as much reason that a rich man should own a magnificent car as to own a splendid residence, and both spring out of the same prideful prompting.

But the private car, which, like a yacht, is taken to be an evidence of the great wealth of its owner, does not represent the limits of use to which special coaches may be put, for at the Exposition was exhibited a chapel car which was the property of the Baptist Publication Society. This novelty was eighty feet long and ten feet wide with an auditorium that had a seating capacity for one hundred persons. The purpose of the builders is to provide religious services in newly settled parts of the country where the railroad has preceded the church. In one end of the car is a raised platform and organ, and also a very ornamental brass lectern. Other equipments include a pastor's study, living-room, a full section berth, kitchen, locker, lavatory, and storage room. The society has six cars of this same character and their use is said to have been so satisfactory that others are being built for missionary purposes.

The exhibits in Transportation Building comprehended everything appertaining to railroading in all its manifold

12-INCH DISAPPEARING GUN.



SECTION OF NORTH RIVER TUNNEL, PA. RAILROAD.

phases, not only locomotives, cars, rails, ties, etc., but every kind of safety appliance, turntables, wrecking paraphernalia, joints, couplers, brakes, heating apparatus, testing plant, smoke-consuming devices, spark arresters, bridges, concrete beds, and innumerable other things belonging to transportation both on land and water.

One of the most unique exhibits was a full-size section of the tunnel which is now being constructed by the Pennsylvania Railroad Company, which when completed will connect by rail New Jersey with Long Island. In other words, the tunnel passes under North River to the new terminal station in New York City, when the road leads to East River, under which another tunnel leads to Long Island City. The tunnel, which will be driven through sand, gravel, and bed-rock, consists of cast iron rings, the external diameter of which is twenty-three feet, and the internal diameter twenty-one feet two inches. These are arranged in segments two and one-half feet in length, bolted together with one and one-half inch bolts. Inside of this ring is a lining of concrete and an invert two feet thick and vertical side walls with perforations to allow the laying of telephone and telegraph cables, and the tunnel is lighted by electric bulbs placed at intervals of ten feet. The nature of the bed of North River being generally organic deposit and slimy silt, to give strength and stability to the tunnel structure it is being laid on a foundation of steel pointed screw piles fifteen feet in length, surmounted by steel cross bearers and connected by steel beams. The device for screwing down the piles consists of a hydraulic machine that seizes the pile and imparts a rotary motion as it forces the pile downward. The excavation is being made sufficiently large to admit the laying of a double tunnel under North River and four tunnels under East River, so that each track will be confined to a separate tunnel, by which both safety and facility are secured. To operate cars in this confined space electricity will be employed, which will be by a system that makes use of both the overhead conductor and third rail.

Another one of the many very interesting exhibits in Transportation Building was a model, complete in all exterior details, of the mammoth terminal station being erected in Washington City by the Pennsylvania and the B. & O. Railroads, which will cover an area of 250,000 square feet and with the train sheds included will occupy an area of 750,000 square feet, making it the largest station in the world. Trains will enter the station by passing through a double track tunnel that will run under Capitol Hill, fifty-six feet below the surface. The total cost will be $14,000,000.

Exhibits in the Department of Transportation comprised, besides locomotives, cars, and equipment, sections of track, which being of considerable length, to show operation, the construction in some cases was given necessary space on the grounds outside of Transportation Building. Steel ties, which are in common use on the European continent, have not as yet found favor with railroad managers in America, because of the cheaper cost of wood ties, but growing scarcity of timber will presently require the substitution of some other material. In anticipation of this prospective early demand, an exhibition of concrete ties and road-bed was made just outside of Transportation Building which claimed large attention from railroad men.

Over on the hill slope, north of Arrow Head Lake, the German Government made an outdoor exhibit of track, switches, and interlocking and block-signal apparatus, showing the standards adopted by the Prussian State Railways. This exhibit, which comprised 1,500 feet of road-bed, was substantially installed so as to represent service conditions in every detail. It included track construction of different types, three full-size towers fully equipped with interlocking and block-signal appliances, a full-size station house, semaphore signals, and auxiliary devices. There were three sections of double track road, one part of which was laid with creosoted ties, and the other with steel ties. The latter were of rolled material, of inverted trough shape, five-sixteenths of an inch in thickness, to which the rails were fastened by bolts, clips, and tie-plates.

Within Transportation Building the London & Northwestern Railway exhibited a full-size section of main-line track of standard construction, laid with bull-head rails ninety pounds per yard, sixty feet in length, laid on creosoted pine ties nine feet long and six by twelve inches.

There was a large exhibit of photographs and drawings of the Langen system of suspended electric railways, by the Continental Company for Electrical Enterprises, of Nuremburg, Germany. In this system the cars are hung from and travel along an overhead rail, which may be fixed at any level above ground or may be carried along the roof of a brick tunnel or iron tube. Railways on this system can be carried continuously over existing railways, tramways, rivers, canals, or public roads, without in any way interfering with the ordinary traffic thereon. They can be constructed with curves sharper than can be employed on street tramways, and steep gradients can be used. The construction is such that the cars can not be derailed, and sharp curves can be traversed at good speeds. The station platforms are usually about sixteen feet above ground level, so that no lifts are necessary. The ground space is not required for the purpose of the railway, so that in crowded cities the most valuable part of a site may be leased for other purposes. As no flooring is required, a light structure is admissible, and it is possible to economically span long distances without intervening supports. This renders the construction of a suspended railway easy, where it would otherwise be impossible as, for instance, in the case of a line over an existing railway, in entering a large terminus or in crossing an important junction. It greatly reduces the cost, and is small obstruction to light and air.

Two lines are in existence and working, one at Elberfeld,

MAIN ARCH, WESTINGHOUSE EXHIBIT.
2,000 H. P. WESTINGHOUSE INDUCTION MOTOR.

in Rhenish Prussia, and the second at Loschwitz, near Dresden. The first of these is eight and one-quarter miles long and has been in operation since March, 1901. This line is now carrying about 10,000,000 passengers per annum, and no traveler has been injured.

The reader will appreciate the need of a building so colossal as was the Palace of Transportation when, besides the exhibits referred to, space had to be allowed for the automobile and carriage display, in addition to which there were huge models of the North German Lloyd Terminal at Hoboken; the Pennsylvania New York City Station; the West Philadelphia station; the Edge Hill, England, Gravity Yard; the Tyne and Sunderland Harbor Docks; and a topographic model of the Japan archipelago, on which was shown all the steamship routes, cities, and harbors of the islands that comprise that kingdom.

It was like turning from the sublime to view the ridiculous, though a very encouraging retrospection of man's progress, to pass from the exhibit of palace cars on the north side of Transportation Building to inspect the really remarkable collection of crafts and vehicles displayed in the southeast section of the building, by the addition of which the transportation display was made to comprehend almost every known means of conveyance of both ancient and modern times.

There were steam vehicles, and vehicles the motive power of which is man or beast. Facilities for transporting people were to be seen, from the crude wagon of the Mexican peon to the palatial trains of the Pullman Company and the luxurious yacht of the millionaire, and the great ocean greyhounds, the latter, of course, being only models.

It is difficult for one to realize the tremendous strides made in transportation in the last fifty years, and it is difficult, too, to understand that there are people using such crude and ancient means to-day when the problem has not only been solved, but it appears that there is nothing to be added to the transportation facilities of the world, either for pleasure or business.

To-day tobacco is hauled by steam or electricity or at least by huge wagons drawn by four, six or eight horses, but the exhibit showed that in Virginia in revolutionary days an iron bar was shoved through a hogshead of tobacco which was then drawn by two oxen.

There was shown the wheelbarrow used in Amoy, China, to carry people. The seat takes the place of the regular bed of the ordinary barrow, and this crude device is trundled by a man. There was the Red River cart, made all of wood without even a nail, and drawn by two men.

The style of racing chariots used before Christ's time was in the exhibit. It was used in Etruria, Italy, and has two wheels with X spokes and a cane seat. It is low and awkward and one wonders how it ever came to be devised, and least of all for pleasure purposes. It is in striking contrast to the bike sulky of to-day.

There was a Mexican wooden cart, with heavy wooden wheels, in two parts, and held together with heavy cleats of wood. It has a gigantic tongue and is so cumbersome that one wonders if a single pair of oxen can pull it, to say nothing of a load placed upon it for them to draw. But they do. It is the cart used to-day by the peons of Mexico.

A curiosity that was in the exhibit is a cart used on holy days in Palermo, Sicily. Its wheels and bed are gaily decorated with figures of men and women and the coloring of the whole cart is as the rainbow. It is drawn by a diminutive donkey.

There, too, was the volante of Havana, Cuba, with the horses tandem and the vehicle with high wheels and a low bed of wood and a leather top. A more awkward thing it would be difficult to find.

There were scores of other strange vehicles used in transportation from all parts of the world, carts used for holidays and carts for holy days, and carts for every common day. There were pack animals shown so naturally, too, that they appeared to be alive.

And equally wonderful to American eyes were the varied water crafts included in the transportation showing, which besides beautiful yachts, launches, and row-boats included canoes, sail-boats, luggers, catamarans, and a medley of river and sea vessels used in China, Japan, Philippines, islands of Oceanica, the South Sea, Alaska, and in Arctic waters, for commerce, fishing, hunting, and pleasure.

# DIVISION CXXXIII.

## Automobiles and Airships.

Roger Bacon, in his "Opus Majus," in the latter part of the thirteenth century, wrote the following very remarkable prophecy: "We will be able to construct machines which will propel large ships with greater speed than a whole garrison of rowers, and which will need only one pilot to direct them; we will be able to propel carriages with incredible speed without the assistance of any animal; we will be able to make machines which by means of wings will enable us to fly through the air like birds." Wonderful, amazing prescience, which, thought to be the ranting of a flighty imagination at the time, has been so completely fulfilled that only the last remains to be accomplished in absolute perfection, and even man-flight in an experimental stage has really been achieved.

It will interest all persons to know that the steam road-wagon antedated the rail locomotive, though this fact will have been discovered by readers of the preceding division. A steam carriage was the dream of inventors two centuries ago. Watt took out a patent (1784) on a machine that was designed to run by low pressure steam on English road-ways. He accomplished very little, but his idea took root in the brain of others and to such purpose that Trevithick actually built a steam road-wagon in which he carried passengers, but the enterprise was not profitable and after less than a year's continuance was abandoned. Whether failure was due to operating expense, lack of patronage, or to an act of Parliament imposing heavy tolls on such vehicles, history does not specifically relate. Nevertheless, spasmodic efforts were made to establish a steam carriage service, and competition with railways was kept up in a feeble way until about 1835, when further attempt was abandoned and much that had been learned by experimenters was lost.

The automobile, as we know it, came into being in 1894, when Leon Serpollet built a steam carriage in France that had about it so much promise of commercial success that other inventors directed their energies to making improvements, and presently three separate types of machine were evolved, viz.: the steam, electric, and gasoline, each of which still has its devotees and it must be admitted each one has some point of superiority. The electric storage furnishes an ideal motor, viz.: freedom from vibration, offensive odor, and danger of explosion; but against these advantages must be placed excessive weight, and difficulty at times of recharging, especially in country districts, and expensive construction. When these objections are once overcome, as they will be in a little while, the electric automobile will be as commonly seen on country roads and in the city as wagons and street cars. In fact, it is not at all unreasonable to believe that in a few years the automobile will completely displace the street railway and the horse-drawn vehicle. The wonder is that it has not already been done to a much larger extent than we see, for the operating of an automobile street car service has been demonstrated to be practicable, both commercially and mechanically. When the time shall come, as it must, that horses are banished, and the rails of street cars removed, giving place to asphalt avenues and automobile service, city life will be a joy and satisfaction greater even than was felt by the happy people of Utopia.

The steam plow has been added to other labor-saving devices in the past few years and its success has greatly stimulated inventors in their ambition to produce a simple motor, detachable and interchangeable, and considerable has been accomplished in this direction. It is accordingly within the range of prophecy to say that the time is not far distant when a motor and gearing may be bought that can be used at will to quickly convert a buggy or wagon into an automobile; that can also be used to run a threshing machine, a reaper, a plow, a feed-cutter or any other kind of farm machinery, thus practically relegating the horse to the exclusive pleasure of driving. Moreover, the constantly increasing use of the automobile is giving corresponding impetus to the good roads movement, so that it is not simple enthusiasm which encourages belief that in a few years there will not only be a well-constructed highway across the continent, as is even now projected, but good roads will be as common in America as they are in Europe; and, it may be added, convict labor, instead of competing with honest toilers, will be used to build them.

The display of automobiles at the Exposition was most impressively large, ranking next to that made by railroads, and included a great variety of vehicular forms—express wagons, vans, surreys, traps, carriages, coaches, omnibuses, touring cars, ambulances, runabouts, wagonettes, and high speed cars of curious shapes. Automobile clubs were represented by scores of members coming to the Fair in their machines from as far east as Boston, thus testing the endurance and trustworthiness of this kind of vehicle for long distance traveling. But there was also exhibited at least one automobile that without a break had performed the remarkable feat of traveling across the continent from New York to San Francisco, which necessitated traversing sandy plains, crossing the Rocky Mountains, and passing over long stretches of forest and plain where there are no roads, thus subjecting the machine to the severest possible tests. There was also shown one or two automobiles that had been kept in continuous action for three weeks, with no impairment of their efficiency other than wear and injury to the tires. With such a showing of service the most skeptical were compelled to believe in the great usefulness and permanence of the automobile as a motor vehicle that is destined to very soon supersede all other forms of highway travel.

From transportation upon land came by sequence transportation upon water, by both of which man made a wonderful advance toward civilization, and by improved methods which have been devised from time to time progress, commercial, industrial, and sociological, has been powerfully promoted. It is a part of human nature, a sixth sense, so to speak, to ever aspire to higher conditions and this ambitious craving has stimulated effort not only to discover and master forces, but to become lord of the elements. Thus the old alchemysts sought the elixir of life with even greater persistence than they pursued their quest of means for transmuting the baser metals into gold. And in our day when travel by either land or water is made luxuriously comfortable and safely speedy, man is not only unsatisfied but his ambition is thereby enlarged and he accordingly aspires to navigation of the air. The very dangers which it seems to invite act as spurs to his courage to dare as well as to achieve. But the mariner who first had the temerity to venture beyond sight of the shore needed to be no less strong of heart, for a superstitious fear prevailed that the great sea was the realm of Satan and diabolic monsters, and that the horizon was the edge of the world, passing over which a vessel would descend to the infinite depths of the universe.

Strange conceits have always filled the minds of men, but these fancies have not infrequently been stepping-stones used to help us over difficulties, and as confidence grows with every new success, we have progressed to that polar point where all the longitudes of life find their convergence, and our ambitions having conquered the earth unsatisfied longings lead us to exploration of the skies. Who shall deny that to our inordinate desires is to be credited popular conception of angels, to whom wings are given that they may conquer space?

But whatever may have been the earliest promptings to the effort, from time immemorial man has cherished the wish to escape the limitations of land and sea and like a bird soar in the empyrean. It has been less a figure of rhetoric than a sincere hope and when, in 1783, the Montgolfier brothers made an ascension in a hot-air balloon to a height of 8,000 feet, belief was very generally shared that gravity having been overcome, man was no longer bound to the earth and that the azure fields were now thrown open to his daring invasion. And, indeed, it might well seem so, for the first ascension having been safely made, both the means and result argued strongly for a repetition of effort to accomplish navigation of the air.

A pleasing fancy having developed into a fact, it is a thing approaching the wonderful that a practical and commercially successful flying machine has not long ago been devised. The difficulties since Montgolfier's demonstrations do not appear to be greater in perfecting a dirigible airship than were met by early mariners before they learned to build stout vessels and to steer by compass. Yet the art of sea navigation has developed amazingly while ships of the air still exist largely in our imagination.

Let it be told that directly after, and in the same year, the Montgolfiers made their initial ascension, General Meusnier, of the French army, published a series of articles on aerostation, in which he suggested means for building and operating a steerable balloon. But his recommendations received so little attention that it was not until 1852 that any one is now known to have attempted to construct such a craft. Henri Giffard has this distinction, who made a cigar-shaped vessel 144 feet long, which, while the motor he used had insufficient power to wholly control the large gas-bag against adverse winds, nevertheless demonstrated dirigibility of the vessel under favorable conditions. And it may be added, Giffard's methods have been closely followed by nearly all subsequent experimenters, and without perceptible improvement except to use lighter motors that have increased power.

Since 1852, several inventors, chiefly Frenchmen, have been experimenting with airships, but until Santos Dumont entered the field nothing more noteworthy was accomplished than the ability to slightly direct the course of the vessel when in a calm. In 1891, however, Dumont, who is a wealthy Brazilian, entered upon a series of experiments, dur-

BALDWIN'S AIRSHIP IN FLIGHT.
BENBOW'S AIRSHIP ON EXHIBITION.

BALDWIN'S SHIP BEING CAST OFF.
FRANÇOIS' CAPTIVE ASCENSION.

ing the course of which he constructed several cigar-shaped balloons, to which he attached a framework and provided propellers that were driven by different kinds of motors. Finally, in contesting for the Deutsch prize of $20,000, for a successful flight and circling of Eiffel Tower within a period of thirty minutes, he succeeded in making a distance of nine miles and circumnavigating the tower, but the time occupied was forty seconds greater than that stipulated in the conditions. In this attempt Dumont's vessel had a length of 108 feet, and was driven by a four-cylinder petroleum motor of 216 pounds weight and twenty horse-power.

While the elliptical form has been most generally adopted, and petroleum motors used for propelling airships, other means have been employed to navigate the air. Not to speak of Lillienthal, and other Darius Greens who have attempted flight by the aid of artificial wings, and most often with disastrous results, experiments made during the last dozen years include: Professor Langley's aerodrome, Professor Bell's tetrahedral-celled kite, Chanute's gliding machine, and Maxim's flying machine. In all of these the aeroplane method is employed; that is to say, the principle illustrated by the kite, which is sustained in the air by opposing its face to the wind. In this case the necessary resistance to cause it to mount is created by the string that holds it in a position inclined from the perpendicular, by which the wind is made a lifting power. The aeroplane and, in fact, all the other machines named make use of this same principle, only instead of being restrained by a rope, the machine is launched from the earth and is driven forward by means of a motor operating a propeller. From the sides, or in tiers, one above the other, are wings, or aeroplanes, which being set at an inclined angle, serve to hold the machine in suspension as it moves against the air.

So great has been public interest in the subject of human flight for the past dozen years, stimulated as it has been by French experiments and attention given it by the military branch of several governments, that the Exposition management decided to offer a series of prizes open to all nations, for successful flights of aerial machines under stipulated conditions and restrictions. As the aggregate of these prizes was $150,000, it was with reason believed that there would be a large number of entries and public curiosity was aroused accordingly. The newspapers had prepared visitors to expect a great showing, by publishing accounts of successful attempts made by inventors in several places of America, until small doubt was left in the minds of the masses that at the St. Louis Fair might certainly be seen several crafts sailing at will and under perfect control, competing for the honor and reward that were held forth. At one time announcement was made that no less than ninety-two contestants had filed their application of entry, but as it came to be known that the requirements were less experimental than practical, and that the governing rules made it necessary that to win the prizes contestants must sail over a prescribed course, execute certain movements, and return to the starting point within a specified time, the list of entries diminished so rapidly that when the date set for the flights arrived not a single inventor had fulfilled the conditions necessary for eligibility to compete for the prizes. Santos Dumont was among the first to signify desire to enter the list, and built an airship with this special purpose in view. He even brought the gas-bag and machinery from Paris, and this action served to arouse interest and confidence to the utmost, but at the last moment some vandal succeeded in getting within the aerodrome, where the material was deposited, but was as yet unpacked, and slashed the balloon so badly that several days would be required in which to make the repairs. Detectives were called upon to discover the culprit, and an exhausting investigation was made, but without other result than a very general suspicion that the damage had been done by some one who, if not acting under Dumont's orders, was at least prompted by a desire to save the young Brazilian from the embarrassment of a failure. This suspicion may be unjust, but color was given it by Dumont's retirement from the field, and the mutilated material of his airship was shipped back to Paris, thus closing the incident but leaving a bad impression.

No one really qualified for the contests, but a factitious showing was made by four inventors, viz.: Baldwin, Berry, Benbow, and Francois, the latter a Frenchman who brought into the competition a huge airship provided with a motor of twenty-four horse-power that operated a double pair of propellers fixed to the sides of the car. It was with much difficulty enough gas could be obtained from the plant set up on the grounds to inflate it, and when finally this was supplied and the great vessel was sent up, not enough confidence was felt by the inventor to have it liberated, and being held in leash by a long rope, the monster behaved like a ham-strung elephant, completely disappointing the hopes of the multitude that paid an extra admission to see it. While being returned to the balloon shed the top of the big bag was caught by a nail that tore a great rent in the envelope and let all the gas escape, which terminated Francois' career at the Fair.

Berry showed an airship provided with a gas-bag that in shape resembled two saucers with their rims placed together, or a huge double-convex lens, intended to form a parachute in case of accident. It made no free flights and was eliminated with scant consideration.

Benbow's ship had the merit of being graceful in appearance, the points being sharply defined and the machinery almost delicate in its lightness. But his effort to reduce the weight to a minimum was carried to such an extreme that the motor proved to be wholly inadequate to warrant a free flight being undertaken.

Baldwin's ship was measurably successful in that it made several ascensions, under the direction of Knabeschuh, who accomplished the feat several times of making a wide circle and returning to the balloon enclosure. These flights were very interesting to the multitude and the sight was a delightful one to behold. This bold mariner of the celestial seas made no provision for his security, but stood upon lateral pieces of gas-pipe that composed the frame-work of the ship, and skilfully directed the movements of the vessel, over which he exercised very considerable control. By shifting the steering blade and propeller he was able to ascend or descend at will, and similarly the ship was brought to change its course and to describe a circle, though the vessel was not thus controllable in a wind of more than six or seven miles per hour. Seen high up in the heavens, bathed in the sunlight and waving its delicate arms like a strange thing of life, veering, dipping, mounting, and circling, it was truly an inspiring vision, prophetic, let us believe, of the almost dawning day when ships will navigate the skies as they now do the seas; when man will be liberated from the limitations of his feet and in winged chariots will ride and soar with the ease, grace, and freedom of the fowls whose ranges are far above the world.

Though no particular use has as yet been made of airships, due to their imperfection as a means of traveling, the balloon is serving many purposes of a utilitarian as well as purely pleasurable character. The military service of the balloon has for a long while been of the greatest value, in providing a way for observing the enemy, making photographs of surrounding country, and under favorable conditions it may be employed as an offensive arm for dropping explosives upon fortifications. This latter is possible, of course, in very rare cases, such as a close investment of a city, when a balloon may be sent up outside the zone of fire and shifted into position by favoring winds, or held captive and conducted to a position where it may drift, at a safe altitude, over the enemy. In any case the dangers of such ballooning are not greater than are incurred by the crew of a torpedo boat that must take the most desperate chances in order to deliver, with much show for success, one of their deadly engines.

The uses of balloons, however, are by no means limited to war purposes; on the contrary, they are now much employed in the investigation of atmospheric and other scientific problems. It was by a balloon's flight to a great height that positive determination was made of the intense cold of extreme altitudes. This was indicated by the existence of snow upon very high mountains, but it was known that the same mountain altitude does not produce corresponding temperature. But it has been established, through ascensions, that usually at the height of three miles below zero temperature prevails regardless of seasons, and that at five miles fierce cold is always present, rapidly increasing with the altitude. But it is also demonstrated by observations that there are isothermal lines in the upper regions, just as there are on the land and in the depths of the sea.

Several scientific researches were prosecuted at the Exposition, one of which required the use of balloons for determining temperature and air currents in the upper regions. The purpose of these investigations, as explained by Prof. H. H. Clayton, is thus explained:

We would learn something of the restless currents, something of the temperature and humidity in regions inaccessible to man, as well as of the region in which he lives. We would know something of the climate of the region ten miles above the earth and how it compares with the climate of other regions. We would know to what height in the atmosphere the influence of ocean and continent extends. We would know whether the annual and daily changes of temperature felt at the earth's surface are also measurable at great heights. We would know the conditions under which storms originate; whence and in what manner come the driving snow and pelting rain; what are the conditions which cause them and what prevents them. From whence come our blizzards and cold waves? Are they thin bodies of cold air which rush along the surface of the ground, or do they embrace large bodies of air? Are they first felt aloft and would a knowledge of this fact aid in prediction? The solution of questions of this kind is what is sought by the balloon work.

The balloons used in these experiments were not intended to exert much lifting power, seven pounds being their limit, their real work being to carry delicate instruments into regions where human life can not be supported and which automatically record temperature, wind velocity, humidity, and altitude. All these were carried in a wicker basket, which was suspended to a rubber balloon that would expand under certain conditions and then burst and fall gently, the descent being guarded by a silk hood that formed a parachute. A number of such balloons were released that fell to the ground more than a hundred miles distant, to each one of which a card was attached offering a reward of two dollars to the person returning the instruments to Professor Clayton at St. Louis, by which nearly all were recovered.

In conducting these experiments, when the recording instruments are recovered, after the balloon has fallen back to earth, the cylinder on which the records have been made is straightened out into a flat sheet and treated to a fixing bath. This makes its records as permanent as a photograph. Then, to ascertain under just what conditions the various humidity, temperature, and barometric records were made, it is only necessary to subject another cylinder to artificial cold, to create a vacuum, and to develop humidity conditions until the same points are registered on this second cylinder. The temperature records thus far secured, ranging from fifty to eighty degrees below zero, exceed those obtained by Doctor Berson of Berlin in 1901, whose balloon attained a height of six miles.

Following is the tabulated record of these balloon flights so far as they were obtained. In some cases the instruments failed to do their work, or were injured, which accounts for the blanks in the table:

| Date. | Elevation, feet. | Miles traveled. | Temp. below zero, degrees. | Speed per hours, miles. |
|---|---|---|---|---|
| Sept. 15 (1904) | 46,000 | 50 | 68 | 26 |
| Sept. 23 | 51,000 | 10 | 68 | ........... |
| Sept. 24 | 29,000 | ......... | 33 | ........... |
| Nov. 22 | 20,000 | 65 | 10 | 25 |
| Nov. 24 | 15,000 | 145 | ........... | ........... |
| Nov. 25 | 40,000 | 280 | 72 | 101 |
| Nov. 26 | 33,000 | 235 | 76 | 101 |
| Nov. 29 | 19,500 | 140 | 21 | 59 |
| Nov. 29 | 36,000 | 260 | ........... | ........... |
| Dec. 1 | 20,500 | ......... | 2 | ........... |
| Dec. 2 | 45,500 | 105 | 73 | 56 |

The principal object of these experiments, the results of which have not yet been published, is to discover the origin of storms, the cause of cold waves, the upper air conditions during each of the four seasons, and whether or not there is an annual change of temperature there as in lower atmospheres. It was also desired to obtain all other facts possible as to differences in conditions at different heights. Blue Hill Observatory originated the system of kite observations which has now been adopted in Europe, and it is the first in America to take up this system of rubber balloon observations, which was inaugurated by Germany.

It is believed that these observations will show that cold waves have their origin in cyclonic blasts of cold air from the North Pole, those polar winds traveling at a velocity of possibly 250 miles an hour. The speed of very high clouds has already been estimated to the satisfaction of scientists as sometimes attaining a velocity of 230 miles an hour, thus giving some idea of the terrific speed that must be attained by the polar winds that travel at a height of from eight to twelve miles above the earth. It is the descent of a certain proportion of this polar cold, scientists believe, that causes our cold waves.

Heretofore there has been no means of obtaining records of these extreme upper air conditions. Human life can not be sustained there. It is a region of continuous sunshine, but of extreme cold, the air being peculiarly dry, almost without moisture. Not until this system of balloon observations was brought into service has it been possible to explore the extreme heights. Now, however, we are obtaining satisfactory records of conditions that prevail as high as twelve miles above the earth. At that height the temperature ranges continually from about fifty to sixty degrees below zero, and a record as low as eighty degrees below has been obtained.

# DIVISION CXXXIV.

## United States Government Exhibits.

The United States Government made a greater showing at St. Louis than was ever before attempted by any nation at any Exposition. The monetary cost of the representation is given statistically in an earlier volume, but in previous references the character of the Government's participation was indicated rather than described. Ten millions of dollars appropriated and loaned to the Exposition Company by Congress made success of the Fair, as an educational exhibition of world achievements, certain, but it was in the wise expenditure of this enormous sum that the real greatness of the nation, in all fields of research, scientific and industrial, in all that constitutes civilization, was made manifest to those who exercised the good judgment to attend the Fair. It is regrettable that millions were unable to visit the Exposition, and it is lamentable that there were other millions of well-circumstanced persons who totally disregarded the opportunity, and by so doing robbed themselves of a benefit great beyond the possibility of estimating.

Many there are who refuse to answer the knocking of fortune at their doors, and spend the rest of their days in repentance; it is hardly an exaggeration to say that those who, having the chance, neglected to attend the Exposition, lost that which they will never be able to retrieve, and that opportunity was grieved by their apathy, as in after years the idler at school bewails his failure to improve the advantages which had been given him.

Government, to be most beneficial, is essentially paternal; not merely protective of the citizen in the enjoyment of his rights, but likewise contributory to his advancement, mentally and materially; thus, government promotes education, and encourages effort by favors, by copyright and patent, and also by research, bounty, and in a hundred other ways, as circumstances may suggest, to help communities and benefit the individual. It was this paternalistic spirit that prompted Congress to make so large an appropriation, not for exploitation, but as an incentive to the citizen and for a showing of how the Government, in its manifold branches, protects, cares for, and favors the units and the masses.

Those who were so fortunate as to spend a while at the Exposition found it a wonderful university of specialization, where education was instilled by object lessons that were as permanent for impression as they were readily understandable. The Government Building and its environs was a focal point of interest, quite as much for the scientist or the seeker for information as it was for the curiously inclined. The Giant Bird Cage was filled with feathered specimens of hundreds of different kinds of birds, not con-

EXHIBIT IN U. S. FISHERIES BUILDING.

fined to such as are found only in North America, but included species peculiar to all the zones and of many far-away countries. This afforded a school in ornithology more instructive than it is possible for books to do, for lessons thus learned are not easily forgotten.

Near the Bird Cage was the Fishery Building, provided with two score of aquaria tanks for a living demonstration of how various inhabitants of fresh and salt water spend their existence, from the egg to the adult, among which were to be seen the delicate and iris-tinted anemone, infusoria, the sea horse, and other diminutive forms of life, some of which are upon the border line of the animal and the vegetable. And there were also specimens of the larger species, a special showing being made of food fishes, including artificial means of propagating, devices for capturing, and methods of preparing for market. There were monster catfish disputing and disporting with seals and turtles in the large central basin, and arranged around the court was an immense exhibit of paraphernalia appertaining to the fishery industry. Most interesting because least often seen were weapons used in killing whales—harpoon-guns, lances, explosive bullets, and whale boats. The sealing industry was likewise represented, as were also the lobster, salmon, oyster, and other pursuits that engage the labors of more than 212,000 men in the American fisheries, who gather from the rivers and seas an annual product valued at more than $50,000,000. The salmon output alone is estimated to exceed 250,000,000 pounds, and the fisheries of the Great Lakes produce 100,000,000 pounds.

Near the south end of Government Building were parapets, fortifications, field-guns, powerful mortars, magazines, and coast defense guns mounted behind emplacements ready for actual service. This display of the heavy ordnance arm of the Government attracted the profound interest of visitors, especially during the hour when exhibition drills were given. There were two coast defense rifled breech-loading guns, one of twelve-inch and the other six-inch gauge, both mounted on disappearing carriages, which represented the latest type of that formidable class of weapons. The larger gun was handled by a crew of eighteen men, directed by three non-commissioned officers from the regular army. The weight of the projectile was 1,000 pounds, which by a charge of 270 pounds of powder may be hurled a distance of fourteen miles. By the use of hydraulic machinery the gun is made to rise from its level below the top of the emplacement and when fired the recoil brings the gun back to its loading position behind the parapet. Shots may be fired from this monster weapon at the rate of one each minute, necessitating a change of crew, however.

Other pieces of heavy ordnance in the display included a six-inch rifle mounted on a barbette carriage, a fifteen-pound rapid-fire gun, a seven-inch field mortar, a twelve-inch rifled mortar, and a seven-inch howitzer. In handling these guns the drill was thorough in every respect except actual firing, in lieu of which percussion caps were used to complete the process, and retiring of the coast defense pieces was accomplished by a crank shaft operated by hand.

The greatest interest was manifested in the means employed for giving accuracy of aim and efficiency to the coast defense guns. People who were unadvised naturally wondered how it was possible to fire a shot with any degree of certainty of hitting a moving vessel seven or eight miles out at sea, and it was to give this information, as well as to show the measures taken by the Government to protect our coast cities, that the daily drills were given. Our coast defense guns are often planted in a low-lying situation so that from the site level a ship at sea is not visible for more than about seven miles. There is, however, an observatory station connected with the gun parapet by a telephone, the latter situated at a considerable distance and is in charge of the fort commander, who gives his orders over the wire to the fire commander. The latter in turn communicates with the range fire commander, and thence orders are given down the line to the three non-commissioned gun directors. A large field of the outlying harbor is accurately mapped, which the fort commander has in front of him in the form of a cross-sectional diagram, and every section is numbered, the range upon which has been found by target practice and mathematical calculations which take into account wind, tide, and movement. When a hostile fleet approaches, the fort commander from his elevated station is able to discover it long before the vessels can obtain the range upon the fort, even if the ship's commandant should know its exact location. As quickly as the fleet looms in view, the fort commander communicates with the fire commander, ordering that the gun be aimed at a certain section, which constitutes the target. This the position finder proceeds promptly to do by aid of the instruments devised for the purpose, in connection with the azimuth. As the firing of a shot from a twelve-inch gun costs the Government $1,000, and upon the result depends the defense of the city, it will be seen how very responsible is the post of position finder.

The largest coast defense gun mounted at the Exposition was a twelve-inch, but several are in service that have a caliber of sixteen inches, a wood model of one of which was on exhibition within the Government Building with a 2,000-pound steel pointed projectile beside it, which by the discharge of 500 pounds of smokeless powder may be fired a distance of twenty miles, though accuracy is not possible beyond a range of ten miles.

Besides the display of very heavy ordnance named the outdoor exhibition included a varied assortment of sinister weapons, one more particularly powerful being an immense mortar for coast defense. Only one was shown, though in actual practice it is customary to place four of these guns in the same pit. This pit is merely a mound of earth, showing absolutely nothing of its warlike character

12-INCH MORTAR GUN, GOVERNMENT EXHIBIT.
3-INCH RAPID FIRE GUNS, GOVERNMENT EXHIBIT.

on the outside. It is so arranged that it can be damaged only by a shell dropping from another mortar or from very high angle fire of regular cannon, into the mouth of the pit, which at a distance of even a mile would offer a most difficult target.

This mortar weighs 29,000 pounds and its carriage nearly three times as much. Five immense double springs take up the recoil. It is capable of discharging four twelve-inch shells in six minutes, throwing them a distance of seven miles. The firing is usually done at an elevation of forty-five to sixty-five degrees. The projectile, weighing 800 to 1,000 pounds, is made especially for piercing the decks of warships, and it is reasonably certain that one shot from such a mortar would put the stoutest of battleships out of commission. The United States is the only nation using mortars for coast and harbor defense, having developed the weapon much further than other countries, which utilize it only for siege purposes.

Close to the mortar pit were several guns of from two to four-inch caliber in barbette mountings, that is, in such position that they are always above the level of the parapet. On the other side were a mountain gun and several other larger cannon which might be used for field or siege purposes. Notable among these was a siege howitzer which throws a 105-pound shell a distance of two and one-half miles.

A weapon that attracted much attention was a Vickers-Maxim "pompom," such as was used in the Boer War. It was mounted on high wheels and protected by a shield. The projectiles weigh one pound and the gun is capable of discharging 175 shots in a minute. Close by was another interesting weapon, mounted on a low carriage—a mountain gun that was used in the Moro campaigns. It has a seventy-five millimeter (nearly three inches) bore; the projectile weighs twelve and one-half pounds and the range is over two miles. It can be taken to pieces and carried by mules wherever those useful animals can go.

To illustrate the possibilities of artillery fighting in a rough country, an artillery train of horses and mules loaded with rapid-fire guns and ammunition occupied a conspicuous position in the War Department's section. It was somewhat similar to the equipment that has helped make the Japanese so wonderfully successful in their Manchurian campaign. They were able to plant comparatively strong batteries in positions which the Russians could neither reach with their own artillery nor approach with their much vaunted Cossacks on account of the nature of the ground. A mountain battery is set up and put in position after reaching the desired position almost as readily as the heavier and more powerful regular field guns.

Heavy ordnance and field artillery composed the larger part of the Government's military showing, but it also included a display of infantry arms, guns, bayonets, pistols, the most interesting of which was the 1903 pattern of army rifle believed to be the most effective ever invented and much superior to similar guns used by any foreign government. This rifle may be used either as a magazine or single shot weapon, capable of firing thirty-five shots per minute. The barrel is covered with a wood jacket to prevent burning the hands during rapid firing.

It is in range and penetrating power, however, that the model of 1903 most clearly shows its superiority. The .30-inch bullet, made with a cupro-nickel jacket over the leaden cone, has a muzzle velocity of 2,300 feet a second. It has penetrated thirty and three-quarter inches of solid well-seasoned oak across the grain. As one of the soldiers in charge of the exhibit said: "It's no use hiding behind a tree any more. Unless it's more than three feet through, no tree would be any shelter at all from one of these bullets."

The best previous army rifle was able to penetrate only a little more than twenty inches, while the Springfield type ball would penetrate only three inches of oak. The Springfield bullet would also spread after striking the target, tearing a huge jagged hole, while the new rifle makes a small, clean hole. The maximum effective range is 4,781 yards—almost three miles.

The War Department made an interesting comparison to show the development of the army rifle in the last half century. In 1870, after the fearful lessons of the Civil War had been applied, the maximum rate of fire was twenty-five shots a minute and the extreme range 2,000 yards. Twenty years earlier two shots a minute was the limit and 200 yards was as far as any marksman expected to be able to do any execution.

In field guns also wonderful progress since the great Civil War was shown, though much of this antedates the Spanish War. However, the guns on exhibition showed improvements even over those in use in the Santiago campaign. An insignificant looking weapon was a Colt automatic .30-caliber gun. Its carriage is low, so that it gives the impression of a viper ready to strike. It is capable of discharging 400 shots a minute. A Gatling gun, using ammunition exactly like that used in the regular army rifle and protected by a heavy steel shield, is capable of firing 800 shots a minute as long as the magazine is supplied. The muzzle velocity and power to do damage to the human frame are the same as in the rifle now used by the army. Three men—one to aim and two to keep ammunition handy—could exterminate a regiment before it could traverse a quarter of a mile of open ground.

The Bethlehem Steel Company, which has much to do with manufacturing armor plate and artillery, made an interesting exhibit not only of armor plate, but of artillery. One of the most improved guns shown was a field rifle of the "long recoil" type—that is, in which the recoil is taken up by cylinders filled with a non-freezing fluid. The accuracy and safety of the gun are thereby much increased. It has a range of nearly four miles, and, using fixed ammunition, is extremely rapid.

16-INCH GUN MODEL, FOR COAST DEFENSE.
MODEL U. S. GOVERNMENT DRY DOCK.

Passing into the Government Building at the south entrance, the visitor found as he turned to the right a very interesting exhibition of pictures, statues, medallions, relics, medals, swords, etc., appertaining to the executive, state, and judicial departments of the Government. Beyond these were models illustrative of test methods and results in irrigation, evaporation, soil fertilization, sample products, preserved fruits, grains, and grasses. There was a kitchen laboratory in which the chemical changes which take place in cooking both meats and vegetables were shown.

One of the extremely profitable, as well as attractive exhibits that occupied a large section on the east side of the Government Building, included what was catalogued as the Economic Entomology of the United States. In this elaborate display were to be seen beetles, moths, caterpillars, weevils, scales, aphis, flies, cicadas, parasites, lice, mites, worms, ants, and, in fact, specimens of every kind of bug, fly, or insect common to America. Among these, that created very great interest, was a colony of live coddling moths, the ravages of which are said to destroy $11,000,000 worth of apples annually. And there were specimens of the lady bug introduced here from China to destroy the San Jose scale. Equally attractive was a bunch of ants brought from Guatemala in the belief that they will feed upon and exterminate the boll-weevil that is threatening the cotton-growing industry with ruin.

Large models of the chinch bug and San Jose scale were exhibited that gave the complete life cycle of these dreadfully destructive pests, from the egg to the imago, or mature insect.

The models shown of pests too small for satisfactory observation without the aid of a magnifying glass were often frightful to look upon, comparable to the Chinese conception of dragons more than to anything else, but a study of the insect was thereby afforded, and accompanying the examples were directions as to means for destroying the pests.

Equally instructive and interesting to the masses as well as to those engaged in agriculture and its associated branches were exhibits of the Hessian fly, which is said to do $60,000,000 damages annually to wheat; also the grapevine louse, a dipterous insect that stings grapevines and causes a gall to form in which the eggs are deposited and hatched. There was also shown the real kissing, but usually called the assassin, bug, which, though it feeds off other insects, has also been known to bite persons with very severe results. In the exhibit there was shown the curculio that ravages plum trees and, in fact, every kind of destructive insect common to America, together with its enemy, by which both the enemies and the friends of the gardener, farmer, and horticulturist were distinguished.

Silkworms were likewise shown feeding off mulberry leaves and weaving their cocoons, nor was the great variety of butterflies omitted from the exhibit, which demonstrated the metamorphoses which they pass through.

The most marked interest, perhaps, displayed by the masses centered about the aquatic insect exhibition, in which division was placed the yellow fever mosquito that has within the past few years come to be recognized as the real distributor of the plague. Besides the mosquito exhibit in the Government Building, there was also a more general showing of the habits of this pestiferous and dangerous insect in Cuba's exhibit in Education Building, which was in charge of John R. Taylor, of Havana.

It has for a considerable time been known that the spread of malaria is due, very largely at least, to the bites of mosquitoes and this having been demonstrated led to experiments being made with a view to determining whether yellow fever was similarly transmitted. In conducting these experiments, which took place at the Las Animas Hospital in Havana, August, 1901, under direction of the U. S. Army Commission, eight volunteers were secured who permitted themselves to be bitten by mosquitoes that were known to have bitten yellow fever patients a short while before. Of the number seven were stricken with the disease three days later and three died. Mr. Taylor was one of these volunteers, who was taken down with the fever and his death was expected, but he finally recovered and was thereafter detailed to lecture on the mosquito. A very careful study of the insect reveals the following interesting facts: First, it is useful to know that it is only the female insect that bites, the male confining his diet to vegetable juices, for he is not provided with lances like the female for cutting through the skin. The female is something of a surgeon, nature having given to it, apparently for pestiferous use, both lances and saws, as well as a pump, and these are always ready for an operation of blood letting. When the season for depositing her eggs arrives, the female seeks a victim, and filling herself with blood she makes off to some stagnant water and there lays a large number of boat-shaped eggs which hatch out in forty-eight hours in the form of wiggletails with which every one is more or less familiar. After continuing in the larval state for six days, it passes into the pupæ, and about three days later develops wings and becomes the mosquito, in which mature condition its natural life may be four to five months.

The spread of a yellow fever epidemic may be carried an unknown distance by swarms of mosquitoes in a wind, and by experiment the insect has been seen to retain its infection fifty-nine days, which is practically the length of the life of the average mosquito. Hence, when once inoculated with the parasite, a mosquito is always dangerous thereafter.

The distinction between the malarial mosquito and all others is that it stands at an angle of forty-five degrees from the surface on which it rests when in action. Its mouth rests on the glass or the human skin on which it stands. The common and the yellow fever mosquito was seen by observation in the hatcheries at the World's Fair to rest parallel,

MEDICAL DIRECTOR LAIDLEY AND STAFF.
THE EXPOSITION EMERGENCY HOSPITAL.

with its head and tail an equal distance from the surface on which it stands.

The dangerous yellow fever variety, however, may be readily distinguished from the malarial and the common mosquito by its general silvery color, and by its legs, especially the two hind legs, which are banded silvery white.

Also the difference in variety may be detected in the larvæ or wiggletails in the rain barrel. The malarial larvæ habitually float horizontally at the surface, while the common and fever variety breathe perpendicularly or obliquely, the head hanging down and the tail, through which it takes breath, resting at the surface of the water.

The foregoing statements are based upon representations made by Mr. Taylor, who is looked upon as an expert, but it is clearly reasonable to believe that while there are several kinds of mosquitoes all alike are capable of transmitting yellow fever or any other infectious or so-called contagious disease. It has in innumerable instances been shown that the bite of a mosquito or fly that had just before been feasting on carrion, has produced blood poisoning, and this fact may be taken as demonstrating the likelihood that any kind of mosquito may carry the infection of yellow fever, cholera, smallpox, or other disease communicable by infection.

Next to the Entomological Division in Government Building was the Weather Bureau exhibit, by which the workings of the signal service system, the means of determining weather changes, storm warnings, etc., were demonstrated.

Adjoining the Weather Bureau was the Navy Department display, which comprised models of nearly every battleship and cruiser belonging to the United States, also torpedoes, torpedo boats, and torpedo boat destroyers, floating and stationary mines, dry docks, tide measures, and the fore-section of a first-class battleship. This latter exhibit was a full-size reproduction of our most powerful man-of-war, complete in every detail from the furnaces to the crow's-nest and fighting tops. Visitors were permitted to inspect every part of the ship, and to see the sick-bay, the quarters of men and officers, the parade deck, and to understand how our navy boys live, move, and have their being on the most powerful crafts that protect our commerce and make the United States respected by all countries of the world. The most attractive sights, however, for the visiting multitudes were the armament, the big guns of thirteen-inch caliber that weigh sixty-two tons, cost $53,000, and which by the use of 250 pounds of smokeless powder discharge a projectile of 1,100 pounds weight more than twelve miles, and have an accurate range of more than seven miles. Every such discharge costs $600. The large guns naturally received proportionate attention, but the smaller caliber rapid-fire weapons came in for a goodly share, as did the torpedoes and the means by which they are launched at an enemy's ship from torpedo tubes. The machinery by which the shells and ammunition are brought from the magazine and conveyed to the guns was specially interesting, as were the provisions made for communicating orders to every part of the ship during an engagement. Electricity now performs a most important part, not only for lighting vessels, but also in handling the guns and projectiles and the system was accordingly exhibited and explained by officers detailed by the Government for that duty.

Beyond the naval exhibit was the Natural History display, made by the Smithsonian Institution, which excited the curiosity of thousands and the admiration of those who delight in studying the forms of animals and reptiles prehistoric and contemporary. There was among the former the skeleton of a horned dinosaur twenty-five feet in length, and a restoration of another species more reptilian in appearance, described in another volume. Suspended above these very ancient and now extinct creatures was the complete skeleton of a sulphur-bottom whale and also a papier mache restoration of this leviathan of the ocean as it appeared in life.

Objects which claimed very great attention and also inspired many inquiries, were enormous messengers from other worlds than ours, riven from their beds by some mighty force which science is as yet unable to fully explain. These curios from the skies were colossal meteors, one of which known as the Bacubirito meteorite from Mexico was thirteen feet one inch long, six feet two inches wide, five feet four inches thick, and weighs fifty-three tons. In the collection were four others, from Greenland, known as the Peary, the Tent, the Woman, and the Dog, the largest of which has a weight of ninety tons. When these gigantic chunks of metal fell upon the earth no one knows, no more than whence they came, but the knowledge is certain that they were launched from some world perhaps millions of miles distant and coming within the influence of the earth's gravity, fell with a force sufficient, we must believe, to shake our world like a volcano exploding in our immediate vicinity. The impact of a ninety-ton body falling from a height so immensely great can not be measured; we may console ourselves with the single fact that it failed to destroy the stability of the earth, for otherwise forced from its orbit the world might have gone on an undefined course and crashed into one of the planets, bringing destruction upon both.

Beyond the stuffed animal exhibit was an extensive mineral display and an exhibition of fossils, such as prehistoric fishes, invertebrates, crinoids, medusas, jelly fish, coral, all of extinct species. Near this division were strange deep-sea creatures, also butterflies, birds and birds' eggs, crabs and mollusks, sea-worms, anemones, other marine animals, and a synoptic series of existing invertebrates.

Next in the order of arrangement was a splendid exhibition of American Indian sculpture and Indian heraldry. This feature possessed very great interest for the student especially, since it served to show that early man recognized class distinctions quite as fully as does modern society, and probably had a system of caste as inexorable as that which is maintained in India at this time. Their sculpture work as shown did them little credit, the artistic instinct being undeveloped, nor do the Indian tribes of the present period exhibit any talent in this direction. Mysticism, however, may account in part for this lack of development, for the Indian has preferred figures that personify the power to terrify and appeal to the imagination with fear, rather than forms of beauty that invoke contentment and ideals that inspire to loftier aims. Specimens of Indian symbolic art pottery, which composed a part of the exhibit, clearly indicated this conception.

Adjoining the Indian sculpture collection were examples of ancient carvings resurrected from buried cities of Assyria, Greece, and Rome, which afforded a study of contrasts, but more consequential than these were copies, in plaster and models, of ancient Mexico and Central America statues, temples, and palaces. Reproduction of these evidences of artistic and constructive tastes and abilities of prehistoric races that once peopled the American continent, brought directly to the understanding of the masses a knowledge which they had only dimly perceived and which readers even had imperfectly apprehended from descriptions given by historians. These specimens of sculpture, architecture, and engineering accomplishments serve to give us a higher appreciation of the attainments of the Aztecs than the most exhaustive histories are able to impress, though they are useful at the same time to show that their achievements as builders and artists failed to divorce them from the most horrible superstitions which characterized their religious life.

Passing by with the haste that limited space makes necessary, omitting notice of the astro-physical observatory and the children's room of stuffed birds and a model of Professor Langley's flying machine, the visitor, in his examination of the Government Building exhibits, approached the Post-office Division, which comprised the most complete exhibition ever made of the system now in effect for mail transportation and distribution. There was the added interest which is derived from contrasts, for as present methods are the results of many years of experience and experimenting, the showing included the successive steps of development from the slow coach and saddle-bag, when it cost twenty-five cents to carry a letter three hundred miles, to the swift locomotive, fastest steamships, and pneumatic tube that carries and delivers to every part of the United States a letter for two cents. It is an amazing transition, which may be compared to the metamorphosis of a butterfly, from the chrysalis to the beautiful creature that adds color to the flower and bejewels the summer landscape.

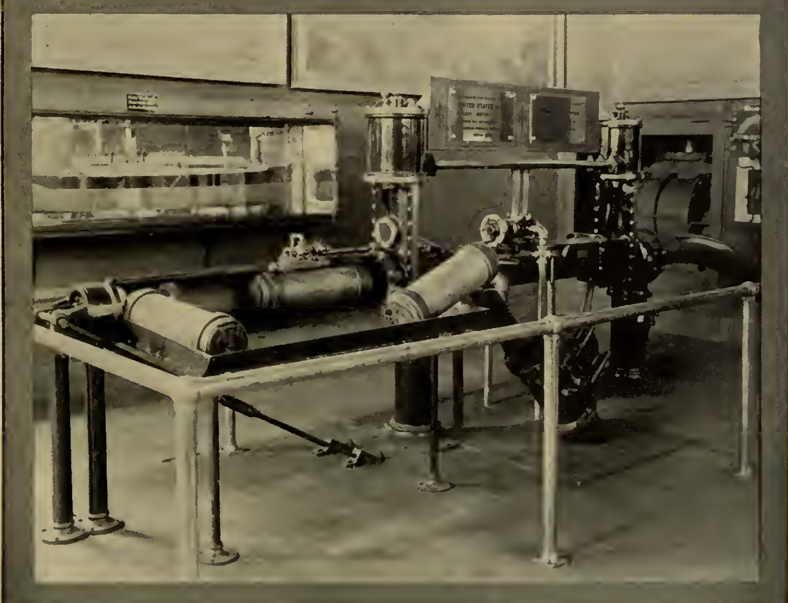
The first thing to claim special attention was a wonderful collection of articles that had been deposited in the mail, but which for lack of proper direction or insufficient postage were forwarded to the Dead Letter Office, and still remain uncalled for. In this strange medley of improbable things were to be seen snakes, horned toads, lizards, scorpions, spiders, bowie knives, pistols, bottles of poisons, combs, false hair, teeth, fancy work, shoes, a bucket that had traveled around the world, jewelry, funny hats, dolls, daguerreotypes, war-time photographs, picture frames, a stuffed dog, chains, bric-a-brac, watches, clocks, pen-knives, spectacles, clothes, etc.

Next to this collection was an Esquimo dog team, of real stuffed dogs, and sled, such as is used for carrying mail in our Alaska possession, beside which was the pony express, a plainsman mounted upon a sturdy broncho, which carried the overland mail through desert, forest, mountain, and hostile Indians before the Union Pacific Railroad was completed, in 1869. Behind the Pony Express Mail Carrier was an illustration of the primitive means that are still employed in many of the South American countries, in regions which the railroad has not yet penetrated. Instead of saddle bags, the carrier in the Andes country deposits the mail entrusted to him in two boxes that resemble small trunks, which are balanced when thrown across the horse, and with these he trots or ambles along at an easy pace because time is of small consequence, and there is no business hurly-burly in that country.

But that the comparison might be more striking, beside these relics of the olden time were shown the pneumatic tube service which is being installed in all large cities for the expeditious transmission of letters from one city station to another, a means that is next to electricity in celerity. Near these was a full-size mail car, fully equipped for catching a mail-bag hung up for an express train, and equipped with all facilities for assorting, distributing, and delivering. To better illustrate actual processes of mail handling, a half dozen or more biographs were placed in the Post-office Division, and fitted with several stereoscopic eye-pieces so that four or five persons might use one instrument at the same time. These were kept constantly running and being free to visitors were enthusiastically patronized. The motion pictures showed operations in every department of the postal service, collecting, delivering, assorting, distributing, and depositing. There was also a canceling machine through which letters and postal cards were run with such high speed that by its use it is possible to make 2,000 cancellations per minute.

An instructive comparative expense and income card was hung in the Post-office Department from which the following statistical information was obtained:

In 1890 Germany and the United States had practically the same postal income, but for that year the United States expended $10,000,000 more than Germany, the greater cost being due to larger territory served. For example, the postage on a letter sent from New York to Boston is the same as that on a letter that passes from New York to any point in Alaska, though several hundred miles may



PONY EXPRESS, AND SOUTH AMERICAN MAIL CARRIERS.
PNEUMATIC TUBE SERVICE, FOR DISPATCHING MAIL.

have to be traversed by the carrier with no other means of conveyance than a dog sled. For 1900 the United States postal income was $102,354,579, while that of Germany's was $107,958,839. In the same year the United States postal expenditures were $107,249,298, and that of Germany's $103,533,420. These figures are given, showing the comparative income and expenditures of two countries where conditions are dissimilar, in order to illustrate how much more expensive it is to give good postal facilities to a country much of which is thinly populated and the territory served is continental in size.

The Post-office exhibit was in the north end of Government Building, and occupied a large section on the east side, opposite which was a display made by the Coast and Geodetic Survey and Hydrographic Department. Near this section was an extremely interesting exhibit, made under Government direction, of the properties and uses of radium, upon which lectures were given daily and demonstrations made of its marvelous powers of light penetration. In connection with this display a radiograph exhibition was given in a dark room specially fitted for the purpose, with an auditorium that accommodated 200 persons, which was always filled with an interested crowd during lecture hours. In the adjoining section was an exhibit made by the Indian Service Department, in which were to be seen characteristic model habitations of many Indian tribes of North America, in connection with which there was displayed valuable statistical information showing population and what the Government is doing toward civilizing and elevating its wards.

By this showing it is made known that the total Indian population in the United States, excluding Alaska, is 270,000, and the number now within the Louisiana Purchase Territory 144,000. The total land allotment made to Indians, since the Act of 1887, is 50,226 acres. The number employed in the Indian service, as agents, teachers, physicians, mechanics, and police, is, whites, 2,264; Indians, 1,769. Annual expenditures for Indian education, under appropriations by Congress, $3,000,000; tribal funds, $104,000; contributions by missionary societies, $425,000. In the State of New York are still quite a number of Indians (5,257 by the census of 1900) descendants of the Mohawks, Iroquois, and others of the Algonquin parent stock, for which the State makes an annual appropriation of $25,000. According to the school statistics for 1903 the number of Indian pupils enrolled in 117 boarding schools under Government control was 19,860. Besides these there were 140 day schools with 4,500 pupils; 65 mission schools with 5,000 pupils; 43 public schools with 928 pupils, and 415 schools supported by five civilized tribes, that had an enrollment of 14,500. Growth of Indian education, excluding New York and Indian Territory from the statement, is shown by the number of pupils enrolled for three decades, as follows: In 1870 there were 3,095; in 1880 the number was 7,240; in 1890 the enrollment increased to 17,477, and the enumeration made in 1903 showed a total of 28,411.

Next to the Indian Exhibit a series of statistics was displayed by the Pension Department of the Government, from which some very instructive as well as surprising information may be gained. For example, few of us supposed that there were any pensioners of the War of the Revolution, which was terminated by a treaty of peace signed at Paris, 1783, more than 120 years ago. Yet report of the commissioner shows that in 1903 there were carried on the rolls, 2 widows, and 3 daughters, pensioners of that war. Of the War of 1812, there was 1 survivor and 1,115 widows. Of the Indian wars, there were 1,565 survivors and 3,169 widows. The Mexican War pensioners included 5,964 survivors and 7,910 widows. Civil War pensioners were classified as follows: Invalids, 702,832; widows, 230,381; children, 5,855; mothers, 9,682; fathers, 2,286; brothers and sisters, 186; army nurses, 624; making a total on the rolls, preceding the Spanish-American War, of 971,565. Pensioners of the Spanish-American War are classified as follows: Invalids, 9,200; widows, 933; minor children, 157; mothers, 2,241; fathers, 329; brothers and sisters, 2; a total of 12,862; or a grand total of all war pensioners on the rolls in 1903 of 984,427. But besides these there is a list of pensioners in what is called the Peace Establishment, as follows: Invalids, 9,170; widows, 2,304; minor children, 91; mothers, 472; fathers, 69; brothers and sisters, 2; a total of 12,108. No reports were made of pensioners of the War in the Philippines. In the above showing the total annual value of the pension roll is $133,029,090, and average annual payment to each pensioner $130.49.

For the first time at any Fair, so far as I have been able to ascertain, the Government exhibited a coining machine in full operation within the National Pavilion, and the process had all the drawing qualities of a great show. For obvious reasons there was no production of real gold or silver money, but the means shown were in all respects identical with those employed at the mints. Instead of precious bars, brass or composition was substituted and these were passed through the machine and subjected to every process, pressing, cutting, stamping, milling, and polishing, the same as real money, always excepting that the Government stamp was not impressed.

In 1795, the United States having blossomed out into full-fledged familyhood with the nations of the world, Uncle Sam foresaw the necessity of possessing a mint. A coining machine was purchased. This machine was exhibited side by side with the one above referred to.

The old apparatus is a turn-the-crank affair, and looks as if it might be an apple press or something equally rustic. But the contrast vividly tells the story of 100 odd years.

Hardly less absorbing than the coining is each of the numerous steps through which our metal money passes. Four or five thousand ounces of gold, silver, or copper are melted at a time in a naphtha furnace, which generates 1,900 units of heat and which roars like a tornado. The liquid, lifted out in cups, is poured into molds and comes out in sticks about a foot long, one-half inch thick, and one inch wide. The sticks are then compressed in a device which requires fifty horse-power to operate it. They are run through the press time and again to secure an exact thickness, which must be, in the case of double eagles, not a jot more nor less than eighty-three one-thousandths of an inch. By an infinitely delicate gauge—a "clock," it is called—the thickness can be regulated up to a thousandth of an inch. This accuracy is necessary in order that the strips from which the coins are to be made shall be of a uniform weight throughout their entire length; in other words, that a twenty-dollar piece shall have in it exactly twenty dollars' worth of gold.

The pressing hardens the metal. The strips then must have the first annealing process, which softens the gold. This means passing them under a spray of cold water. Now, all is ready for punching. The strips pass under a stamp which is capable of 180 perforations a minute, each punch resulting in a disk of precisely the correct diameter.

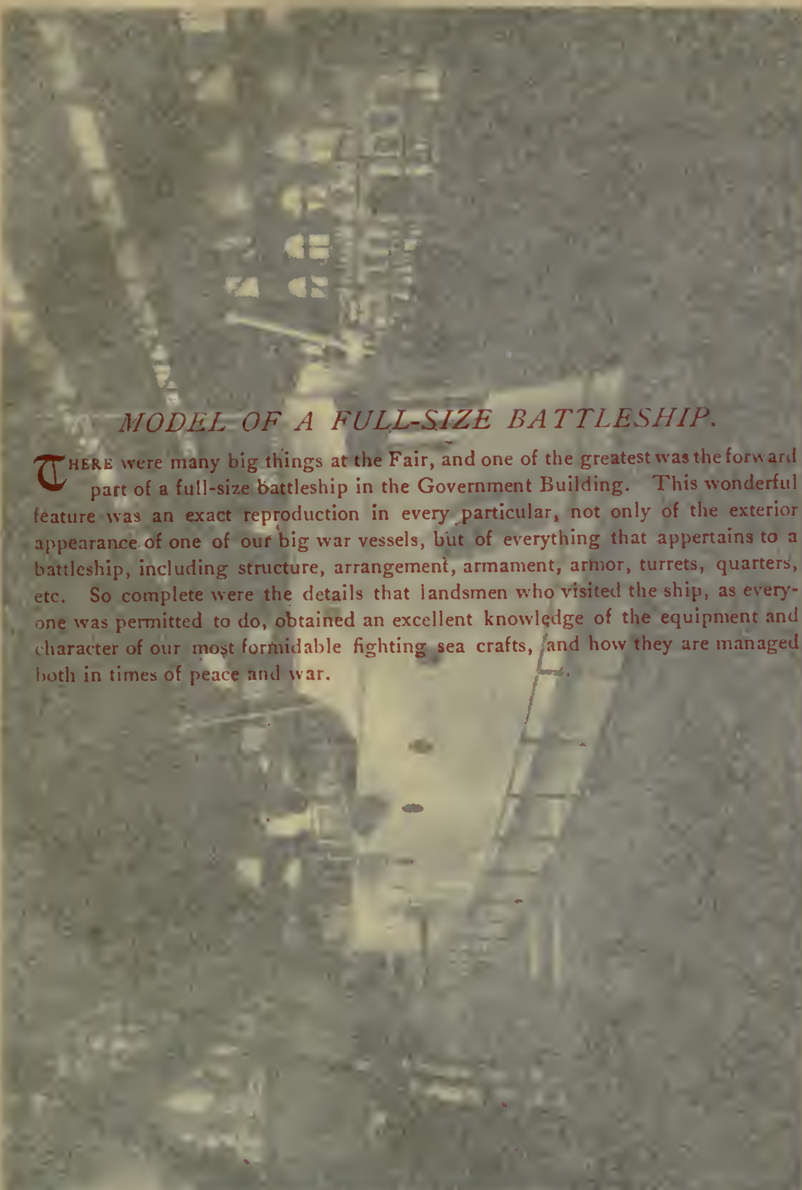
The punching frays the edges the least bit. This is remedied in what is termed the "up-setting machine." The term is simply a practical expression of what the device does; it turns over these roughened edges and also creates the little border or circle of indentations which are to be seen near the edges of every silver or gold coin, and at the same time the edge of the coin is milled.

The punching has again hardened the coin beyond its desired consistency. The seventh step of its manufacture, then, is a second annealing. From the "annealing cylinder" it comes out, if gold, a dull brown or blackish color.

Uncle Sam's new double eagles must shine with an undimmed luster, and the eighth process is a cleansing apparatus which cleans by the oxidization of the copper or the alloy metal. After cleansing, the coins must be dried; and a special device, as intricate as a dryer in any laundry, is designed to accomplish this purpose. Dried, they are ready for the coiner.

West Point was represented in a section devoted exclusively to that great national academy, the most attractive feature of which was a monument composed of guns and swords surmounted with a score of flags that have been carried through the bloody jaws of war. On one side of the monument stood the figure of a cadet adjutant, and upon the other a uniformed sentry alert and patriotically intent. The walls of this section were adorned with portraits of graduates of West Point who have earned military renown as commanders of armies in the field.

There was also a representation of the Naval Academy at Annapolis, which included a miniature reproduction of the numerous buildings, dry docks, testing basin, and ship models to be seen at that great institution, connected with



## *MODEL OF A FULL-SIZE BATTLESHIP.*

THERE were many big things at the Fair, and one of the greatest was the forward part of a full-size battleship in the Government Building. This wonderful feature was an exact reproduction in every particular, not only of the exterior appearance of one of our big war vessels, but of everything that appertains to a battleship, including structure, arrangement, armament, armor, turrets, quarters, etc. So complete were the details that landsmen who visited the ship, as every-one was permitted to do, obtained an excellent knowledge of the equipment and character of our most formidable fighting sea crafts, and how they are managed both in times of peace and war.

... silver or gold coin, and at the ... milled

... hardened the coin beyond its de- ... step of its manufacture. ... From the "annealing cylinder" ... blackish color.

... with an ... a cleansing ... upon ... intent ... portraits of ... military renown

There ... Naval Academy ... reproduction of the ... basin, and ... on, connected with

which was a representation of all naval uniforms worn by every rank, when off duty and when in action, at inspection, on parade, or serving the guns.

The War Department was in evidence both in the Government Building and on several parts of the grounds; chief interest of visitors centered about the guns, however, which were exhibited in marked variety as explained. Within the building were heavy army wagons, one of which followed Sherman's march to the sea and shows scars of injuries received in severe engagements. There were also stuffed horses that won distinction by carrying famous officers through many sanguinary battles. These attracted attention from those who have a fondness for relics of greatness and bravery. But even larger interest was shown for the Rock Island Arsenal display, in which were exhibited, among other military features, batteries of howitzers mounted upon mules, specially serviceable in a mountainous country where wagons can not be employed. These howitzer guns had a particular charm for the curiously inclined and the wonder was many thousand times expressed as to what effect a discharge of the weapon might have upon the mule that carried it. To gratify this desire for information, it may be told here that in many cases the unsuspecting animals, before being accustomed to their duties as gun carriages, are thrown upon their heads by the recoil. But they soon learn that by bracing themselves for the discharge, evil consequences may be avoided. The howitzer, however, is not so much used now, being replaced largely by quick-firing guns that throw shells much more destructive than were those used in howitzers during our Indian Wars.

The Army display also included an exhibition of weapons of all kinds that have been in service during and since the Revolution, and uniforms that distinguish all ranks, from private to general. These were shown on lay figures, and with a *vraisemblance* of men in action that excited much admiration.

In the northeast section of the Fair site was a large camp, where soldiers of the regular army and troops of militia were stationed and drills were a daily duty the same as at military posts. Artillerymen maneuvered with brass howitzers into position as if to attack the enemy, cavalry performed interesting evolutions, and infantry went through those many kaleidoscopic changes that at times seemed confusing, then suddenly changed into the greatest order. Each afternoon there was a dress parade, which is one of the most beautiful spectacles in military life. Soldiers from foreign countries joined with those of the United States in the display.

In the southwest section of Government Building, covering a large amount of space, was an Agricultural and Animal Husbandry exhibit, in which was shown the effects of fertilization, irrigation, selection, and rotation of crops, and also the housing, care, feeding, and breeding of live stock for dairy and market purposes. There was a department devoted to showing the pathology of diseases peculiar to cattle, sheep, and swine, a veritable museum, in which by the use of wax models that perfectly counterfeited dissected animals, visitors were able to note the beginning, progress, and ravages of such contagions as tuberculosis, glanders, anthrax, cholera, milk-sickness, murrain, and indeed all the ills that domestic animals are subject to. The exhibition was a most instructive one, accompanied as it was by information freely distributed respecting the prevention and treatment of all such diseases.

The Departments of State, Interior, and Justice occupied the entire south end of Government Building, in which were to be seen, among hundreds of other very interesting historical relics and documents, the first pension certificate ever issued by the United States; commissions signed by King Louis XV. to officers serving under Rochambeau in America; letters written by Commodore Paul Jones, and by Paul Revere; letters from Lafayette; treaties with England, France, and Spain; diplomatic correspondence from China, Japan, and other Oriental countries, and messages signed by scores of foreign potentates. There were pages of the Virginia Company's records of 1619-1624; autograph letters of Washington; Jefferson's letter of credence to Napoleon, introducing James Monroe as Minister Plenipotentiary; Monroe's journal giving his conversations with Marbois; songs that obtained vogue during the Civil War; the sword of Washington; Jefferson's rough draft of the

Declaration of Independence; the Purchase Treaty by which the United States acquired Louisiana Territory; table upon which Jefferson wrote the Declaration; Lincoln's Emancipation Proclamation; ceremonial letters from foreign rulers; proclamations signed by every President, from Washington to Roosevelt; treaties with all countries. In short, the almost infinite, as it is precious, wealth of national history of the Government was on exhibition at the Fair and the sight was such as inspired every American with a more patriotic appreciation of the nation and set a higher value upon his citizenship.

A few of the many other educational exhibits made in the Government Building include the following:

Poulsen's telegraphone, an invention that enables one to magnetically record sound waves on a steel surface, and is operated by talking through a telephonic transmitter connected to the machine, or by connecting the machine with a distant telephone. In the latter case, if the person with whom it is desired to talk happens to be out at the time, or is too busy to respond to the call, the message is automatically recorded and may be reproduced at any time. The original record may be obliterated and the wire, or band, used over again by passing the magnetized wire between the poles of a strong magnet.

De Forest's wireless telegraphy, one of the marvels of the age, which transmits messages between far-distant stations, whether on land or sea, and without any wires connecting the same. It has long been known that, owing to the phenomena of induction, certain electrical disturbances at one point would cause like disturbances at a distant point, although no wires connected the two places. This invention utilizes this principle by sending out waves of induction in all directions from the transmitting station, and then receiving the same at the distant station on a suitable instrument. By properly proportioning the wave frequency and the self induction, and the capacity of the instruments, it is said to be possible to so tune the receivers electrically that each will only respond to waves intended for the same, and thereby the messages intended for one station will not interfere with those intended for another. These induced waves are supposed to readily pass through any intervening object, as the light rays created in Crook's tubes penetrate dense substances.

There was also an exhibition of recent inventions for photographing colors by the Ives' process, and the same inventor showed specimens of parallax stereograms, which are photographs of persons or landscapes that appear to stand out in solid relief, perfectly simulating the natural view.

Evolution of the harvester was shown by illustrations of the various important steps taken by inventors during the past hundred years, in their efforts to produce a machine that would reap, bind, and thresh grain. In this exhibit were models operated by an electric motor, to represent an actual harvest scene, with all its color and animation.

# INTRODUCTION TO THE DIVISION OF MINES AND METALLURGY.

By Joseph A. Holmes, Chief of the Department.

Recognizing the fact that mines and agriculture are the fundamental sources of supply for the world's needs, and that until the date of the Louisiana Purchase mining was but little known in the United States, the Directors of the Louisiana Purchase Exposition Company were most liberal in their appropriations for the Department of Mines and Metallurgy. The building prepared for exhibits of this character far surpassed anything of the kind ever before provided for a like purpose.

The prime aim of the Exposition authorities was to show in the great palaces for exhibits at St. Louis not alone products and results but the processes and stages through which the products pass in order that they may become of use to mankind. The exhibits in the Palace for Mines and Metallurgy were accordingly divided into five great groups, and these in turn into fifty-three classes which covered all the stages of mining from the preliminary prospecting and surveys down to the manufacture of mine products into articles of public and general utility. Wherever it was pos-

WYOMING EXHIBITS, MINES AND METALLURGY.

sible so to do, these processes were shown in actual operation.

Group 115, Classes 667 to 681, inclusive, provided for exhibits which illustrated the equipment and processes connected with the working of mines and ore beds, including the equipment and methods of geological surveys; the methods and equipment for prospecting for mineral deposits; the methods of opening up, draining, and ventilating mines; the equipment for the underground and aboveground transportation, and handling of ores and minerals.

The nineteen classes under Group 116 provided for exhibits illustrating the mineral resources of this and other countries. It included all minerals and the equipment and processes for preparing them for use. Under this group were shown systematic collections in geology, general mineralogy, crystallography, and paleontology; ornamental and building stones; mechanical appliances and processes used in cutting, shaping, and polishing marble, granite, and other building stones; rocks which produce lime and cement; grindstone and other mineral abrasives; slate and equipment for preparing same; refractory rocks; clays, kaolin, flint, and feldspar; mica and asbestos and other non-metallic minerals; gems and precious stones; mineral waters; mineral fuels, peat, lignite, bituminous coal, anthracite, equipment and processes for compressing coal and other mineral fuels; the storing and refining of oil.

Class 701 provided for maps, charts, photographs, and models illustrating geologic or topographic features, and their relation to mineral deposits, or the structure or mode of occurrence of mineral deposits; mine models; working plans of mines; maps, photographs, etc., of mining operations, plants, camps, etc.

Group 118, which comprised seventeen classes, provided for exhibits of the equipment and processes for the handling and preparation of ore; hand sorting, storing, sampling, crushing, and pulverizing; screens and screening, concentrating, conveying, drying, etc.; the equipment in the amalgamation of ores and in the use of cyanide, chlorine, and other chemical solvents in the treatment of ores; the equipment and processes in smelting ores; the equipment, processes, and products used in the treatment of the ores of iron, manganese, chromium, nickels, and other metals used in the manufacture of iron alloys and special steels; the equipment, methods, and products of the manufacture of iron and steel; ordnance equipment other than naval, large forgings, gun-barrels, projectiles, tubes, etc.; equipment, material, and processes used in the metallurgy of copper, gold, silver, zinc, tin, nickel, cobalt, and aluminum; general foundry equipment; equipment, processes, and products of electrometallurgy, etc.

Under Group 119, Class 719, provision was made for exhibits of statistics and publications relating to the geology, mineralogy, paleontology, topography, quarrying, min ing, metallurgy, the manipulation of mineral products, the development of water resources, etc.

In some cases it was only possible to secure a representative exhibit of an industry by making the display a collective one and having a uniform method of installation which would show the industry in a manner more complete than could be possible if these exhibits were made by the individual concerns operating independently one from another. In this manner collective exhibits were prepared to show, in the most attractive and comprehensive manner possible, our mineral water resources, our wealth in coal, our iron and steel products, and our brick and clay industry. These exhibits illustrated the resources of the entire country and proved of great interest to the general public and a source of information and study to those who were particularly interested in these industries. The identity of each concern contributing to these collective exhibits, however, was preserved.

Carrying out the purpose of an international exposition, the spaces granted to foreign countries were most liberal, and the exhibits exceeded any previously made by these countries in the Mining Department. Emphasis may be given to the exhibits of France, Germany, Great Britain, Mexico, Brazil, Italy, Canada, and Japan. Other countries, such as Sweden, Belgium, Argentina, Chili, Peru, etc., also installed exhibits illustrating their mining and quarrying industries.

Turning to the more technical and educational feature, there was a fully equipped operating assay office conducted by students and efficient experts, and a fully equipped technical and scientific library, a liberal space being allotted for geological maps, charts, models, etc. In addition to these educational and practical features, several states and nations installed in their exhibits certain specially distinctive objects more likely to attract the popular eye, such as the gold quartz of California, the rare copper ores of Arizona, and the tellurides of Colorado, with occasional stone and metal monuments and trophies of artistic merit and industrial significance.

A shallow ravine, extending south from the Mines and Metallurgy Building, and embracing about thirteen acres, was filled with operating mining and metallurgical exhibits. This had a length of about 1,200 feet, with an average width of 400 feet. At the northeastern end of this ravine and where it widens on the west side was erected the cement building. In this building, which was constructed entirely of cement, was exploited the many methods now in use for the preparation and mixing of cement rocks. To this were added articles illustrating the uses of cement and equipment for cement testing. The cement building of itself was one of the most important features of the exhibit.

As an allied industry to that of cement was a working exhibit illustrating the manipulation of fire and pottery clays, with the continued processes from the rolls and

BETHLEHEM STEEL CO. EXHIBIT, MINES AND METALLURGY.
HUNGARY'S MINERAL WATER DISPLAY, MINES AND METALLURGY.

crushers through grinders, mixing pans, and dryers, to the potter's wheel and firing ovens, the artist's studio and the final glazing.

Adjacent to the pottery and cement works was erected the terminal or dumping bins of a series of aerial wire tramways, which having taken their contents from the sources of supply at the head of the Gulch, conveyed them at high levels along the entire length of the ravine to be finally deposited or reconveyed to their source automatically by methods in constant and actual practice in many mining districts.

Occupying the intervening spaces between the elevated tramway cables, projected the derricks of several artesian wells and oil boring outfits in actual operation, together with a full display of tools and other appliances, demonstrating by actual operation all the practical methods of sinking through sand, gravel, and rock, the extraction of wedged and broken tools, the application of sand pumps and torpedoes, together with the processes of tubing, and finally of the pumping of the oil with subsequent storage and transportation. On the abrupt slopes of the area was erected an operating gold mill, in which was shown the method of crushing gold ore, and the collection of the metallic contents on plates, followed by the concentration of the tailings and slimes. In continuation of this practical gold mill was another especially designed to demonstrate the use and application of cyanide and other chemical processes in the extraction of gold from tailings that have passed over the plates and concentrating tables. On the low east slope at the side of a dry ravine was erected a typical miner's cabin, beneath which was illustrated as in actual existence a New Mexican turquoise mine with the turquoise enclosed in its native rock in place and the lapidary reducing the gem to merchantable form. Further on was exhibited the primitive and picturesque methods of smelting copper ores practiced by Mexican Indians by the means in use when Cortez visited that country. The natives, during the time they were engaged in this work, lived on the ground in their tile-covered huts and prepared their corn and food in primitive hand mills, baking their tortillas in still more primitive clay ovens. Adjoining this rude camp was erected a structure devoted to a demonstration of the more modern methods of mining, breaking, washing, and sizing of coal, together with the several methods for transportation and delivery at destined points.

As an allied exhibit to the coal mine there was an electric railway, which demonstrated a novel and effective method for the utilization of the third or central rail in the operation of coal mining trains around abrupt curves and over steep grades. The overhead tramways were utilized when needed to convey raw and waste materials to and from the several special points indicated above, illustrated what is rapidly becoming one of the most economic features in the operation of mines located at otherwise unaccessible points.

## DIVISION CXXXV.

### Exhibits and Processes of Extracting and Converting.

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Legends of the North, preserved in the Nibelung, with remarkable picturesqueness of the imagination, assert that the recesses of the earth are peopled by a race called gnomes which, though it is not told how they obtained food, applied themselves with industry to gathering the precious metals and to exercising the authority that vast wealth gives. These are not wholly idle tales, because they serve at least to teach the folly of seeking to acquire inordinate wealth and the misery which riches often entail, for though the gnomes possessed gold and silver in measureless quantity, they were slaves of toil and victims to their own rapaciousness. But with wisdom directing the object and the quest, delving in the earth for mineral is one of the most useful and profitable pursuits, ranking next to agriculture both in benefit and profit to mankind. History fails to tell us what inspired early man to dig in the earth for ore, but in the earliest records he is represented as an artificer in iron and brass, which shows a knowledge of alloys and the compounding of metals. As Prometheus was believed to have stolen fire from heaven, so it was the gods that gave iron to man, in the form of meteoric thunderbolts hurled by Jove, which afterwards being found were wrought into weapons for war and the chase. The first metal which primitive man knew came out of the heavens from some far-away wandering world, which shot through space in the form of a blazing meteorite and falling upon this earth, brought both fire and mineral. Such an introduction gave rise to a belief that it was a gift of the gods, and the circumstance, it must be admitted, was well calculated to create in the superstitious minds of our remote forebears a faith in the existence and interposition of divinities.

Mining has always had a fascination for bold spirits, due to a mixture of danger and reward involved in the pursuit, and though it is said that for every dollar of gold taken from the ground two are expended in the effort, the quest continues with no relaxation or loss of ambition. But while the precious metals are made the basis of commercial trade and values, their use to mankind is one of the least as compared with iron, coal, copper, zinc, in the order named, though with these the gnomes were not believed to be concerned.

On the other hand, however, Vulcan, the god artificer, had no use for money or ornaments, and with a superior wisdom established his forge for the fabrication of iron implements and weaponry. In the Mines and Metallurgy Building it was therefore peculiarly appropriate that a great

GIANT VULCAN, BIRMINGHAM, ALA., EXHIBIT.

CALIFORNIA EXHIBIT, MINES AND METALLURGY.

statue to this mythologic divinity should be reared as a personification of the bigness and importance of the mining industry. This enormous figure, made of cast iron, is fifty-six feet in height and weighs 130,000 pounds, and was contributed by the iron manufacturers of Birmingham, Ala., through the Commercial Club of that city. The removal and setting up of this enormous mass taxed engineering ability, since the weight was supported entirely by the feet and a sufficiently solid basis was therefore extremely difficult to form. This was accomplished, however, by driving heavy piles down to bed rock, a depth of nearly thirty feet, and upon this foundation the mighty blacksmith stood with dart in his uplifted right hand defiant alike of all the powers of earth and sky.

The most extensive exhibits in Mines and Metallurgy Building were of coal and coal production, in which displays Pennsylvania easily had commanding place, as her interests led visitors to expect. Most interesting was a miniature coal mine in operation, every conceivable detail being represented, which demonstrated the processes of mining, hoisting, screening, handling, and transportation. Pennsylvania exploited her coal and coke industry in a more attractive manner than any other State, but West Virginia, Indian Territory, Kentucky, Illinois, and Indiana were well represented by expositions of their coal productions.

While coal had the first place in point of prominence, the iron and steel industry was only a degree less conspicuous, and some of the displays, such as that made by the Bethlehem Steel Company especially, equaled, possibly exceeded, in extent and interest that of any other industry. Visitors were attracted by the display of naval armament, the big thirteen-inch guns, the rapid-fire weapons, the battleship turrets, and the sections of Harveyized steel plates made for the Government by the Bethlehem Company.

Next in prominence was a display by Werth Brothers Company, which exhibited the process of rolling sheets of steel, and the forging of boilers, tubes, and such like metallurgical triumphs in special fields.

The Taylor Iron and Steel Company made a very fine display of manganese steel, and in connection with the International Nickel Company the exhibit included a showing of nickel alloy with manganese that produces a metal of extraordinary strength and fineness. Near this exhibition was a display made by the Lanyon Zinc Company, which demonstrated the wide range of uses to which this metal is adapted, not the least of which is its employment in architectural decorative work. The installation, that covered acres of space, which, though it appertained in all instances to mines or metallurgy, the raw product or the manufactured article, comprehended a variety that was apparently interminable and occasionally taxed the judgment of visitors as to the proper classification. Every one could, of course, readily understand that metal, minerals, and stones belonged of right in the mineralogical department, but in the course of their examinations visitors occasionally met with a display of oils, waters, wool, woods, vegetables, and even animals, which produced marked confusion until explanation was made that the oils were produced from petroleum, which by refining processes became lubricants and medicinal, serving practically all the purposes for which extracts from animal matter are used. The sparkling waters that looked so grateful to thirsty visitors during the warm days, were also of mineral origin, many of which were very much more inviting in appearance than pleasant to the taste. The wool was asbestos, which is mined extensively in its natural state, or produced from slag by a blast process. The woods were originally trees which in the very long ago were felled by storm or a convulsion of nature and became transmuted into uncrystallized quartz called agate, susceptible of a high degree of polish, and in which all colors are perpetually imprisoned. The vegetables and animals shown had also changed their properties and become converted into petrifactions of solid stone, a wonderful thing to the masses, but well understood by the scientist.

There was real human interest in the displays of operative machinery, such as coal cutters, rock drills, hoists, conveyers, mill apparatus, mangles, jigs, washers, stamps, lathes, planers, borers; in fact, machines of so many kinds that human muscles and fingers appeared to have been completely supplanted, and only intelligence was henceforth needed to direct.

The Allis-Chalmers Company, Milwaukee, displayed in the Mines and Metallurgy Building, a number of various sized steel shafts suspended from a frame in the center of their exhibit of rock breakers and cement making machinery. There were ten of these finished shafts used in their gyratory rock and ore breakers, the largest of which was seventeen feet eight inches long and twenty-one inches in diameter, built for the machines having a crushing capacity of 500 tons of rock an hour. The smallest of these was two and three-quarter inches in diameter by twenty inches long, for the light machines of one-half ton per hour.

It is the nature of woman and man alike to feel chief concern and admiration for things that stand for wealth and aggrandizement. Among uncivilized people this tendency is strongly indicated; the African takes delight in brass rings; the Laplander has his preference for reindeer; the people of the pampas love cattle; the Indian aspires to paint, feathers, and blankets; the South Sea Islander most admires gewgaws. But civilized man worships the golden calf, and builds temples of Mammon in his mind where he sacrifices all the days of his life. To minister to this aspiration and give assurance that wealth is not to be estimated merely by imagination, there were displays of gold and precious things to please female fancy so ample as to excite the thought that all the gnomes of the earth had brought their stores to the Exposition to prove by this showing of superabundance that gold is really as plentiful as stones;

BRAZIL'S EXHIBIT, MANUFACTURES.
BRAZIL'S EXHIBIT, MINES AND METALLURGY.

that in Colorado especially the one obstacle to successful farming is the work required to clear the land of gold nuggets, which so cumber the ground that all planting must be done by the use of crowbars.

While imagination may not soar to so great a height without danger of melting its wings in the heat of a golden sun, it is a truth that the Colorado display was quite enough to break the heart of a sordid man. In the section devoted to precious metals the Colorado commissioners had collected a quantity of gold so large that not a few supposed it was a counterfeit presentment. The gold thus shown was in nuggets and masses that resembled crystallizations, immense bunches of wire, and gold-bearing quartz, some of which having been roasted beads of gold were brought to the surface often as large as buttons and as thick as measles. In other cases there were masses of stone that carried gold and silver in such generous proportions that white and yellow seams permeated and ramified every square inch.

But the Colorado exhibit of metals was not confined to gold, for the showing included copper, bismuth, cadmium, chromium, antimony, sulphur, and many others, besides carnotite from which radium is extracted in greater quantity, it is said, than from pitch blende.

Another interesting feature in Mines and Metallurgy Building was a life-size figure of Lot's wife in salt, which was a part of Louisiana's exhibit, salt mining being one of that State's leading industries. Utah, however, to show that she is a competitor, made an exhibit, by photographs and sample jars, of the inexhaustible supply which Salt Lake affords, the harvesting of which is attended with no great labor and relatively small expense. The proportion of salt carried in solution in the lake is one barrel of salt to every five barrels of brine.

California, recognized as the Golden State, verified her claims by a display of models of the largest nuggets ever found in the United States, and samples of auriferous-bearing quartz, second only to that of Colorado's. The showing was so seductive that the spirit of '49 was revived in the aged and the present generation became ambitious to become Argonauts and seek the golden fleece in California.

Montana also entered the lists as a gold-bearing State, but her greatest effort was in exploiting her copper mines, which now have the distinction of being the richest in the world.

Arizona, famous for many things besides horned toads and Gila monsters, exploited her vast alkali deposits, carbonates, the fertility of her soil under irrigation, and her lakes of liquid asphalt; nor were her gold and silver mines neglected in the exhibits, though these were not very prominently brought forward.

Nevada is a part also of the great gold range, from the quartz of California through the tellurides and sulphates of Arizona and Colorado to the placer mines of Montana, to reappear in the quartz of the Black Hills. But though

Nevada has a large annual output of gold, the State exploited the borax industry most prominently. It is the few that know the uses or properties of this natural product; that it is a crystalline salts extensively employed as a flux, also in soldering metals, making enamels, fixing colors on porcelain, and for making soap. The largest deposit probably in the world is in Death Valley, a torrid oblong-shaped desert that occupies a territory fifty miles long and thirty-five miles wide on the dividing line of Nevada and California. The desert lies 210 feet below ocean level, and being waterless the temperature rises to 135 degrees Fahrenheit. It derives its name from a tragedy that occurred in 1850, when an emigrant party of thirty persons attempted to cross it on their way to California, and suffered so horribly from heat and thirst that eighteen of the company and all their animals perished. Nature seems to have tried to debar man from the region, and thus to protect from ravishment the mineral treasure which here abounds, but discovery of borax was followed by an invasion of this eerie land, and despite burning atmosphere, alluring mirage, deadly poisonous reptiles, and terrific sandstorms, the Pacific Coast Borax Company has developed the industry into one of great profit. A part of Nevada's exhibit accordingly was a twenty-mule team, such as is used for hauling borax out of Death Valley. All the water used by men and animals on the trip has to be hauled, and provision is made accordingly so that the twenty mules are required to drag a train of three wagons, one of which is for the load of borax, another for camping outfit and the third is a tank vehicle with a capacity of 1,500 gallons. The wheels are seven feet in diameter and the tires are seven inches wide, to prevent, as much as possible, sinking in the sand. The average distance covered each day, while making the trip, is about fifteen miles.

There were several very decorative exhibits in Mines and Metallurgy, prominent among which were coal arches and towers; marble colonnades; a pyramid of mineral from which lithia, an alkaline caustic similar to potash and soda, is made; booths of crystals; statuary of mineral composition; granite shafts, etc., but the most beautiful of these attempts to produce ornamental entrances to exhibits proper, was a vault and imitation safe, electrically lighted, which contained Canada's $60,000 display of gold dust and nuggets taken from the Yukon district. This virgin store was arranged on five shelves placed inside the open safe, protected, however, by strong iron bars. The safe was enclosed by a vault, sixteen by fourteen feet in size, composed principally of quartz and ore-bearing rock found in Canada, such as jasper, conglomerate, alabaster, copper, and limonite. A very pretty feature of this vault architecture and arrangement was a mantel and fireplace, the latter filled with gold dust and nuggets to simulate fire. In this exhibit ninety-three mining camps of the Dawson district were repre-

WISCONSIN EXHIBIT, MINES AND METALLURGY.
KANSAS EXHIBIT, MINES AND METALLURGY.

sented, but the gold was the property of the Bank of Montreal and the Canadian Bank of Commerce.

The Palace of Mines and Metallurgy contained the most valuable objects that belonged to that department, but within was only a part of the mining exposition, for the plans comprehended an exhibit of actual processes, demonstrations of appliances, devices, heavy machinery performing the work required in taking mineral from the mine and preparing it for market in the case of coal, and crushing, washing, refining, and the many other workings to which gold and silver-bearing ore must be subjected. In order to accommodate an out-of-door exhibition on the scale contemplated, thirteen acres of ground were set apart for the purpose in a ravine which lay between Art Hill and the Plateau of States. This reservation was called the Mining Gulch, and in some respects it was a rival to the Pike attractions as a show place. A narrow gauge third rail electric railroad ran through the center of the Gulch, performing the double service of carrying passengers and hauling trains of loaded freight cars. A metal pavilion sixty by one hundred feet, at the north end of the Gulch, housed the operating machinery used to illustrate electrical metallurgy, which comprised smelting and refining of copper, zinc, lead, and alloys. There was also a model foundry, one hundred by one hundred and ten feet, adjoining the metal pavilion, which was equipped with cupolas for melting iron, crucible furnaces for casting, cranes, ovens, and every facility for moulding, finishing, and polishing castings.

There were models that showed underground workings, reproducing in miniature every detail of mining operations. This exhibition was most realistic, the representation being made to appear more interesting by construction of a scenic railroad 1,740 feet in length, that carried visitors the full extent of the mines. By this means of conveyance passengers were enabled to witness with comfort and gratification automatic mannikins at work with picks, shovels, and wheelbarrows, blasting, sorting, loading miniature cars, hoisting, and simulating all the duties of real miners.

In the Missouri section of the Gulch were a coal tipple, a lead and zinc concentrating mill, and a magnetic separator for lead and zinc ores.

South Dakota made a very ambitious display, by setting up a full-size stamp mill, in which ores were treated without regard from whence they came, to show the relative value of competing processes for extracting metal from ore.

The Carizzo Copper Company provided a unique show, in which a party of eleven Mexican Indians gave frequent daily exhibitions of primitive copper smelting and producing souvenirs for visitors.

The Arizona Mining Camp, in a large enclosure, gave an entertainment characteristic of the frontier, furnishing all the concomitants of mining operations and rollicking after-hours spent in dance halls.

20-MULE TEAM, IN FRONT OF PENNSYLVANIA BUILDING.
ARIZONA'S MINING EXHIBIT IN MINERS' GULCH.

Other interesting features of the thirty-two separate exhibits in the Gulch were the following: The United States Fuel Testing Camp, under the direction of the Geological Survey, demonstrated methods of testing fuels of all kinds, also of washing, briquetting, coking, gas-making, and the steaming values of fuels.

The South Dakota Gold Reduction Plant gave exhibitions of the cyanide process of gold reduction, but a scarcity of ore made it impracticable to attempt these demonstrations daily. There was also a gold mill set up by California to illustrate methods of crushing auriferous ore and extracting the gold by the amalgamation and concentration processes.

The New Mexico turquoise exhibit was a representation of the Porterfield mines, near Silver City, from which most of these pretty gems seen in the United States are obtained. Entrance to the mine was through a cabin that was stocked with a large store of specimens of cut and polished stones, and thence led by a gradual descent to a fifty-foot level that was ramified by 120 feet of tunnels through turquoise-bearing rocks. The showing accordingly represented a real mine, exhibiting leads, veins, and embedded gems exactly as they exist, and in connection with the reproduction was an exhibit of methods employed for extracting, cutting, and polishing the stones.

There were steam drills at work for oil, water, gas, and minerals, and the Delavel Steam Turbine Company showed a fifty-five horse-power high pressure pump at work lifting a stream of water to an incredible height and throwing it against a barricade with a force of 250 pounds to the square inch; placer mining processes were exhibited; endless chain conveyers were carrying coal and mineral ore across the valley, and throughout the Gulch there was the animation of a large camp in full operation.

As an adjunct to the Gulch, though not a part of it proper, was a cement pavilion 80 by 100 feet that demonstrated the uses of concrete for foundation and architectural constructions, next to which, at the north end of the valley, was a very large exposition of the Zanesville, O., Art Pottery Works. This was a most interesting exhibit, showing as it did every step in the manufacture of all kinds of pottery ware; grinding the clay, mixing, kneading, moulding, modeling, baking, glazing, and decorating. Objects thus made and exposed for sale were of great variety, from a flower pot to the most beautiful jardinieres, vases, and pedestals, besides admirable imitations of French Siccard and Aurelian pottery.

## *AN ALASKA DOG TEAM.*

In the recent development of Alaska, which is scarcely more a mineral than an agricultural land, for it is almost equally great with potentialities of both, the United States Government has taken a prominent part. The problem of providing mail facilities was one of the most difficult, but was finally solved, to a large extent, by the use of dog teams, that are now extensively employed to haul specially built sleds upon which mails are carried to and from every post station in that arctic country. The picture herewith shows one of these dog teams as it was exhibited in the post-office department of the Government Building at the Exposition.

# INTRODUCTION TO THE ELECTRICAL EXHIBITS.

By Prof. W. E. Goldsborough, Chief of the Department.

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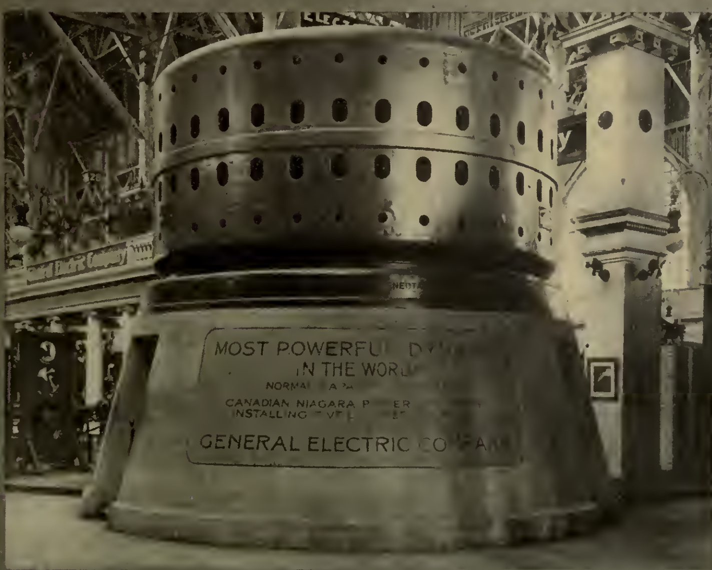
Even though, to the average observer, the art and science of electricity embrace, for the greater part, phenomena which it is hard to understand, it is yet fair to say that electricity, as pictured in the exhibits of the Louisiana Purchase Exposition, was revealed in many of its most fascinating aspects in a way to be readily comprehended by any who were willing to give a moderate amount of time to studying the electrical installations. In and about the Palace of Electricity and in various places on the grounds, every present-day electrical activity was illustrated and demonstrated in one or more of its adaptations.

The history of electricity from its beginning in little things was pictured in the exhibits of Edison, Gramme, and Farraris. In the exhibit of Edisonia, which was arranged in the southeast section by the Association of Edison Illuminating Companies, the most important creations due to Mr. Edison's earlier work were exhibited. The thoroughness with which this exhibit covered the field is best appreciated by a brief review of the more important items shown. The first commercial Edison electric lighting plant was installed on the steamship "Columbia," running between San Francisco and Portland, Ore. The dynamo, which was part of the exhibit, was one of four machines that formed this pioneer installation for commercial electric lighting by incandescent lamps. This dynamo is still in good operative condition. The electric locomotive and trailer car shown were built and first operated at Menlo Park, N. J., on May 30, 1880. Improved types of electric locomotives were afterwards constructed and operated at the same place, one in 1881 and another in 1882. At the present time the electric locomotive is probably receiving a greater amount of attention than any other one item affecting the economic welfare of the world.

The equipment used in the Edison Electric Lighting Station at Sunbury, Pa., in 1883, and which includes engine, dynamo, and electrical measuring instruments, was also shown. This equipment was in continuous use until it was dismantled to be brought to the Exposition.

Edison's first direct-connected, steam-driven electric generator, "Jumbo," was an interesting feature of the display. This dynamo is the first of all the direct-connected, steam-driven electric generators which to-day have attained such enormous dimensions. In contrast, huge modern units of this character were in active operation at the Exposition in the joint exhibit of electricity and machinery in the west end of Machinery Hall; while one of the latest and most gigantic power units of modern times, which are now being


EDISON'S FIRST ELECTRIC LOCOMOTIVE AND CAR.
ONE OF THE BIGGEST THINGS AT THE EXPOSITION.

installed in one of the great power plants at Niagara Falls, was exhibited in all its dimensions by the General Electric Company not many feet away from Edison's first installation.

The first "Jumbo" was exhibited in Paris, October 11, 1881, and twenty-four similar steam-driven machines were commercially installed in London, New York, Milan, and Santiago. The "Jumbo" exhibit thus mentioned consisted of a generator and engine, the total weight of which is thirty tons.

To the right of the center of the Edisonia exhibit, and suspended from the ceiling, was an electrolier, the first ever made and wired for incandescent electric lighting, with the original incandescent lamps. It was placed in service some time in 1880 at Menlo Park near the laboratory where all of Mr. Edison's experimental work in connection with the incandescent lamp was done.

To the right of the electrolier was a most remarkable display, illustrating the complete development of the incandescent lamp in examples taken from the product of Mr. Edison's laboratory from the inception of the work until the present time. This is the first time the collection has ever been shown in its entirety. It may truly be said to represent the history of the art and is the result of systematic efforts on the part of Mr. William J. Hammer during the past twenty-five years.

The above is but a glance at one of the most remarkable exhibits of the work of one man ever brought together. The exhibit of Edisonia was unique in many particulars and its full description, as compiled and printed, constitutes a volume of over 200 pages.

The beginning of things electrical in Europe was shown principally in the exhibits of France and Italy. The French exhibit occupied an area of 25,000 square feet, just east of the main entrance to the Palace of Electricity. A feature of the fine exhibit made of the modern adaptations and developments in the use of electricity in France was the special historical exhibit by the Societe Gramme, which showed the first dynamo built in Europe by Zenobe Gramme in 1869. This machine rested just below the bust of Zenobe Gramme.

A notable part of the Italian exhibit was a historical collection of the above apparatus made by Volta, Paccinnoti, Belli, and Farraris. The exhibit was most interesting, and though it pictured what might appear but a small result, yet it was as substantial a recognition as any man may ask, for around these creations as a center clusters not only the sentimental regard but, as well, the profound admiration of the thinking men of the age.

Of course, the exhibits in electricity went far beyond the early history of the art. A better conception of the extent and variety of the things shown is obtained from one of the monogravures printed in this volume of the Westinghouse exhibit, which gives a general bird's-eye view over the northwest corner of the building on two sides of the court. In this picture are embraced examples of the best efforts of the best electricians of modern times. It is needless to attempt to pick out each detail here, but, in brief, it may be said that the exhibit represented, in commercial perfection, a complete line of machines for generating electricity, a complete line of machines for changing electricity from direct to alternating current, a complete line of single-phase alternating current motors, five complete new systems of electric illumination, and a multitude of smaller things in the way of instruments, recording apparatus, and special adaptations, all of which are the result of the inventive genius of a decade.

Among the sources of illumination shown in the Palace of Electricity and which have been brought to public attention since the Chicago Exposition may be mentioned the enclosed arc lamp, now almost universally used in street illumination in replacing the older forms of open arc lamp; the Nernst lamp, which is a new form of incandescent glow lamp; the Bremer arc lamp, which is a new form of arc lamp emitting a rich yellow light instead of the bluish purple light of the common arc; the Magnetite lamp, another form of arc emitting an intensely white light; and, finally, the mercury vapor lamp, emitting a light with a wonderfully small consumption of energy, but of a quality so green and ghastly as to make it entirely impossible for use under ordinary social conditions.

The advance made in the art of illumination has opened the way to production of artificial illumination at a very much less expense than has heretofore been possible and while several of these new sources of illumination are not yet in common use, with their introduction should come also the possibility of cheaper light and more light for the people of the world. When we remember the tremendous scientific journey which has been accomplished during a few short years in emancipating humanity from the tallow dip of the ages, no further example is needed to bring vividly before us the picture of the breadth of life which is now enjoyed by comparison with the confined environment of times past.

We have not yet touched upon the dominant idea and principle underlying the exhibits in the Palace of Electricity. They were developed with the most painstaking care by the best talent which America possesses, to bring out, through active, working, pulsating exhibits, the real uses and diversified applications of the myriad number of appliances which are thrown into almost life-like activity when actuated by an electric current.

On a slab in the center of the general electric exhibit was a little white glass tube. This relatively insignificant piece of apparatus was, in fact, an appliance for converting alternating currents into direct currents of electricity. It is a modern invention which takes the place of electrical machinery weighing several hundred pounds, and, in the present instance, was connected in circuit with the huge electric generators in Machinery Hall for the purpose of converting the alternating currents which these generators develop into direct currents of electricity for charging the storage battery in the box on the rear platform of a skeleton automobile. The automobile was one designed and built to be driven by the storage battery through the medium of the electric motors just beneath. The whole apparatus was equipped and arranged to be operated at a moment's notice for the benefit of any observer who desired to study its details.

On the right of the apparatus described was a mining locomotive arranged on a stone ballasted track. This locomotive was constantly kept in operation over its short length of track, which was amply sufficient to demonstrate the method of control of the equipment; in fact, the exhibit was most unique in that it demonstrated in active working order a greater variety of electrical apparatus than has ever before been shown in actual operation and without duplication in any exhibit by one company heretofore devised.

There were, of course, in a building such as the Palace of Electricity, many exhibits which required a high degree of technical training to enable one to fully follow the many steps through which their perfection is attained. Notably among these was the automatic telephone exchange apparatus, which was beautifully demonstrated in one of the finest exhibits in the building. It is customary, in the present-day telephone exchange, to have at the central office a large number of operators employed in connecting the telephone of the party who is calling with the party who is called. This is done by connecting, manually, the terminal wires from the telephone of the person calling to the terminal wires of the person called. By a very ingenious system of connections it is possible for these operators to connect the party calling with any one of the several thousand subscribers to the exchange in question. These connections are, however, made by intelligent operators, and without the equipment of the exchange performing any selective function. Picture now the great task which is involved when an apparatus is perfected by means of which any one of a hundred thousand people, each having a telephone, can call any other one of the nine hundred and ninety-nine thousand nine hundred and ninety-nine people without the intervention of a single manual operator; in other words, in accomplishing this seemingly impossible selective feat the telephone exchange equipment operates with more than human directness in carrying out a chain of events accomplished in its completeness by an electric current initially set in motion by the calling party closing an electric circuit. This most wonderful combination of electro-magnetic mechanisms which are used to bring about the results stated in the case of the particular system discussed was amply shown.

But there were also other life-like things being accomplished by electricity which are, in a measure, quite as astonishing as the selective power exhibited by the automatic telephone exchange. I refer now particularly to the telautograph, which was on exhibition. To be sure, a telautograph was shown at the Columbian Exposition, and by the same company which made the St. Louis exhibit; but the modern telautograph should not be confounded with the previous instrument, the latest instrument being an entirely new creation which only resembles its predecessor in the fact that it performs the same function. The most improved instrument, through the medium of but two wires connecting two distant points, is used to transmit with exactness a message written at the sending point to the receiving station. The person writing the message writes with a stylus much like an ordinary pencil, and at the distant receiving station a second stylus accurately reproduces each stroke of the point in the hand of the sender. The modern telautograph is a commercial instrument, as the expense of installing it and using it comes well within commercial requirements. The old telautograph was so complicated as to make it impossible commercially. It has taken ten years to perfect an instrument for carrying out a well-conceived idea and we are, apparently, just reaching the time when the telautograph can be successfully put in use for the conduct of a portion of the business of this great country.

Naturally, among the wonders of electricity exhibited at St. Louis, one expected to find wireless telegraphy, and wireless telegraphy was demonstrated at the Exposition in a state of perfection to which the promoters of the department had little right to look forward during the months of preparation. The wireless telegraphic display included, in all, five stations on the Exposition grounds. Three of these were in the Palace of Electricity.

For the benefit of the interested student, the apparatus was arranged so that messages could be sent from one station in the Palace of Electricity to another. Messages could also be sent from the Palace of Electricity to either one of the long-distance wireless telegraph towers out on the grounds. From these long-distance stations messages were successfully and repeatedly sent from the Exposition grounds to Springfield, Ill., Chicago, and Kansas City; and with such certainty was this service carried on that the company making the exhibit took commercial messages for delivery in the cities mentioned. Wireless telegraphy has thus been demonstrated to be entirely practical and successful in communicating between distant places over land as well as over sea. The long-distance wireless telegraphic communication was opened up on September 14th, the day set apart by the Exposition authorities as Electricity Day.

Electricity Day was made memorable by the further fact that on that date a joint meeting of the International Electrical Congress, with the American Institute of Electrical Engineers and the Institution of Electrical Engineers of England was held in Festival Hall. At this gathering were present delegates from many foreign countries, and the assemblage represented an active and most energetic body of

GENERAL VIEW WESTINGHOUSE EXHIBITS.
225 H. P. WESTINGHOUSE HORIZONTAL ENGINE.

WESTINGHOUSE SWITCHBOARD EXHIBIT.
WESTINGHOUSE TRANSFORMER SWITCHBOARD AND ROTARY CONVERTERS.

thinkers in electricity. The Congress was, in all, in session for one week in St. Louis, and accomplished far more through its wonderfully fine organization and the administration of its affairs than has any previous electrical congress yet called together. It was a matter of remark by the delegates from all parts of the world that, in the amount of work accomplished, the number of subjects touched upon and creditably presented and discussed, and the general far-reaching character of the policies adopted for recommendation to the several participating foreign governments, the Congress here advanced the art and practice of electricity to an unprecedented degree.

Among the demonstrations of electricity at the Exposition, and one which was viewed by the members of the International Electrical Congress with no small interest, was the demonstration of high-power electrical discharges. During the Exposition there was erected in front of the Palace of Electricity a structure in which was placed a large high-tension transformer. This piece of apparatus is capable of transforming 200 kilowatts, or about 270 horse-power, of electric energy from a low pressure, such as that used in incandescent lamps for house lighting, to a pressure upwards of 500,000 volts. This pressure was so enormous as to cause an arc to strike between points four feet apart, producing electrical flames which leaped through the intervening space in resemblance of a thousand discharges of lightning continuously. This transformer and the displays produced by it are chiefly remarkable for the fact that they show the character of electric currents at enormously high pressures. Through the medium of apparatus akin to this, it may be possible ultimately to transmit electric energy to points as much as a thousand miles distant from a generating station. A small wire, as small as a slate pencil, when influenced by these high pressure currents, has a corona developed around it three or four inches in diameter.

Among other interesting things which were demonstrated by the exhibits of the Palace of Electricity was that of wireless telephonic transmission. There were two exhibits illustrating the possibility of transmitting speech between two persons without wires by the aid of adapted telephone instruments. One of these systems, commonly termed the "radiaphone," requires the use of an arc, the rays of light of which, when projected upon a receiving mirror, can be made to transmit articulate sounds produced by a person at the sending station into a telephone receiver and collected from the light rays impinging upon the mirror. This apparatus permits one to talk over a beam of light. It is a form of wireless telephony. The receiver is inserted with a battery and a selenium cell, which is placed at the focus of a searchlight reflector. The selenium cell is sensitive to light. Changes in the intensity of the beam of light cause the electrical resistance of the selenium to vary and sounds to be heard in the receiver. A telephone transmitter is arranged to influence the electric arc of the searchlight whose rays are focused on the selenium cell. The sound waves produced in the air by the speaker are transformed by the telephone transmitter and the electric arc into light waves. These light waves are transmitted as such to the receiving station, where the process is reversed, and they are transformed through their effect on the selenium into sound waves by the receiving telephone.

The second exhibit of wireless telephony was arranged by having embedded in the ground surrounding the court of the Palace of Electricity an electric circuit connected with a telephone transmitter. Any person walking within or near the court and carrying a hoop of wire connected to a telephone receiver was enabled, through electro-magnetic induction between the hoop of wire (a few inches in diameter) and the circuit embedded in the court (approximately 300 feet in diameter), to hear all of the sounds spoken into the transmitter. These demonstrations of wireless telephony, while not illustrating commercial adaptations, nevertheless point to what may ultimately be achieved on a commercial scale. This achievement will, however, presumably be brought about by apparatus differing somewhat in principle from that which was exhibited.

Many who visited the Palace of Electricity found in the incandescent lamp factory, in which upwards of 2,000 incandescent lamps were made per day by a number of operators handling most improved machinery, one of the most effective and interesting working exhibits at the Exposition.

Great pains had been taken to bring this installation to perfection, and the fact that it found so much favor with the public generally was ample reward for all of the trouble in putting it into successful operation.

Possibly enough has been said about the electrical exhibits, in touching upon the few specific things here enumerated, to indicate with what painstaking detail each avenue of electric research was illustrated and pictured for the benefit of both the public and the technical men as well in the Palace of Electricity. It would be unfair, however, to close this article without reference to the participation in the electrical exhibits by the Empire of Japan in the Palace of Electricity. The principle objects of the display were a modern direct-current dynamo and a modern high-tension transformer. The transformer shown was capable of developing a pressure of 100,000 volts, and was a piece of machinery of which no European or American firm would feel at all ashamed. When it is further remembered that Japan's participation, which comprised a well-filled space 2,000 feet in area, was conceived and inaugurated after the war with Russia had begun, the wonderful energy and progressiveness of the Japanese as a people may be better appreciated.

All in all, the electrical exhibits presented to the mind much that was well worthy of mature reflection. Electricity was a most potent factor in the success of the Exposition when viewed from almost any standpoint. Without it transportation of the people to the Exposition would


RECEPTION HEADQUARTERS WESTINGHOUSE COMPANY.

TROLLEY BASES, WHEELS, GEARS, AND PINIONS, WESTINGHOUSE EXHIBIT.

REAR VIEW WESTINGHOUSE EXHIBIT, PALACE OF ELECTRICITY.

WESTINGHOUSE AUDITORIUM.

have been impossible; the conduct of business in the city of St. Louis, surrounding cities, and, in fact, in many parts of the world would have been hampered had it not been for the most complete telephonic and telegraphic facilities which were afforded at every hand; and but for electricity the greatest enjoyment experienced by the thousands of visitors, and which came after a day of sight-seeing in rest amid a scene of beauty beyond description, would have been lost in vacant blackness.

## DIVISION CXXXVI.

### Exposition of the Uses of Electricity.

To the masses electricity is a force as little understood as was lightning by primitive man. Both alike perceived the effect without comprehending it, which, however, is not at all strange, because it is not easy for the untrained mind to understand how an unseen cause can produce a visible effect. And belief prevails among the majority that Benjamin Franklin, by a simple experiment in 1752, was the first person to pluck electricity from the sky, because our school readers have all told us so. It is true that Franklin demonstrated the existence of atmospheric electricity by the use of kite, string, and key, but the properties of magnetic attraction, which is one form of electricity, were discovered by Thales, a Greek philosopher, 600 years before Christ. By accident he ascertained that by rubbing amber acquired the property of attracting light bodies, and thereupon he called this principle "electricity," which is the Greek word for amber.

Franklin's experiment may be taken as the starting point in the evolution of our knowledge respecting electricity, but fifty years afterwards investigation had resulted in practically nothing, being confined to the very feeble manifestations produced by electrically charged pith-balls and the ability to create sparks. Magnetic attraction was in the embryonic stage, but while it was used in the compass, this subtle principle was not supposed to belong to electricity as it is manifested in the lightning bolt. The truth is that for more than a century after Franklin's demonstration the world knew very little more about electricity than was afforded by his experiment, even though Galvani and Volta in 1800 succeeded in making batteries that proved the theory of connection between electricity and magnetism. About the same time Sir Humphrey Davy made the discovery that two pieces of carbon joined by a conductor and subjected to an electric circuit became highly heated and when slightly separated a blue flame was produced. This was the beginning of the arc light that Davy exhibited in 1809 and it remains the essential feature to this day, but at most it was only a laboratory experiment and the knowledge thus gained was not utilized until forty years later, when Morse gave us the telegraph. In 1861 Paccinnoti invented the armature, which when improved by Gramme, three years afterwards, became the dynamo and the electric motor. In 1876 the telephone was invented and this produced a stimulation of world energies commercial and industrial even exceeding that produced by the telegraph. People began to prophesy wonderful things that were to be accomplished through the employment of electricity, but the wildest flights of enthusiasts failed to reach the heights to which we have attained, and it is not visionary to predict that electricity is still in the infancy of its capabilities.

The principle of the dynamo was discovered by Faraday in 1831, but it was fifty years later when a motor was built by Siemens of sufficient power to haul cars. I had the fortune to ride on one of the first electric trains, which was operated on a circular track at Sydenham, near the Crystal Palace, in 1882, and repeated the experience at a fair held in Moscow the same year. Both of these experimental lines were operated on the third-rail principle, if my memory is correct, which was superseded by the trolley system now in common use.

The storage battery has been the dream of electrical engineers and students for more than a century, and it is astonishing, therefore, to know that such a battery was actually made as long ago as 1801, in which year Gautherot discovered and obtained a secondary current by making a cell composed of two silver electrodes immersed in a solution of table salt. But although an important principle had been thus discovered, little was done toward applying it until Planté, in 1860, constructed a cell composed of strips of lead, instead of silver or platinum, which he immersed in a diluted solution of sulphuric acid. When the cell was charged with a current it was found to produce a reverse current, and that repeated charging and discharging in reverse directions increased the capacity of the cell. This discovery led him to


1. Dr. Theodor Lewald, Com. Gen. Germany.
2. Col. Chas. M. Watson, Com. Gen. Great Britain.
3. Mr. Georges Gerald, Com. Gen. France.

multiply the cells into a battery, which generated a power great enough to be of commercial value, and to him must therefore be given the credit of having invented the storage battery. Convenience of the storage battery must be acknowledged, but excessive weight of the multiplied cells, greater cost of production, and necessity of maintaining an electric plant to charge the batteries have prevented this system from being adopted generally in place of the trolley, which has the disadvantages of being unsightly and dependent upon power furnished from a central station, an accident to which puts a stoppage to the entire line. At this time the storage battery, though cured of the defects that condemned the Planté type—the softening and washing away of the peroxide of lead on the positive plates and buckling—is used chiefly on automobiles, though the promise is made by Edison that he is upon the point of overcoming every objection that can be laid against the storage battery and predicts that in a short while it will completely supersede the trolley.

Electricity is to-day used for an almost endless variety of purposes, of which the following may be mentioned: Telegraph, telephone, telautograph, telautophone, transmission of energy, lighting, cooking, railroading, yachting, welding, talking at great distances, electroplating, refining metals, electro-chemistry, decomposition, electro-culture of plants, heating, capital punishment, treatment of diseases, massage, to give hearing to the deaf, bathing, electric torpedoes, blasting, signaling, phonograph, musical instruments, and supplying power for all kinds of machinery. While steam is most generally the parent of electricity, the child has developed greater capacity and is adaptable to multiplied uses. Fuel, however, is not the only food upon which this prodigy thrives, for the water that plunges over cataracts or sweeps in mighty volume down the numerous streams that nourish the valleys furnishes aliment in abundance; and looking into the future when the world's coal supply shall possibly be exhausted, our rivers will support electricity for all future time, and it will continue to be a willing slave to serve our needs, until its service is no longer required or is supplanted by a better servant, whose birth is not yet anticipated.

Electricity Building at the Exposition was indeed a palace, not in expensive decorations, architectural embellishments, luxurious furnishings, and other rich, gaudy, garish, and the almost awesome grandeur that distinguishes a king's residence, but such a palace as genii are fabled to have erected in wonderland; a museum, a treasure house, a colossal repository in which were gathered the fruits of genius, the works of discoverers, the products of inventors, the offerings of master spirits, the marvels of our age.

I have just told you of the birth and development of electricity, a force which was first harnessed for commercial purposes fifty years ago, and which was performing few labors even twenty years ago, but which is now a sturdy, commanding, titanic, almost omnipotent power that stretches its Briarien arms over the entire globe, and at a grasp has brought all nations into the fellowship and communion of a neighborhood.

It was startling, dazzling, almost fearsome, to the visitor who upon entering the building was immediately confronted and confounded by whir of machinery, hum of vibrations, flashes of blinding light, gardens of electric flowers, and wonders upon wonders too great for the unaccustomed eye and mind to apprehend.

There was a sharp, though not ungenerous, rivalry manifested by leading electric companies of Europe and America, by competitive displays that comprehended everything in the line, from novelties to great multi-phase machines, and dynamos of 10,000 horse-power, the largest in the world, five of which machines are now being installed at the Niagara Falls plant by the General Electric Company.

As the largest electric company in the world, the Westinghouse made an exhibit that did both justice and honor to its greatness and reputation. This company furnished the mighty dynamos that manufactured the electricity used by the Exposition and concessions. This was a wonderful display in itself, but the same company, occupying several acres of space, showed other machinery that was not a whit less interesting. For example, there was a Baldwin-Westinghouse electric locomotive, a compact, stocky piece of machinery of extraordinary power, designed for switch-ing and coal mine service. There were no speed qualities in this locomotive, its drivers having a diameter of only thirty inches, but the weight was 20,000 pounds, and its hauling power was accordingly equal to that of an ordinary steam freight-engine. Another locomotive of the same weight but of much greater power was the Baldwin-Westinghouse mine-engine, a long, enclosed, and to the eye an apparently solid piece of metal for use in restricted situations in mines, and which penetrates passages where mules can not safely be used. Comparable with this locomotive was a Westinghouse storage battery auto truck, which, however, was exhibited in Machinery Palace, where many other Westinghouse exhibits were displayed for lack of floor space in the building where they more properly belonged. It happened, indeed, that the larger part of the Westinghouse exhibit was contained in Machinery Hall, and a considerable part was also shown in Transportation Building.

In Electricity Palace the Westinghouse exhibit embraced besides a beautifully furnished pavilion, high and low capacity generators for chain or belt drive; oil insulated air-blast transformers; rotary converters; single and polyphase induction motors for constant and variable speeds; motor generator sets; direct current motors, including motors for variable speeds on single and double voltage systems; complete details for switchboard installations, with ammeters; synchroscopes; power factor meters; voltmeters; circuit-breakers; wattmeters; switches; potential regulators—in fact, there were no details or accessories used in the field of electricity but had some representation in this display.

Other remarkable exhibits shown by the Westinghouse Electric Company in Electricity Building included the largest induction motors that have ever been in operation anywhere in the world, a switch intended for breaking the highest voltages that have ever been created for commercial purposes, and such an exhibition of electrical appliances, devices, generators, and controllers as was never before seen at any world's fair.

There was also shown in the exhibit the first incandescent lamp ever made, the work of Edison in 1878, which was shown in a case containing a collection of every one of the many types of lamps devised by Edison during the course of his experiments. There was everything from the first, a platinum iridium thermostatic regulator lamp, to the most recent types. The collection also included the first bi-polar motor ever invented and Edison's "Jumbo" steam dynamo, the prototype of all direct connected, steam-driven electric generators. On the walls of the rooms were to be seen portraits of the great inventor and a series of photographs showing him at work in his laboratory. Two large maps showed the underground system of electric lighting of the Boroughs of Manhattan and Bronx. In the north section of the exhibit were Edison's latest inventions, including his latest storage battery.

The Edison exhibit contained some very interesting relics, but the one that will stand as an enduring monument to the genius of the great inventor, if he never gave us anything else, is the first electric locomotive, in its original form, as it was built and operated in Menlo Park, N. J., in May, 1880, together with the car it hauled at that time. The engine is simply a four-wheeled truck carrying a motor which is belted to a pulley placed on a frame at the rear, and again belted to the driving shaft. Full adhesion of the machine was had by means of a truck in contact with commutator on each wheel hub. The actuating current for the motor was taken from the rails, feeding the field magnet and armature in multiple or parallel. There was an initial arrangement of plug resistance boxes in series with the armature for controlling the power and speed of the motor. This machine is as much of a curiosity now to the electrical engineer as the old steam relics, marking the mile-stones of progress of the steam locomotive, are to the mechanical engineer.

In Electricity Pavilion were a large number of exhibits that were entered as early products of Edison's brains and these attracted even larger attention than was given to the newest inventions. Immense crowds of visitors constantly surrounded that section of the building devoted to the incandescent filament work under the deft touch of girl experts, all very interesting and instructive, but the historical exhibit under the comprehensive title of "Edisonia" contained as much solid food for reflection as anything to be


Strauss Photos.

1. A. R. von Stibral, Com. Gen. Austria.

2. Dr. N. G. W. Lagerstedt. Com. Gen. Sweden.

3. Dr. G. De Szogyeny, Com. Gen. Hungary.

seen in that vast show of electric wonders, for it comprised everything pertaining to the earliest work of the man whose name it bore, in the invention and perfection of the electric light. The whole story was made complete with original lamps having the date of their manufacture, and arranged in proper sequence to aid in grasping the particulars without loss of time, all in a glass case, secure from vandal hands.

In another glass case there was to be seen, under the apt title of American Illuminants, three little object lessons in the development of lighting, that bridged the gap from the earliest and crudest form, to the latest and best of to-day. It was simply a three-piece collection, but it told an eloquent story of the progress of lighting in America, with the dried candle-fish of the red man of the Northeast on one side; the kerosene lamp of 1846 as the center-piece, and the incandescent lamp as the crowning achievement. It was a nice little conceit, representing the ocean, the earth, and energy.

In still another glass case was a history of the results of foreign investigators of the electric lighting problem, also showing lamps progressively arranged by years, furnishing an accurate story for posterity, which taken in connection with the individual record of Edison, furnishes a very complete and reliable history of the electric light, and is, no doubt, the most accurate and complete of any scientific work in the world. Another very interesting relic to the student of electricity was the old Edison dynamo of the two-pole type, which was used with one of the first installations of the incandescent light in May, 1880, and in constant service until July, 1895, and in the same exhibit was also the first Edison bi-polar motor, both of which were in working order.

In the Electricity Building Mr. F. B. Behr, 5 Queen Anne's Gate, London, S. W., England, had an exhibit of a working model of the Behr high-speed electric mono-railway. The model was constructed to a scale of one-sixteenth. The inventor of this system of rapid transit claims that speeds of 100 to 110 miles per hour can be made quite safely. It was represented that such a line can be built for approximately the same cost as a first-class road for the operation of trains on the present system, while the cost of maintenance and the cost of electricity required to operate it should be less.

Several inventors and companies prepared plans for exhibits of wireless telephony, over comparatively short distances. The stations, separated by the length of the building, were used without any metallic connection between them. The waves were made to emanate from the coils of one station and induced corresponding pulsations in the coils of the receiving station, so that a conversation could be heard from one to the other.

It is probable that no branch of therapeutics has made a greater advance within recent years than that which employs electricity in its many ways of application. Electricity in the form of direct, alternating, and intermittent current is now utilized in the treatment of many forms of diseases, particularly chronic cases which have been especially refractory, and most comprehensive and instructive exhibits illustrative of the progress made and the results attained in this direction were accordingly presented in the Electricity Building. The apparatus shown included X-ray tubes for physical treatment and for diagnosis, and the Finsen lights which give actinic or higher light rays, and are supposed to be especially efficacious in the treatment of certain kinds of maladies.

Electro-magnetic instruments were on exhibition in great numbers and kinds, most of which were shown in operation and their use in various treatments, notably for eye and ear diseases, explained. The acousticon, an instrument which very largely performs the function of the ear, was graphically demonstrated, and persons who had never heard a sound since birth received the sense of hearing by means of this invention. In view of the great number and variety of electro-therapeutic exhibits covered by this classification, the Electricity Building proved a center of interest to the physicians and surgeons who are keeping abreast of the times in their particular work.

The large number of inventions in the line of electric lighting which have been made in recent years were placed on exhibition in a way that was exceedingly attractive to the public. Arc lamps of every kind and incandescent lights of every size and color were displayed in a decorative and practical manner, to show beauty and usefulness.

The Nernst lamps were utilized in lighting one of the buildings. The Cooper-Hewitt vapor arc lamps which illuminated the cascades were shown inside of the Electricity Building. These lamps give an intense white light, in which the absence of red rays produces a very peculiar effect. Vacuum tube lighting by means of induced currents was also displayed, and as a majority of visitors saw them for the first time at the Exposition there were many exclamations of astonishment uttered and not a few ludicrous opinions expressed, the majority apparently believing that the light was produced by radium, though there was a good number who maintained that it was an exhibition of the X-ray.

# INTRODUCTION TO THE DIVISION OF MACHINERY.

By Thomas M. Moore, Chief of the Department.

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It is very difficult to grasp the full meaning conveyed in the information that the Universal Exposition of 1904 required for its operation a total of something over 45,000 horse-power. Very few people understand the importance of this statement. There are in existence to-day but two power plants larger than the one that was installed to operate the machinery of the Exposition. One of these two is the Manhattan Elevated Railway power plant in New York, and the other is the Metropolitan Street Railway plant, also in New York.

The power required for lighting, pumping, and for operating concessions and exhibits in the St. Louis World's Fair was about two and one-half times the total power required for lighting the streets of the city of Chicago. An engine horse-power is really one-fifth greater than the average power of the ordinary draught horse working eight hours daily; consequently the work performed by the power plant of the Exposition closely approximated the performance of 54,000 horses. Fifty-four thousand horses harnessed in spaces of ten feet from head to head would make a line over 102 miles long—a distance somewhat greater than from New York to Philadelphia. But 45,000 horse-power does not represent the total, for there was an over-load or reserve capacity of at least 25 per cent. which could be counted upon whenever it was needed for a limited period of time. This represents a working force equal to a line of horses 128 miles long, or reaching from St. Louis to Jefferson City, or from Boston to Hartford.

A great deal is said and written about the power developed at Niagara Falls, and it is interesting to know that the total capacity of the Niagara Falls power plant, at the time of the Pan-American Exposition, was 25,000 horse-power. Of this about one-fifth, or 5,000 horse-power, was used for the decorative lighting of that Exposition. Since then the capacity of the Niagara power plant has been doubled, and it now stands at 50,000 horse-power. The St. Louis Fair, therefore, had available nearly eleven times the amount of power delivered to the Pan-American Exposition by the Niagara Falls plant, and something over 4,000 horse-power greater than the total capacity of that famous power plant.

The power plant of the Exposition occupied practically all of the western half of Machinery Hall, a space about 600 feet long by 300 feet wide. In this space the engines and generators were installed in a most attractive manner, and these prime movers represented the best engineering ability not only of America, but of England, France, and Germany.


Strauss Photo.

1. T. E. DONNE, REPRESENTATIVE OF NEW ZEALAND.

2. A. L LAUSHE, PRESIDENT PHILIPPINE COM.

3. GUSTAVO NIEDERLEIN, DIRECTOR PHILIPPINE EXHIBITS.

4. G. H. TEN BROEK, COM. GEN. NETHERLANDS,

The steam for the operation of these engines was generated in the Steam, Gas, and Fuels Building, a fireproof structure 350 feet long by 300 feet wide, located about 100 feet distant from Machinery Hall. The pipe lines, conveying the steam from the boilers to the engines and returning the condensed water back to the boilers from the condensers, filled a tunnel seven feet broad and eight feet deep. One of these steam lines was eighteen inches in diameter, another was sixteen inches in diameter, and none were less than ten inches in diameter. When the boilers operated at full load they evaporated something over 700,000 pounds of water per hour. This means that 350 tons of water were hourly changed into steam, passed through the engines, returned to the form of water by passing through huge condensers, and then re-delivered to the boilers to be again transformed into live steam.

Owing to the central location of the Steam, Gas, and Fuels Building, it would have been unsightly to set up tall smoke stacks required for the operation of the boilers under natural draught, consequently the draught had to be created by huge fans, and the weight of this apparatus alone closely approximated 300 tons. A number of the fans were twenty feet in diameter and for driving them independent engines were provided. To avoid the smoke nuisance the boilers were equipped with mechanical stokers, which were automatically supplied with coal by a conveyor system that took the coal from the cars, crushed and delivered it into ten and twenty ton hoppers which were placed directly in front of the various batteries of boilers.

The eastern end of Machinery Hall was given up to exhibits of machine tools and wood-working machinery and the accessories which are availed of in power plant and machine shop practice. A most interesting machine was an hydraulic press, built at the Krupp Works, in Essen, Germany. This press exerted the enormous pressure of 90,000 pounds to the square inch. It was constructed for the purpose of embossing metals, and it performs this function by the direct action of the water on the metals to be embossed.

The range in machine tools; that is, in tools for cutting, forming, and manipulating metals, from small machines for working out tiny screws, bolts, and gears of a watch to huge lathes for turning the largest cannon or the shafting for an ocean liner, was most comprehensive. Some of the machines for planing metal were more than seventy-five feet long and eighteen feet wide, covering an area larger than the floor plan of an ordinary residence. In the wood-working section the display was exhaustive and showed machines capable of performing the most delicate grill work, and from these led up to massive machines for transforming into merchantable lumber the giant trees of the Pacific coast.

The total value of the exhibits in Machinery Hall and the Steam, Gas, and Fuels Building exceeded $8,000,000.

The most massive and powerful engine with its electric generator weighed over 600 tons, and this generating set complete with boilers, mechanical draught, and stoker equipment, condensers and accessories, had an aggregate weight of more than 1,000 tons, while the total weight of the exhibits was over 60,000 tons.

The Machinery Department furnished as an exhibit three pumps which delivered the water that flowed over the Cascades, and fed the fountains. The capacity of these pumps at normal load was 90,000 gallons per minute, but they were planned to take care of an overload of over twenty-five per cent, which brought their maximum capacity up to 115,000 gallons of water per minute. This work they performed against a total head of 158 feet. Larger volumes of water have been handled to a lesser elevation, but no such amount of water has ever been artificially moved to such a height as was required in the Cascades at the Exposition.

It is stated that the average daily consumption of water for all purposes by the entire City of St. Louis is about 65,000,000 gallons. The Cascade pumps of the Universal Exposition of 1904 were capable of handling 165,000,000 gallons of water daily; that is, 100,000,000 gallons more than the entire city of St. Louis uses per day.

These statements of facts will afford the readers of *Louisiana and the Fair* a conception of the magnitude of the Machinery Department, and an idea of the cost of operating the show features of the Exposition.

## DIVISION CXXXVII.

### Scope and Character of the Machinery Exhibition.

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It is a very long way from the shell hoe to the steam cultivator, from the shadoof to the turbine pump, from even the treadmill to the engine that sets the spindles to whirling, the great wheels to revolving, and the heart of industry to pulsing with an energy that gratifies the ambition of man.

As a boy I was delighted by the sight of machinery in motion, whether it were the sluggish movements of the always tired water-wheel, splashing and groaning, or the ever industrious whip-saw that plunged up and down with so much interest in its work as to offer a wholesome lesson to an idle youngster like myself. To me any mill was an exposition of machinery, and to my inexperienced, unformed mind the village saw and flour mill combined was a wonder, the equal of which was not to be found in many weeks of travel. These callow ideas, that rusticated in the border land which divides fact from fancy, came back to me like a dream that had repeated itself when I entered Machinery Palace at the Exposition for the first time. Experience had familiarized me, as a spectator, with many

Strauss Photos.

1. JAS. H. GORE, COM. GEN. SIAM.

2. HERMAN LANFORD, COM. GEN. EGYPT.

3. WONG KAI-KAH. VICE COM. CHINA,

4. H. S. TAVSHANJIAN, COM. PERSIA.

kinds of engines and given me an apprehension of the power that is latent in steam, water, and electricity; but though I have seen Niagara in its most turbulent mood, and watched the giant two-phase alternating dynamo, driven at a speed of 250 revolutions per minute, converting the power of the cataract into electricity, yet no sight so impressed me as did a survey of the large, small, and almost infinite variety of machinery that crowded all available space of the immense structure erected in which to display it.

To those who would count the steps of human progress, who are contemplative in disposition and take pleasure in measuring the distance that lies between the civilization of to-day and the struggles of primitive man, fettered by the simplicity of his little knowledge, the spectacle was almost confounding. It was more than a revelation, because few persons had conceived, even in their imaginings of ultimate accomplishment which would reward the efforts of inventors, things one-half so remarkable as those that made up the exhibition in Machinery Palace which was a veritable symposium of mechanical achievement.

The Universal Exposition at St. Louis represented the progress of the world in the highest development of the mechanic arts, and the improvements made in prime movers and the means whereby their power is utilized for useful work, stand as a record of original thought, in a field that is wholly responsible for the revolutionizing of the power of the world. In the decade passed since the World's

Columbian Exposition at Chicago in 1893, the observer who has followed the trend of things mechanical will have noted the fact that the water tube boiler has supplanted the cylindrical type for steam generation in all situations where evaporative efficiency is of first consideration in its bearing on fuel economy. It is also seen that but little improvement has been made in this type of boilers as far as heating surface and its advantageous disposition is concerned. But it will be noted that automatic stoking has entirely supplanted manual firing in all plants laying claim to progressive management; since the fuel is consumed with the least possible waste, and therefore is made to give up its highest percentage of thermal units, in addition to reducing the smoke volume from chimney.

The boiler as a type, therefore, is practically where it was a few years since, and improvements were shown in details rather than principle. The boiler plant of the Exposition at St. Louis represented more than 26,000 horse-power, in fifty-two boilers, embracing various builds, including the Babcock & Wilcox, Cahall, Heine, Belleville, and a German installation, the latter two being hand-fired, while all of the American product were fired automatically by Roney stokers made by the Westinghouse Machine Company.

In the case of the means of transforming the above amount of energy into useful work, there were many examples of multiple expansion engines furnishing power for pumping and driving tools and dynamos. The reciprocating engines represented more powerful units than were known ten years ago, but the compound principle has not been improved upon in the sense that an appreciably higher horse-power per hour per pound of steam is available from the present engines. It would appear that the efficiency of the reciprocating engine has some room for improvement from the standpoint of steam economy. Among the large power units there were four Westinghouse-Corliss vertical cross-compound reciprocating engines of 3,500 horse-power each, or a total of 14,000 horse-power installed in the Machinery Building. The immensity of proportions of these engines will be seen by a glance at the appended values:

Diameter of high pressure cylinders, 38 inches; diameter of low pressure cylinders, 76 inches; stroke, 54 inches; shaft 31 inches in diameter by 25 feet long, fluid compressed open hearth steel, weight, 50,600 pounds; fly-wheel, diameter, 23 feet, weight 170,000 pounds, speed 85 revolutions per minute; boiler pressure, 150 pounds; vacuum, 26 inches; cranks, counter balanced disk, 90 degrees; fly-wheel effect, 13,110,000 pounds; weight of engine, with fly-wheel, 746,000 pounds; total weight of engine and generator, 942,000 pounds; generator, 2,000 kilowatts, revolving field, engine-type, three-phase, voltage, 6,600; frequency, 25 cycles per second; overload capacity, 50 per cent for one hour; total weight, 196,000 pounds; width of engine bed, 15 feet; height, 32 feet 4 inches.

This main service plant was designed and installed by

Westinghouse, Church Kerr & Company, by award after the plans of the Exposition had assumed tangible form, the equipment to be a complete central station for supplying electric power for general use; for night illumination of the 1,240 acres covered by the new Forest City; for pumping water for the lagoons and court basins and for the Cascades and fountains, also for operating the exhibits and concessions on the grounds. This plant had been in operation since April 15, 1904, maintaining its own load, and from time to time carrying extra loads which the exhibit plants were unable to sustain. Although this installation furnished the main source of power for the Exposition, and handled all of the commercial operating and lighting load on the grounds, including the Pike, as well as a large part of the decorative night illumination of the main exhibit buildings, it proved more than equal to all demands for power. It was of interest to engineers for its great size and completeness as a whole, and also for the reason that it resembled in general design such large Westinghouse plants as the 40,000 horse-power station just completed at Kingsbridge, N. Y., and the 75,000 horse-power station of the New York Edison Company, where eleven Westinghouse-Corliss three-cylinder compound engines, rated at 6,500 horse-power each—and the largest engines in service—frequently carry a load of 10,000 horse-power for short periods.

The most powerful single prime mover in the Machinery Building, and also at the Exposition, was the Allis-Chalmers


Strauss Photos.

1. Esteban D. Estrada, Com. Gen. Cuba.
2. Juan Jose Zelaya, President of Nicaragua.
3. Eduardo M. Baca, Com. Mexico.
4. Jaime Annexy, Com. Gen. Porto Rico.

Bullock combined vertical and horizontal compound condensing engine of 5,000 horse-power, direct connected to a Bullock generator. The high pressure cylinder was 44 inches diameter, the low pressure was 94 inches in diameter, and stroke 60. Revolutions per minute, 75 for both engine and generator. Steam pressure, 150 pounds. The main shaft was of hollow forged open hearth steel, 37 inches in diameter at wheel and generator fits, and hole in shaft 16 inches diameter. Crank pin was of nickel steel 20 inches in diameter by 18 inches long, pressed into crank; crank pin was common to both high and low pressure engines, the low pressure connection being next to the crank face. The fan tail crank was of cast steel and weighed 32,000 pounds. The fly-wheel was 25 feet in diameter, built in 10 segments and had a rim 30 inches face by 33 inches deep. General points of interest are appended:

Height of engine above foundation, 39 feet 2 inches; length over all, 39 feet; weight of engine, total, 1,440,000 pounds; fly-wheel, 300,000 pounds; shaft, 61,000 pounds; crank, 32,000 pounds; total revolving parts, including generator, 514,000 pounds.

This great steam-electrical unit was one of the most important factors in the operation of the power plant of the Exposition, carrying about 200,000 eight-candle incandescent lamps, besides at stated hours supplying current for operating the St. Louis street car system, and also for operating the pumps supplying the Cascades. The heaviest power at the Columbian Exposition, Chicago, was an Allis-Chalmers-Reynolds-Corliss engine, of the horizontal quadruple expansion condensing type, and had a capacity of 2,500 horse-power. The largest engine at the St. Louis Exposition, just eleven years later, had a capacity exactly 100 per cent greater, at normal rating, but the load at night frequently reached 6,500 horse-power. Mr. George H. Corliss built his famous 3 feet 6 inches by 10 feet vertical beam engine of 1,400 horse-power capacity for the Centennial Exposition in 1876. It would be a pigmy compared with the large engines of this Exposition.

In the smaller power units the gas engine has brought about a very great change by reducing the cost of power transmission, and is also becoming a strong competitor of the steam engine even when gas has to be purchased. In cases, however, where the fuel gas is furnished by a plant owned in connection with power, the greater economy of gas, with equal efficiency, over steam, is no longer a question in dispute. The claim even is maintained, and the demonstration is said to have been made at the Exposition, that a horse-power can be produced with the gas engine on one pound of average coal.

A 225 horse-power gas engine of the two cylinder horizontal tandem type, direct connected to a 100 kilowatt generator, both of which were built by the Westinghouse Machine Company, was in operation in this exhibit.

This was the largest gas engine at the Exposition, but is the smallest of the horizontal type built by the Westinghouse Company, which began the building of gas engines in 1896, since which time about 60,000 horse-power has been placed in operation by this company, and they now have facilities to furnish these machines in sizes ranging from 10 to 300 brake horse-power in the vertical single-acting type, and from 200 to 4,000 brake horse-power in the horizontal double-acting type. These facts are presented as showing the rapid growth of popularity of the gas engine. The Westinghouse gas engines all operate on the four-stroke cycle, the piston drawing in a mixture of gas and air on the forward stroke, and compressing it to a high degree within the clearance space on the return stroke, when it is ignited by an electric spark; the pressure resulting from the expansive force of the rapidly burning gas mixture driving the piston forward, and the exhaust valves opening at the end of the stroke for the escape of the burned gas, while the piston upon the fourth, or exhaust stroke, completely cleans the gas cylinder, thus preparing for a new charge of gas and air properly proportioned.

The Westinghouse auditorium in the Machinery Building was the scene of unalloyed pleasure to countless thousands during the Exposition. This cozy little theater had a seating capacity of over 350, but the biograph entertainments were nearly always given to "standing room only" audiences. The interior finish of this handsome hall, with its brilliantly lighted dome, possessing architectural beauties comparing favorably, inside and out, with the best productions of native or foreign artists, was as much an education feature as the wonderful moving pictures seen on the screen every day at 10:30, 2:30, and 4:30. The novelty of sitting in a comfortable seat and literally taking a stroll through the different Westinghouse plants and seeing them in full operation was one that will be remembered with pleasure as long as memory lasts with those who saw the highest development of the photographer's art. The illumination at the entrance of the auditorium by the ninety six-inch Cooper-Hewitt lamps was one of the most impressive sights, serving to bring out the beauties of the exterior to a resemblance of fairy land, contrasting strangely with the cold commonplaces of the surrounding machinery exhibits.

These large pieces of machinery naturally attracted a proportionate amount of popular interest, and they were also critically examined by experts, but there were innumerable other exhibits that received a goodly share of attention and were equally educational.

I was particularly impressed with the immense exhibit of bridges, among which was the original first iron bridge on the Western hemisphere. It was built by the Baltimore & Ohio Railroad in 1839. The total length was twenty-nine feet and the clear space was twenty-five feet.

A beautiful model was shown of the Oberbaum bridge, in Germany that consists of seven masonry arch spans and


Strauss Photos.

1. Cipriano Castro, President Venezuela.
2. H. Lameda, Com. Venezuela.
3. E. M. Ambard, Com. Gen. Venezuela
4. A. R. Nuncio. Com. Gen. Mexico.
5. Col. F. M. de Souza Aquiar, President Brazil Com.

carries a street roadway surmounted by a second roadway, supported by brick arches, used by a double track railway.

There was also a model of the Frith of Forth cantilever bridge, one of the most famous of the world, and a photograph of the double-track railroad bridge now almost completed that will span the Zambesi River just below Victoria Falls, South Africa. As these falls are much higher than those of Niagara, this bridge will be scarcely less remarkable. The total length, in three spans, is 650 feet, and the height above the water is 420 feet.

There were models, drawings, and photographs of scores of bridges in America and Europe, suspension, cantilever, arch, tubular, and all other forms, but besides there were a few real novelties. Most marked among these were Scherzer's rolling lift bridge, shown by photographs in Liberal Arts Building, and the Newburgh & South Shore Railway rolling lift bridge. Both of these were built upon the same principle, which stripped of technical nomenclature and details may be described as a bridge span 160 feet in length attached to a shore pier by one end and free at the other. The attached end is so weighted and balanced that the free end may be raised to an angle of forty-five degrees, thus permitting boats to pass under, and the action is much quicker than in swing bridges.

Closely associated with bridges was the display of cranes, several of which were shown, in models and also actual size, that seemed to place them in rivalry, for size, with the largest pieces of machinery in existence. There were cranes at the Exposition that were capable of picking up the biggest locomotive and which, if a foundation could be found to support the pressure, might lift a steamship. The Shaw electric crane was built to run on elevated tracks the full length of Machinery Building, and was used for handling and installing the heaviest pieces. The Brown locomotive crane performed a similar duty and after the heavy machinery was in place showed its equal adaptability for light work by coaling cars.

There was a steam turbine of the Westinghouse-Parsons pattern that holds the record for great economy, having run continuously day and night during the seven months of the Fair, at a speed of 3,600 revolutions per minute, and was never shut down a single minute even for lubrication. At the end of this unprecedented run it showed no signs of wear.

The exhibition seemed to comprise every kind of tool, machine, and manufactured product in which iron, steel, brass, nickel, etc., enter, from the mightiest engine strong enough, as it almost appeared, to move the world to the daintiest shop tool. There were lathes in almost infinite variety, punches, planers, drills, riveters, borers, crushers, rollers, stampers, vises, shears, threaders, grinders, cutters, headers, shapers, jointers, mortisers, hoists, pneumatic tools, fittings—the list stretches endlessly, and afforded and impressed a sense of appreciation of the ingenuity of man that raises him to the dignity, if not to the sphere, of a demi-god.

The most remarkable thing that touched my curiosity, and which I put down as being the antithesis of the Allis-Chalmers-Bullock giant engine, was a machine displayed by the Cleveland Automatic Company. As I saw this wonderful piece of complicated mechanism at work it produced from bar pieces of any shape or size, from one-sixteenth to six inches in diameter, threads and taps with amazing rapidity, besides which, by adjusting attachments with the facility of those that may be added to a sewing machine, it formed, drilled, tapped, reamed, slotted, slabbed, knurled, recessed, lettered, and could, at the will of the operator, convert a bar of iron into the most eccentric shapes imaginable. It was one of the greatest wonders to be seen at the Exposition, but being in a rather inconspicuous place, and surrounded by a multiplicity of other machines, every one of which was in constant operation, comparatively few visitors discovered it, or stopped to watch the work it was performing.

# INTRODUCTION TO THE DIVISION OF MANUFACTURES.

By Milan H. Hulbert, Chief of the Department.

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Applications received from the manufacturers of the United States and the respective foreign nations of the world were for eight times the space available in the two palaces of the Department of Manufactures. Fifty-five per cent of the area in each of these palaces was set apart for domestic exhibits, and this reserved space was applied for four times over. This is not surprising, in view of the fact that the latest census discloses the existence of 512,726 manufacturing and mechanical establishments in the United States, the total annual output of which is valued at over $13,040,000,000. The capital employed by this myriad of working concerns is over $9,000,000,000. To answer the questions of those interested members of the 5,000 manufacturing concerns, to ascertain their desires, to sift the really important firms from the unimportant, and to keep in touch with those who were preparing their exhibits—to aid and instruct them in ways too numerous to mention, was the work of the Department of Manufactures, and the index of the correspondence files of the department showed 80,000 names to whom letters were sent.

Among these many applications were requests for space from every line of industry, the applicants in every instance being asked to submit sketches, descriptions, etc., of their proposed installations, in order that the value of each might be determined educationally, commercially, and artistically, the allotments of space being made only to firms giving assurance of the best displays from one or another of these standards.

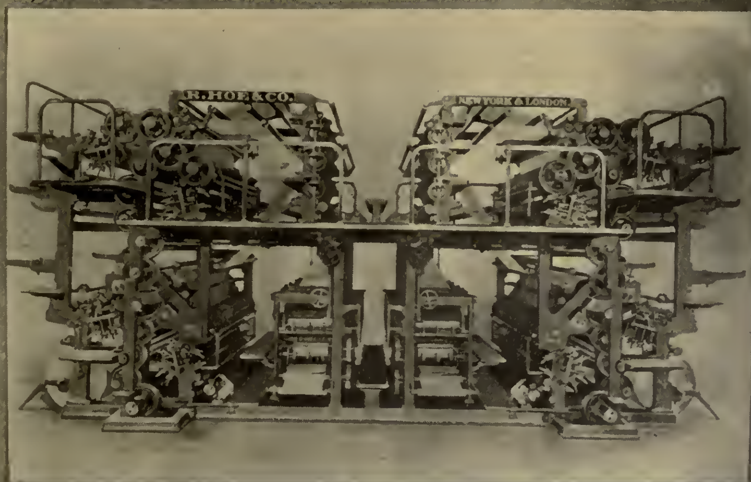
The question of artistic installation is one to which the manufacturers of all countries are devoting unusual attention. At the Chicago Exposition it was generally considered sufficient if the goods themselves were installed in a manner answering commercial necessities. Now, however, the public require a higher and more artistic standard, owing to the education they have received, a great part of which has been derived through the attention generally given to the displays in show windows. In the past few years this dressing of show windows has become a profession, and it is not now uncommon for the large department stores to employ a high salaried man, whose whole attention is given to the conception of original and attractive installations for the different varieties of merchandise.

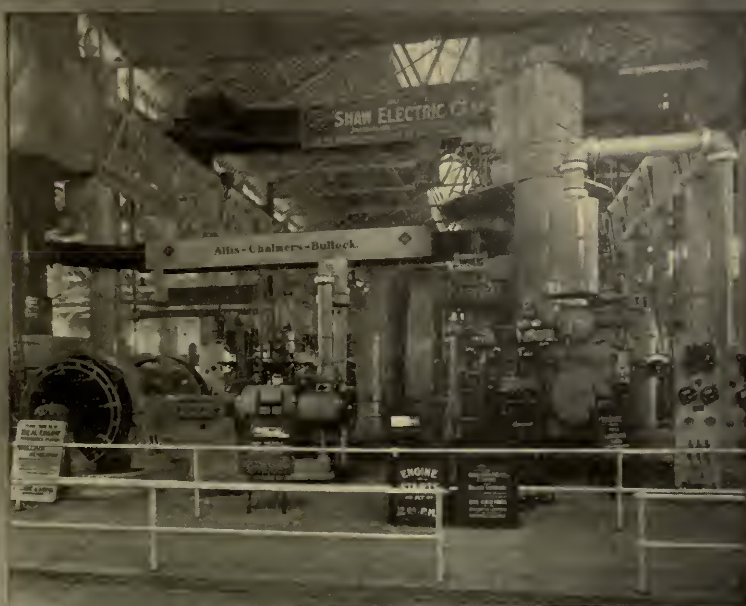
In many other general features the palaces of the Department of Manufactures differed from previous similar structures, notable among which was the aisle arrangement. All the aisles were of equal width. There was no main aisle, and each avenue was of equal value to the sightseer. The enormous size of the palaces and the thousands of people that were passing through each during the months of the Exposition required that a systematic arrangement of the aisles be made in order that exhibits might be easily located. To this end, the aisles were laid out on the same principle as the streets of cities, each having its name, and each exhibit having its number, the same method being applied as that used for city blocks.

Broadly speaking, the classification of 900 industries in this department, which were covered by 230 classes and 32 groups of the Official Classification, included all the goods one would ordinarily find in the following retail stores: Stationery store, artists' supplies shop, hardware store, furniture store, dry goods store, department store, jewelry store, rubber store, toy store, china and glass store, men's furnishing store, tailor shop, millinery store, and many others.

To house this large variety of merchandise two of the largest palaces—Manufactures and Varied Industries—covering a total area of twenty-eight acres, were assigned. The exhibits installed in these palaces were separated into three great classes. In the Palace of Varied Industries was found the merchandise commonly classified as Industrial Art, that which is made to please the eye. In the Palace of Manufactures was presented the other two great subdivisions, consisting wholly of goods utilitarian in nature, in contradistinction to those in Varied Industries.

Among the industrial art displays in the Palace of Varied




HOE'S QUADRUPLE PRESS.
ALLIS-CHALMERS 6,500 HORSE POWER ENGINE.

Industries were most interesting and comprehensive exhibits of furniture and interior decoration, the former including, not only the ordinary exhibits of furniture, but what is known as "Commercial Furniture," shown by the latest filing cases, time-saving business devices, and up-to-date office fixtures and furnishings.

Under interior decoration was shown a grouping of the industries which tend to make "The House Beautiful," consisting of displays of all articles, features, and details of interior decoration, such as upholstery, tapestries, stained and painted glass, etc.

In addition to an extensive display of clocks in the exhibit palace proper, one of the most novel features of the Exposition was the floral clock built on Agricultural Hill, for which the Department of Manufactures furnished the mechanism. This giant time-piece consisted of a dial 120 feet in diameter, the numerals on which were approximately three feet high and made entirely of flowers. At the top of the dial there was a small house built to contain the mechanism, and on the top of this house was placed a 5,000 pound bell, whose tones could be heard throughout the grounds, by the side of which a mammoth hour-glass was exposed to view. This bell struck the hour and half-hour, and upon the first stroke of each hour the immense hour-glass was automatically turned, and the sand made to run back. At the same time the doors of the house were swung open, exposing the mechanism which controlled the striking and operated the dial, closing immediately upon the last stroke of the bell.

The collection of ceramics, pure porcelains, unique pottery, etc., was very attractive. Japan and China offered specimens in this exhibit, which were unusually interesting and comprehensive. England, France, Holland, and Germany, as well as the United States, were represented in this display by the finest products of their artists and kilns. Included under Industrial Art for Children were the exhibits of toys. Germany and France, vieing with the United States, have arrived at a remarkable perfection in the production of all varieties of toys. The manufacturers of to-day are paying special attention to the artistic forms of their creations, and each of the above-mentioned countries therefore showed its most improved and novel specimens.

As before stated, the Palace of Manufactures contained the exhibits of goods of a purely utilitarian nature. These were divided into two divisions, one, including hardware, heating and ventilating apparatus, glass, lighting apparatus (other than eletrical), undertakers' goods, and a large variety of merchandise in woods and metals, being installed in the west half of the building, and the other, consisting of the exhibits of textiles, clothing, etc., occupying the eastern half.

The hardware exhibit included everything that could possibly be classed under that heading, and probably the most effective installations in this section were the displays of cutlery. These were interesting and valuable, and showed the processes of manufacture from the rough metal up to the grinding and polishing. The most extensive variety of table cutlery was shown, as well as pocket cutlery, scissors, razors, and knives.

Following the hardware section was presented heating and ventilating apparatus, including extensive exhibits of radiators, low pressure boilers, stoves, furnaces, etc., as well as every variety of ventilating appliances and systems. Adjoining this was shown all the methods of lighting other than electrical, and these proved extremely attractive on account of the beautiful spectacular effects which they often presented.

Passing from the utilitarian division to the eastern half of the building, there was to be found the most complete exhibit of costumes which has ever been attempted at any exposition, one of its most interesting, and which proved to be most popular features being the show room, where the gowns were exhibited on live models, in addition to the regular installation on wax figures in the cases. Adjoining this there was an effective display of individual work, such as embroidery, lace-making, and needlework of all kinds.

The Department of Manufactures was especially notable for its representative foreign exhibits. In this respect it far surpassed the great exhibit in the Palace of Industries at the Paris Exposition in 1900, which latter has been acknowledged superior to anything that had previously been accomplished at international expositions.

The Paris Palace of Industries was 1,200 feet long and 160 feet wide, less than half the size of either one of the palaces devoted to similar exhibits at the Universal Exposition of 1904. Its contents were so well installed and displayed, and of such attractive interest that this section proved the most popular of the entire Exposition. The nations whose exhibits stood out prominently were France, United States, England, Germany, Italy, Austria, and Japan. Each of these countries presented exhibits of its special products of manufactures for the Universal Exposition at St. Louis. And in addition among the participants were Holland, Denmark, India, Persia, Norway, Sweden, Switzerland, Turkey, and many others. Germany, whose exhibit at Paris was by far the best exhibit of Industrial Arts that nation has ever made, displayed in the Palace of Varied Industries at St. Louis a much more extensive and elaborate showing. France installed in the Palace of Manufactures the most important and representative display that that country has ever made in a foreign land. The exhibits of Italy and Austria were in rivalry with those of Germany and France, while the displays of Japan and also of China were distinguishing features that brought forth many expressions of admiration.

SECTION OF THE HALL OF ART. FESTIVAL HALL AND COURT OF HONOR.

GERMANY'S ARTS AND CRAFTS DISPLAYS IN VARIED INDUSTRIES.

# DIVISION CXXXVIII.

## Manufactures and Varied Industries at the Fair.

Notwithstanding two of the largest palaces at the Exposition were devoted, the one to Manufactures and the other to Varied Industries, thus indicating two departments, they might have been one without conflicting in the least with the plan of systematic arrangement. That all the articles comprehensible under either one of the two heads were not displayed in a single building was due to the fact that a structure large enough to satisfy the applications for space would have destroyed the harmony and symmetry of the general plans of the grounds. In every department, except possibly in that of Horticulture, foreign governments were represented with a liberality that in some cases competed in both quantity and quality with displays made by home producers, and to accommodate the request for exhibit space it was necessary to erect buildings that are about the limit of practicable size for such purposes.

At the Chicago Exposition, Manufactures and Varied Industries comprised a single department confined to one building, somewhat larger than either one of the two at St.

Louis, but less than half as large as the combined area occupied at the latter.

"Arts and Crafts" is the term most generally applied to the division devoted to a grouping of those articles which while being the product of manual labor, the output of a trade that requires special skill or dexterity, are of artistic and esthetic quality—in short, the physical expression of artistic forms. Neither "Manufactures" nor "Varied Industries" applies to such articles, since they are quite comprehensive enough to include the product of every trade, from the heaviest piece of machinery to the finest scientific instrument.

Enumeration in print of the articles that were on display in these departments would have required a volume of 2,000 pages, as there were nearly 25,000 exhibitors, some of whom, notably in the German, French, English, and Japanese sections, showed as many as 10,000 separate pieces, the aggregate value of which it is estimated was not less than $50,000,000. The most expensive single object was a necklace valued at $250,000 exhibited by Maurice Brower, of New York, in Varied Industries Palace. This exquisite ornament was composed of 690 gems, among which were several of great historic interest, some of which were at one time the property of Napoleon, Empress Josephine, Maximilian, Empress Carlotta, Boss Tweed, Lady Francis Hope, and other lesser notables.

A feature most pronounced in both Manufactures and

Varied Industries Pavilions was the process exhibits, by which were shown all the steps through which every article passes in its manufacture, from the raw material to the finished product. Thus the diamond, most expensive of gems, passed before the eyes of visitors from the stone embedded in its matrix, as found in the South African field, through the processes of cutting, grinding, polishing, and setting. Similarly there was conducted in the presence of the crowds the cutting of other precious stones and the manufacture of jewelry and ware from gold and silver, an exhibition of very great interest and instructive as well. This exhibition of processes included also the manufacture of imitation diamonds; counterfeit jewelry; automatically woven wire mattresses; weaving of tapestry; making pocket books; stylographic pens; silk handkerchiefs and pillow covers; all the processes of a complete laundry plant; pen knives, showing the grinding, filing, fitting, tempering, and assembling; paper boxes from the card-board to the finished box; rulingof paper; shoe uppers; women's dresses; women's undergarments; corsets; overalls and jumpers; shoe leather from the stiff, raw leather to the polished, soft product; manufacture of shoes, 300 pairs a day; women's skirts, measured, cut with electric shears and fitted while a customer waits; rubber boots and shoes; elastic web for surgical purposes; lace stockings, thirteen operations; silk in the piece; silken ribbon of various colors and degrees of fineness; binder twine and heavy rope; high-grade lace; cotton fabrics, four patterns, from the loom to finished gowns of the latest style; knit underwear; men's suspenders; artificial flowers; Indian (Navajo) blankets and hammered silver.

Nearly all nations were represented in either Manufactures or Varied Industries Pavilions, the larger displays usually being found in the latter. Japan was here in evidence, as in every other department of the Exposition, the most prominent and characteristic feature of the Japanese display seen being a booth, the entrance to which was a full-size reproduction of the ancient Temple of Nikko, which is said to be the most delightful example of architecture on the islands, illuminated with mosaic effects in brilliant colors. The structure was a pagoda, with a second story of bamboo, of richly carved woodwork with representations of dragons, and chrysanthemums the national flower. In place of a shrine, which occupies the interior of the original, the space was filled with glass cases in which were exposed to view specimens of Japanese ceramic art, golden tapestries, embroideries, and bric-a-brac. There was also shown in the collection a pair of cloissoné vases of green and gold, valued at $10,000. In the manufacture of cloissoné ware the Japanese may have imitators but no equals, just as their lacquering on wood excels that of all other peoples. Examples were also shown of their sowas work, a mixture of gold and copper which they color blue or black in a manner unknown elsewhere.

Satsuma pottery, which the Japanese displayed in profusion, had its origin, as the legend explains, in the following incident: About three centuries ago a Korean prisoner was brought to the Satsuma province, who, finding captivity without occupation irksome, modeled a vase of soft clay and then constructed a rude kiln in which he burned it, producing a piece of pottery of native art that so pleased the Japanese that some of his guards persuaded the prisoner to teach them the process, as a reward for which his freedom was given him.

The space occupied by the Japanese section in Varied Industries Pavilion was 50,000 square feet, which was replete with objects that illustrate the originality, skill, and industry of these patient and capable people. There were screens, bronzes, examples of lacquer work, ivory carvings, porcelains, magnificent vases, peacock fans, silk hangings, mattings, daylight fireworks, cameras, surgical instruments, and a Japanese house, the latter an exhibit made by the Kioto Chamber of Commerce, of two rooms sumptuously decorated and furnished to illustrate the elegant manner in which the upper classes live and the ability of Japanese manufacturers to minister to and provide for the cultured tastes of their people.

Sericulture comprised a large part of the exhibit, which demonstrated every process of silk production. There were cocoons, a model of a silk-worm nursery, and also of a silk factory, following which were specimens of woven silk of various qualities, from the crude to the highest specialized article, manufactured into kimonos, fans, handkerchiefs, and many kinds of fabrics.

England's exhibit in the Varied Industries Building was designed to show very largely the industrial achievements of her colonies, and incidentally her own. But England's future lies chiefly, we may almost believe, with her colonies. Formerly the United Kingdom led the world in the production of coal; but the United States has wrested this preeminence from the English, and her cotton spinning and iron manufacture are now also threatened by this country.

Among the most attractive of England's exhibits was the model of an English country house, which, though it presented a rather simple aspect upon the exterior, was furnished in the most luxurious yet very tasteful manner. Two of the rooms were reproductions, in the furnishings, of the royal apartments on the *Ophir,* which were occupied by the present Prince and Princess of Wales when upon their tour around the world. The dining-room contained a quantity of rare old wedgwood ware, in an old-fashioned cupboard.

The Royal Commission made a comprehensive display of British laces, silks, embroideries, hangings, and furniture, all grouped in a court flanked by tall glass cases. The exterior of the court exhibited a series of panel-paintings showing costumes from the sixteenth to the nineteenth centuries, indicative of historical periods.

France was more generally represented than any other foreign government, excepting Germany, the claim being made that there were approximately 5,000 French exhibitors; 741 of this number showed exhibits in Manufactures and Varied Industry Pavilions, while the displays made by French colonies covered a total floor space of 4,500 square feet. In Machinery Department there were only forty-six exhibitors, but these occupied more space than France used for her machinery exhibit at Chicago; moreover, the showing in this department included not only the finest types of French engines, but some of the best examples of machinery in the world.

It is claimed that in the French section of Manufactures Building articles valued at $10,000,000 were shown. The exhibit of costumes was especially fine, before which thousands of ladies passed hours examining and jealously coveting beautiful creations that serve to make lovely woman an angel in appearance as she is very near, at times, in fact. These superb gowns were generally shown on lay figures and in a luminous room where the best possible effects were to be obtained. Besides charming dresses, elaborate with dainty trimmings, there was an exhibition of furs, with one Russian sable valued at $12,000, and an ermine coat held at the price of $9,000.

While France well maintained her reputation as a country of fashion and taste by the exhibition made of splendid gowns, it was for the gorgeous displays of jewels and jewelry that greatest admiration was elicited from the visiting throngs. In one small case were displayed diamonds valued at $1,000,000, one of which was a 124-carat canary, another a $100,000 blue diamond, and a third a red diamond, said to be the only one ever found. Near the diamond display was a show-case that contained a necklace into which the figures of 2,000 nude women are entwined to form the loops. Across the aisle from this was to be seen the most elaborate piece of jewelry in the French section, in the shape of a large corsage set in diamonds and emeralds. This piece covers the entire chest when worn in its entirety, but it can be separated into twelve pieces, so that each can be worn separately as pendants, earrings, brooches, two pieces for the shoulders, and an aigrette. To give an idea of the carefulness with which the piece has been made, one emerald is located on each side, and in order that their color might match exactly one large emerald was cut in two, and one half used for each side of the piece. Another interesting feature is the signet ring, the size of an ordinary signet ring, but in the top is a tiny watch, keeping correct time, and striking the hour when the spring is pressed, the striking being done by two little Cupids which are visible on each side of the dial. This is valued at $2,500.

It has been stated by some of the Exposition authorities that France had a larger number of exhibits at the Fair than Germany. I have neither the disposition nor facts at hand to justify me in denying the statement. Both France and Germany were sharp competitors and both won honor and praise in measure sufficiently large as to be fully satisfying. It is not invidious, however, to say that whether she had more or less than another country the declaration will hardly be gainsaid that Germany made, unqualifiedly, the most imposing and impressive display that was to be seen at the Exposition—always excepting, of course, that made by the United States.

In some respects there was acute rivalry between Germany and Japan, both of which countries exerted themselves, so to speak, to gain the applause of the world—and they were not disappointed.

Let us stop right here a moment, while the subject is suggested by the mention of Germany and Japan, to ask: while rivals for trade between themselves, are they not also serious rivals for the trade of which we have had control for several years?

Thirty-four years ago Germany stood for a heterogeneous confederation of petty kingdoms, in none of which was property or person secure, and of progress there was practically little. To-day Germany is in the forerank of nations commercial and industrial, as well as militant; a nation that is compact, homogeneous, energetic, patriotic, and ambitious. Think of it, ninety-four per cent of all the children of Germany are attending public school under a compulsory law. Nearly 40,000 German students are in the universities, and they are receiving practical and scientific instruction.

In Japan the department of education is directed by a minister, while in the United States it is a bureau. In Japan ninety-two per cent of all the children are in school under a compulsory education law. Less than twenty per cent of Germans are illiterate, about forty per cent of Japanese can neither read nor write. In ten years the promise is that there will not be thirty per cent. In the United States there are now twenty-five per cent of illiterates, and in some States there are more than fifty per cent, while only fifty-eight cents per capita per annum is spent on education in two States.

The first steamer bought by the Japanese was the *Stonewall* in 1868. To-day Japan has a single steamship company that owns a fleet of eighty vessels, with an aggregate capacity of 300,000 tons, while the several ship companies of Japan operate 1,000 vessels, the largest of which are built in that country.

No mistake, we must get busy, and keep busy, if we would retain our position as a leading commercial nation.

While German exhibitors showed their wares, crafts, engines, or art products in every department of the Exposition, it was in Varied Industries that their display was most attractive, covering, as it did, an area of 80,000 square feet and included an almost endless variety of articles, of both an ornamental and utilitarian character. But the feature that proved most interesting to visiting multitudes was furnished by the architectural novelties and artistic innovations connected with home decoration and appointments that made

LIVING ROOM, GERMAN EXHIBIT, VARIED INDUSTRIES.
GERMAN PORCELAIN EXHIBIT, VARIED INDUSTRIES.

up a greater part of the exhibit. Hundreds viewed with interested curiosity the splendid collection of rich bric-a-brac, the very large display of cutlery, the amber room, the mosaics, the vari-colored tiles, ceramics, the exhibit of beautiful porcelains, and the massive brass show-cases that contained a part of the exhibition, but the thousands lingered longest and gave utterance to their highest admiration for the artistically designed, the exquisitely decorated, and the tastefully furnished apartments of the fifty household art exhibition rooms.

Conspicuous as a centerpiece in the atrium, or main hall, which rose to a height of sixty-three feet, was a gigantic bronze eagle, forged by Armbruster Bros., that represented the highest example of the craftsman's skill, a figure not only typical of German spirit but equally so of German dexterity and art instinct. The very elaborate display in the arts and crafts division included ecclesiastical and profane art works in gold and silver, a colossal wrought iron eagle, bronze jardinieres, pieces of glorious tapestry, figures of hand hammered copper, wrought iron and glass ornamentation a series of apartments fully furnished and appointed, such as ante-rooms, reading, art, reception, sitting, dining, library, nursery, boudoir, study, state hall, living room, tea, music, smoking, etc., which for their chaste elegance were so inviting as to be almost a revelation. The details of every room, both architecturally and in equipment, were complete in the most minute particulars, each one being truly a study in color, in which furniture, carpets, pictures, and decorative embellishments harmonized perfectly and showed admirable adaptation to the room design.

Italy's largest representation at the Fair was, as might have been expected, in marbles, though her efforts to show forth to the world the genius and ingenuity of her people was not wholly confined to statuary. It is not generally known that the Italians are as dexterous in wood carving as they are in fashioning blocks of marble into graceful forms simulating life. But the exhibits which they made of exquisitely carved furniture fully attested their ability in this industry. They are acknowledged to be the first of all peoples in the art of lace making, and their reputation was well supported by the exhibits they made at the Fair. But while Italians are skilful artisans and artists in many lines it is as producers of statuary that their excellence surpasses. The exhibit of sculpture work in Manufactures Building was the largest Italy has ever made at an exposition. It comprised 2,000 pieces, a large part of which was produced by the foremost artists of that country, in Carrara, Castillina, alabaster, and agate marble.

Mexico, our highly esteemed sister republic on the south, exhibited her industrial activities by large representative displays in all departments of the Exposition and it must be owned that the showings served to create a most favorable impression upon all peoples. A few years ago Mexico was either a country of passivity, lethargy, and ignorance, or

RECEPTION ROOM, GERMAN EXHIBIT. COUNCIL CHAMBER, GERMAN EXHIBIT.
ART HALL, GERMAN EXHIBIT. THE HALL, GERMAN EXHIBIT.

ARTS AND CRAFTS DISPLAYS IN VARIED INDUSTRIES.

one of revolution and dynamics that were lethal and contemptible. President Diaz has proven himself the Washington that not only delivered his country from foreign oppression, but who rehabilitated and raised it to the dignity and honor of a great nation respected by every power. And thus has been brought about in the lifetime of a single generation a radical change, social, political, economic, and industrial, that has wrought infinite good, not only to the people themselves but to every other nation that now finds it profitable to maintain trade relations with Mexico. It was a wise and befitting thing, therefore, that Mexico should improve the opportunity to exploit her revivified life, her progress and attainments, at an exposition that brought her into rivalry with every other nation of the globe, for she was able to make a showing that suffered no disparagement from the competition.

Accordingly Mexico occupied a space in Manufactures Building which was equal to that used for the display of any other country. Though less than thirty years ago Mexico had practically no factories and imported nearly everything except gold and silver, the situation is now reversed and she has become an exporting nation. At the Fair was therefore exhibited products of her mills and manufactories, shoes, hats, cloth, furniture, silks, plumbing supplies, onyx, coffee, marble, and a hundred other things that demonstrated her fast growing wealth and rapid industrial expansion. But her advance in other respects has been equally great, for Mexico now supports a splendid system of public schools, and the masses are becoming educated as rapidly as they are acquiring riches.

Perhaps the largest display made by a single firm in Manufactures Palace was that of the Simmons Hardware Company, of St. Louis, which occupied about 20,000 square feet near the center of the building with a unique, very ingenious, and most picturesque hardware exhibition. The exhibit imitated a large revolving windmill, playing fountains, a cataract, a stream of water through which an Indian paddled his canoe, a railroad running on levels, over viaducts and through tunnels, and a bank, dank and forbidding, along which a great snake ran in a sinuous course into its hole to reappear very soon to startle the gaze of passing crowds.

Another beautiful and artistic exhibit was made in this same building by the Broderick & Bascom Wire Rope Company, and for uniqueness and attractiveness was the equal of that made by the Simmons Company, though it was not so large. The booth was enclosed by a handsome fence of woven wire and the centerpiece was a cable spool of bronze colored steel, a facsimile of a seven-mile long cable made for the Metropolitan Street Railway of New York, and which weighed 137,000 pounds. In front of the large spool was a model, one-sixth in size, to which were attached twenty-four horses to show the manner in which the enormous cable was moved through the streets.

Fine gems and jewelry never fail to please the ladies and the displays at the Exposition were so attractive that crowds often blocked the aisles before such exhibits, but a more interesting exhibition was afforded by a showing of admirable replicas of the crowns worn by the great sovereigns of the world. These beautiful emblems of earthly power were of imitation gold, studded with false pearls, rubies, diamonds, sapphires, and emeralds so as to form an exact copy of the original in each case, even the settings thus used being correct imitations in size, shape, and color of the real stones that embellish the actual crowns represented.

In this collection were the following: Crowns of Russia, Italy, Napoleon I., Netherlands, Siam, Denmark, iron crown of Lombardy, Sweden and Norway, Portugal, crown of Josephine, of His Holiness the Pope, of Spain, Great Britain and Ireland, Germany, and Austria. Besides these, in the same exhibition were imitations of the orb of gold with which the Kings of England are invested, scepter of the Pope, and the orb of gold which is a part of the investiture of the Mikado of Japan.

The manufactures display at the World's Fair made by Hungary, in the southeast end of the Manufactures Building, although small, was choice and beautiful. The exhibit was enclosed in a house and courtyard surmounted by four towers, the architecture being Hungarian of about the thirteenth century.

The leading manufacturers of that nation, of jewelry, porcelain, hand-wrought iron, high-art furniture, mosiacs, bronzes, embroideries, pottery, hand-made and hand-embroidered linen, cameo and other art-glass, enamel, and carved, painted, and inlaid leather, were represented. This exhibit was awarded eight grand prizes and twenty gold medals, the total number of prizes voted to this department being over seventy.

Several rooms and the courtyard in the Manufactures Building were taken up with the rich display made by Hungary. Among the finest examples of wrought-iron work at the Exposition shown here were a pair of gates which attracted the particular attention of connoisseurs. In the central hall examples of gold and enamel, silver repousse, hammered metal work, and majolica-ware were displayed. A Louis XVI. room, a copy of that of the Prince Eszterházy, and a complete dining-room of Hungarian oak inlaid were unusually attractive features. A very fine collection of mosaics in marble, glass, and eosin received the grand prize, while a set of china in royal purple specially made for the Exposition was awarded a gold medal. A grand prize was also accorded to Hungarian hand-made laces, and a grand prize and five gold medals were given for embroidery.

One corner of the courtyard was occupied with examples of Hungarian home industries, the most important of which is under the protectorate of Her Imperial Highness Archduchess Isabella. Seventeen different provinces of Hungary contributed peasant work in hand-made linen, embroidery, and stone and earthenware. The wearing quality of the Hungarian hand-made linen embroidery was shown in samples over fifty years old. As unique examples of embroidery there were shown lambs' wool opera and automobile cloaks and jackets, the outside of the skins of which were elaborately embroidered.

Probably the most unique feature was a little jewel case studded profusely with rare and costly gems, about an inch in depth and four inches long, made of silver and gold, wonderfully chased. This little box had a peculiarity in that when you pressed the spring to open the lid a tiny little bird about a half inch long sprang from the center of the receptacle. This bird insisted upon singing, consuming fully two minutes of time and sang so well that but for the ocular evidence one would not believe that it was mechanical. After it has finished its song it returns to its resting-place, the lid closes down and the real lid of the box opens so that the jewels may be seen.

Bulgaria's exhibit cost her $100,000. It was compact, well assorted, comprehensive, and full of picturesqueness. The exposition of the resources and products of this interesting European oriental country, with its population of 3,500,000, was distributed over three of the main buildings, the Fine Arts, Liberal Arts, and Varied Industries. A true collective exhibit illustrating the rich products, industries, and manufactures of this rising principality was shown in a large space of about 6,000 square feet in the Varied Industries Palace near the main entrance, next to Russia. It denoted an immense progress over what was displayed eleven years ago at the Chicago Fair. Bulgaria then appeared in but one building, the Palace of Manufactures, and its exhibit was composed of only a hundred small lots.

The great center of attraction in the Bulgarian section of the Varied Industries Palace was a large decorative sculptural structure moulded for the St. Louis Fair at the capital, Sofia, at an expenditure of $10,000. It represented a plastic landscape of rocky mountains, which embodied by its two life-sized combatants, an armed Turk on the top of the pass and a Bulgarian warrior awaiting his attack, the allegory of the recent war for Bulgarian independence. From the lower rocky terrace trickled into a basin a gentle waterfall of pure rosewater, the first flow from the distilling process of the world-renowned essence, attar of roses. Its fragrance pervaded the entire section, lending it true local character and color. The precious rose extract itself, of three different qualities and colors, yellow, white, and green, the last being the costliest, was displayed in many beautiful cut and ornamental bottles and flagons of all sizes. They were arrayed in a number of vitrines, built into recesses of the rock. A total capital of not less than $30,000 was represented by these bottles, of which a few contained $2,000 worth of perfume each.

Next in importance were magnificent characteristic woolen Bulgarian carpets. They were hand-woven and about 200—very large, of medium, and smaller sizes—were hung up all over this section. Their rich, bright color combination and endless variety of geometrical or flower designs produced here a most decorative effect. The highest quality is made at Panagurishte, others of all qualities at Tzaribrod, Samokov, and Gabrovo.

The silk exhibit represented by twenty-six manufacturers excelled in beautiful robes, materials, raw silk, mostly in white and cream color. Tobacco in leaves and cut; cigarettes in various qualities (six exhibitors); all sorts of preserves; thick honey; a very fine collection of Bulgarian white and red wines in neatly labeled bottles, of the famous "Mastica," a liquor somewhat like absinthe; sesame seed and oil; perfumery; soap; wonderful large samples of grain; beautiful hides and furs (fox, skunk, etc.), by fourteen exhibitors; exquisite leather work; laces; the national white belt with colored embroidery; a choice of knives; daggers with national handles covered with pearls and precious stones; mining cabinets comprising rich specimens of gold, silver, copper ores; marble in all tints; Bulgarian needlework; embroidery; table-linen ornamented by bright colored sewed designs; baskets; life-sized statues of peasant and Macedonian women in gorgeous national costume; many glass cases filled with antique statuettes and artistic relics reproduced from collections in the museum at Sofia, which were transferred to the Missouri Art Museum at the close of the Fair—all these and many other striking features aided in rendering the Bulgarian section one of the most interesting exhibitions in Varied Industries Building.

Denmark made a display in Manufactures Building, in which Royal Copenhagen porcelains predominated. Among these was a dinner set, made for the Queen, consisting of 2,000 pieces decorated with all the flowers to be found in Denmark. A specially interesting part of the exhibit were copies of gold and silver jewelry found in the tomb of Dagmar in the thirteenth century. There was also to be seen the Altenborg horn, made several centuries ago and used as a peace-offering. Other antiquities included duplicates of ancient Grecian ware, a special exhibit of the evolution of the pottery industry for 5,000 years, and several statuettes taken from tombs, supposed to have been regarded as the household gods of the people a thousand or more years ago when the Vikings were in power.

The importance as well as the great attraction of Manufactures Palace was to be found in the working process, the model factories that were in operation in the building during continuance of the Fair. Among the practical industrial plants here to be seen were a paper box factory; a compressed air carpet-cleaning machine; looms for making cotton goods, that showed the process of manufacturing raw cotton into finished fabric; a machine making silk webbing; girls at work making artificial flowers; machines weaving tapestries, making fine embroideries and laces, etc. But probably more attractive than any other of the many factories in Manufactures Building was a fully installed shoe factory that employed seventy-five operators and produced a daily output of 300 pairs of shoes, every process being illustrated from the skin to the finished article.

# INTRODUCTION TO THE DIVISION OF LIBERAL ARTS.

By John A. Ockerson, Chief of the Department.

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The place occupied by Liberal Arts in the higher development of mankind is well indicated by the position given it in the arrangement of the different Exposition departments. It is one step ahead of Manufactures and one step behind Art. In other words, the Louisiana Purchase Exposition recognized that, while no apt phrase has as yet been coined to comprehensively define "Liberal Arts," the department is nearly related to Manufactures and closely akin to both Science and Art.

The department was housed in the most easterly of the exhibit palaces, a splendid structure covering nine acres. It was within the walls of this building, on April 30th and May 1st and 2nd, 1904, that the ceremonies incident to the dedication of the Exposition took place, in the presence of one of the greatest audiences ever assembled in one enclosure west of the Mississippi River, and was graced by the presence of President Roosevelt, former President Cleveland, and other distinguished guests.

Foreign countries to whom space had been allotted in the Liberal Arts Palace were: The British Kingdom, Germany, France, Italy, Mexico, Argentine, Egypt, China, and Siam.

The British Kingdom arranged for a very complete and comprehensive display of products called for by the Liberal Arts classification. It included a large collective exhibit of specimens of typography and books by the very best English printers and publishers. Photography, now so important a factor in the life of every civilized nation, was represented by an elaborate exhibit, including specimens of historic photographs from Sir Benjamin Stone, M. P., and other important collections. Especially important and interesting was the exhibit in the realm of chemistry. There were many models, plans, and photographs of great engineering public works, including models of lighthouses, a model of the Assouan dam, and a most interesting exhibit of geographical maps from the Royal Geographical Society, including exhibits by the Palestine, Egyptian, and Cretan Exploration Funds, and maps from the Imperial surveys, and the British mint showed a most interesting collection of ancient and modern coins, medals, and seals.

Possibly the most attractive exhibit in the British section was that of Professor Dewar, whose conspicuous achievements in the liquefaction and solidification of hydrogen and the remarkable results which he has obtained by his experiments are all matters of common knowledge to scientists. The Liberal Arts Committee of the Royal Commission arranged for a collective exhibit illustrative of the work done in low temperature investigations embracing the recent achievements of Professor Dewar. A complete working plant, practically a duplicate of that employed at the Royal Institution, capable of making two litres of liquid hydrogen, was accordingly constructed under the superintendence of Professor Dewar in London, and erected at the Exposition. There were periodical demonstrations of the properties of liquid hydrogen and the separation of helium, etc., from gas mixtures; phosphorescence, photographic action, luminosity of radium in liquefied hydrogen, electric crystals, direct liquefaction and solidification of air and oxygen, the solidification of hydrogen, and the production of the lowest temperature obtained, i. e.—259 degrees Centigrade, etc.

In the space allotted to France in the Department of Liberal Arts, that nation was given ample opportunity for a most generous display, which was so far availed of that the exhibit in the French section was not only of enormous value, but important and interesting.

The German Empire occupied a generous amount of space in the Palace of Liberal Arts, which was worthy of that great nation. Especially interesting was the exhibit of printings from the German Imperial Office, and the books and publications of the German book trade, specimens of artistic photography, and numerous geographical maps, models, plans and designs of public works, and other evidences of achievements by famous German engineers in river improvements, canals, etc., which was especially arranged for the Universal Exposition by the Prussian Minister of Public Works, and the Imperial Board of Health organized a hygienic exhibition which was very instructive. In the manufacture of paper and chemicals, of scientific instruments, and of artificial textiles, Germany was likewise splendidly represented.

Argentine, while not occupying so great a space as any of the foregoing countries, showed, by many relief maps, albums of photographs, models of docks and public works, the great improvements which her engineers have made in the rivers and harbors of this most progressive South American country.

Mexico, in the space allotted to her in the Liberal Arts Palace, surprised the world by the excellence of her exhibits in typography, chemical production, and engineering works, while Italy and Siam presented displays which were of absorbing interest.

Practically all of the exhibit of the Chinese Empire was installed in the space allotted to this great Oriental nation in the Palace of Liberal Arts. The Honorable Vice-Commissioner, Wong Kai Kah, in a general way, indicated the nature of these exhibits of objects typical of the artisanship and life of his people. From this nation, where printing and the making of books was many hundred years old before Gutenberg invented his movable types, came specimens of early printing, ancient manuscripts, works of ancient carvers in wood and jade, trophies from her temples and palaces, ancient and fantastic armor and weapons of war, old in the days of Confucius and still in use, costumes from widely separated provinces of the Empire, musical instruments strange in shape and weird in tone, together with concrete evidences of China's recent advancement toward closer relationship with other countries and her development as a commercial nation. While all of these things were not in strict conformity with the classification for the Liberal Arts Department, it was the best judgment of the Exposition Exhibits Division that, since this was the first time in the history of expositions that the Celestial Empire had participated as a nation, the entire exhibit should be shown in one great section of one of the exhibit palaces. Hence the entire installation in the Liberal Arts Department.

So great was the demand for space in the Department of Liberal Arts by prospective exhibitors from the United States, that it was found to be quite a difficult matter to allot the different industries more than an amount of space that would inform the public of the equipment and processes, as well as a limited exhibit of the products of the industries represented by each of the thirteen groups in the department classification.

No other class of exhibits so clearly indicated the status of a nation's culture as the one included in those groups which go to make up Graphic Arts. In this section the development in printing and typography in the last century was fully shown by operative exhibits. There was a complete printing office, bookbinding shop, and, for the first time in expositions, complete photo-engraving and electrotyping plants in full operation. The recent inventions for mechanical typesetting and typecasting were fully exhibited. Displays of the products of printing, lithographing, and engraving were very complete. The development of the typewriter and other machines for reproduction of copy was shown by numerous exhibits. In books and publications, in maps and globes, in coins and medals, there were displays to please and interest.

Photography, which has made such advancement in this country in the last decade, was well represented. For the first time in the history of an international exposition, specimens of the photographic art were hung in the Palace of Art, though entered as exhibits through the Department of Liberal Arts, after examination by juries of selection.

The maker of mathematical, philosophical, and other scientific instruments has kept pace with the spread of knowledge and the investigation of scientists. The importance of this industry and its leading position will hereafter be more fully appreciated since the elaborate displays by leading manufacturers at the Exposition. An equatorial telescope weighing 4,000 pounds was one of the most interesting items of this display, next to which, in point of attraction, was the most elaborate exhibit of mechanical computing devices ever seen at an exposition.

Progress in medicine and surgery was shown by an excellent exhibit of appliances, instruments, and apparatus for surgery and medical research. A complete model hospital, with all of the accessories and apparatus known to the most advanced surgery, was the most prominent feature of this group.

The department was, from the first, confronted with the fact that space in the Palace of Liberal Arts would be inadequate to care for all the exhibits presented. Especially was this true in the Music group, where it was early determined to avoid the monotony incident to what might be termed ware-room displays. Therefore, in dividing up the space for domestic exhibits between the thirteen groups of the department, a section of 26,000 square feet was set aside for the exhibits of Group 21. This curtailment of space made the ware-room display impossible and exhibits were necessarily confined to "paramount features." Otherwise it is quite likely that the nine acres in the Palace of Liberal Arts would have been found inadequate for Group 21 alone. But the space made up in interest what it lacked in area. The development of the piano from the earliest days of its history to the present time was shown by the Baldwin Piano Company of Cincinnati and included a special retrospective exhibit showing the evolution of this instrument during the past century. The methods used in the manufacture of a piano were shown by another exhibitor, while the automatic instruments, which have so rapidly developed in the last ten years, were exceedingly well displayed. There were exhibits of band instruments, of cunningly wrought and invaluable stringed instruments, of church, chapel, and parlor organs, of pianos by the most famous builders of to-day, and some positive novelties in music-producing instruments.

In the report of the twelfth census on the chemical industries of the United States, attention was called to the large amount of capital invested in the business and its rapid development during the ten years from 1890 to 1900. The allotment of space to exhibitors in the group of Chemical and Pharmaceutical Arts was indicative of this rapid progress. A complete chemical laboratory was one feature; another showed how perfumery is made from flowers; yet others displayed the products of the best laboratories of the country.

Civil and military engineering, models, plans and designs of public works and architectural engineering, comprising three groups, with excellent displays by many exhibitors, gave a comprehensive idea of the great work accomplished by the engineers of this country. Typical of these groups, in the very center of the Liberal Arts Palace, rose a reproduction to scale of the lighthouse at the Southwest Pass of the Mississippi River. At its base, surrounding it on every side, were engineering exhibits, apparatus used by engineers, and in that vicinity were installed various kindred and related exhibits to which were allotted space in their respective groups. There was also a great array of machinery used in preparing good roads and streets, earth-handling and rock-crushing machinery of the latest patterns, and new devices for mixing concrete, water-purifying machinery, filtration plants, etc. Out-of-doors, in the space between the Palace of Varied Industries and the Palace of Transportation, were exhibits of steam shovels, pile drivers, and wrecking cranes in operation.

In a word, the Liberal Arts Department by its comprehensive exhibition, fulfilled the promise made to justify the prominence given it in the Exposition exhibit arrangement. Its mission was not only to interest but to educate, and in every instance where it was possible, the underlying idea of the Louisiana Purchase Exposition, "life and motion," was fully carried out.

## DIVISION CXXXIX.

### Exhibition of Applied Arts.

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The English language is rich, comprehensive, descriptive, but no one has been able, as Mr. Ockerson states, to find a word that definitely expresses such a collection and exhibition of objects and articles as have, for want of a better term, been classified and assigned as Liberal Arts in American expositions. The grouping under that head seems to be of those things left over from the assignments made to Varied Industries, but that such an arrangement is purely arbitrary, and often inconsistent, no serious-minded person will deny. Without entering into a discussion of this phase of exposition direction, let the knowledge suffice that even arbitrary divisions are not incompatible with successful exposition management, since exploitation is another word for advertising, and the public is more impressed by a showing of many buildings and departments than by a few.

"Liberal Arts" is so called probably because it is a term to be liberally interpreted; because it means anything, everything, or nothing, as mood or circumstances may satisfy, and this we may content ourselves with believing when in that department of the St. Louis Exposition a ponderous printing press and other heavy machinery were shown alongside of a display of dainty bookbindings and pictures, thus spanning the full range between mechanical and strictly artistic industries.

The exhibits made in Liberal Arts Pavilion were without classification, strictly speaking, but this in no wise detracted from their interest or educational value. Near the northwest corner of the building was installed the Hoe and Company double octuple newspaper perfecting press, the largest printing machine in the world, that has the astonishing capacity of 200,000 eight-page papers per hour, or 50,000 thirty-two page papers per hour. This remarkable piece of machinery weighs when boxed 253,000 pounds. To my mind this press was the most wonderful thing to be seen at the Fair, for not only was it an astonishing product of human ingenuity, but it represented in the highest sense, and therefore typified, the educational spirit of our time. Improvement of the printing press may well be compared with that of the locomotive. The first press was used by Gutenberg to print his Bible (1450). This cumbersome affair continued to be the only printing machine until 1620 when a slightly better press was devised, which served the needs of the next two hundred years. Following came the Columbian press of 1816, and thereafter the Washington, of 1827, which connects us with the improvements of to-day, because thousands of these presses are still doing service in country printing offices in America. I worked one myself and by diligent labor was able to run off one side of 500 seven-column papers in a day. The big Hoe press not only prints both sides of 200,000 eight-page papers per hour, but also counts and folds them neatly, ready for delivery, thus proving itself to be the greatest news disseminator that we are now able to conceive.

Near the big press were other machines doing color printing, and in this same section were machines that did casting and typesetting. Farther down the aisle was an exhibition of lighthouses, in which models and photographs were shown of some of the greatest signal towers along the American coast. Still beyond these exhibits, that attest the progress of the age and the new world, was an exhibition made by China, which was colorfully characteristic and also indicative of the binding influence of immemorial custom in that very ancient nation. In China, let it be known, books were being printed from movable type 300 years before Gutenberg thought of accomplishing such a thing, and gunpowder and cannon were in use by the Chinese centuries before the English first employed such an agency, at the battle of Crecy, 1346. Yet notwithstanding these early initiatives, China has lagged behind other nations, a giant in size but, like the cyclops of old, single-eyed and circumvented by smaller but more sagacious nations.

China had a very beautiful exhibit, however, that illustrated the architecture of that phlegmatic though not inartistic people, and also showed many interesting things, among which may be named models of many kinds of sea crafts and various modes of transportation, including a dragon boat, which may have one time been used to frighten enemies at sea, just as manufactured dragons were an auxiliary of the military, depended upon to put their enemies to flight on land. Other things in the display were: beautifully carved wood cases and ivory figures; examples of filigree silver; very fine embroideries; screens of carved ebony wood inlaid with mother-of-pearl; porcelains; war spears; bronzes; curious shears used in various trades; a great variety of implements, such as chisels, brushes, files, saws, etc.; models of temples; teak wood furniture; tiger skins; silk cocoons; musical instruments; coins and charms from every dynasty since 2255 B. C. to the present time, and products of the mine and farm in great variety.

Germany was also represented in Liberal Arts by a very large display of models, pictures, books, photographs, musical instruments, and articles of every-day use. There was a model of the Kaiser Wilhelm memorial; models of Stuttgart and its walls, of road viaducts, and of a slaughter-house with every department that belongs to the industry. The Imperial Board of Health of Berlin made a showing of the means employed in cleaning the streets, sprinkling, and converting the waste and refuse. There was also a model of the waterworks of Kiel, public baths, mineral springs of Germany, model dwellings, water supply, plans of sewerage


THE BALDWIN PIANO EXHIBIT, LIBERAL ARTS.

purification, models of lighting arrangement and plants, the entire exhibit covering a space of 65,000 square feet.

In Liberal Arts was shown a large number of musical instruments, wood, brass, and mechanical, the most elaborate exhibit being made by the Baldwin Piano Company, of Cincinnati, which entered so deeply into the spirit of the Exposition as to make the largest possible display of their facilities and products. Disregarding cost, apparently, this company, though restricted through being unable to secure all the space they applied for, exhibited a model of their entire extensive plant, which included a dozen buildings, lumber yards, railroad switches, ware-rooms. Every building thus reproduced, to a scale, was not only complete in exterior appearance, but details were followed by reproducing miniature equipment, which showed a great force of workmen at their respective benches, cars being loaded, and all the activities of the establishment perfectly represented. This model of the Baldwin Works attracted unbounded attention and admiration, as it was the most pretentious exhibition, in several respects, to be seen at the Exposition. Their display of pianos was scarcely less interesting, for instruments were exhibited that for beauty of design, magnificence of finish, and splendor of decoration, would appear to be the limit of ingenuity and artistic taste.

Other notable exhibits in Liberal Arts Palace were automatic machines for adding, dividing, multiplying, and subtracting; phonographs; irrigation methods; levee systems;

optical instruments; grading machinery; stoves; specimens of book printing and binding; many household utensils; lamps; stationery, and surgical instruments. I noticed among the latter a unique invention placarded "Dispensary for Plaster Jackets." Examination and inquiry disclosed that the exhibit was prepared by Miss Charlotte E. Barnwell, of Baltimore, who, being a sufferer for many years from the result of an accident, required the support of a jacket, and finding none to suit her needs invented one herself. Since that time she has devoted her time and efforts to relieving those who suffer as she once did, and is doing this great service to the afflicted without any other reward than their blessings. Within a glass case I saw eight specimen jackets of various forms, which were plaster casts taken of patients attending the dispensary. These casts are adjustable and, besides being laced in front and light and pliable, may be removed at will by the patient. Attached to the dispensary is a free day school for what are called the "Jacket Children," where they learn elementary branches, take physical exercises, and have a daily Bible lesson. The dispensary is conducted purely as a private charity; Miss Barnwell being a lady of means and imbued with philanthropic ambitions, provides all the expenses above the small income received from a few patients able and willing to pay.

Very interesting were machines exhibited by Germany for manufacturing paper, which showed the various processes of converting pulp, made from both wood and rags, into different qualities of printing and writing paper. A machine was also shown printing wall paper.

Prof. Ansgar Shoppmeyer of Berlin, Germany, placed in the German section of the Liberal Arts Building his collection of 150 or more initials and miniatures. These were all hand work, painted in colors and gold and silver, upon vellum and parchment. They represent the decorative designing of several past centuries in Germany, when all books were lettered and embellished entirely by hand work, with a pen or a brush.

The largest and most complete automatic instrument in the world, an orchestrion, which combines all the instruments of an orchestra with a compass from the deepest note of the contra bass to the highest note of the piccolo, was exhibited in the German section of the Palace of Liberal Arts and performed daily to large audiences.

A collection of 120 miniature books was on exhibition and represented the art of bookbinding in all styles. The smallest books thus shown were about half an inch wide by an inch long and about one-eighth of an inch thick. There was one of these for each State and Territory in the Union, artistically arranged on the upper part of a shield composed of the stars and stripes. Below them were the other books of the exhibit, the largest having covers about two by three inches. Leather of all kinds, silk, satin, and other cloths, were used in binding these little volumes, which were as perfect in every detail as those of any larger books could be.

The leading book publishers of England combined in making a collective exhibit of books, which filled about fifty show-cases in the British section of the Palace of Liberal Arts. These contained books of every sort, historical works and novels, music, Bibles in many languages, and classics, that represented very graphically the state of the book publishing business in England to-day. The highest types of printing, paper-making and bookbinding were also exemplified in the books of this collection.

It was in Liberal Arts also that Pinaud, the French perfumer, made an exhibition, in connection with his own wares, of an historical tableau reminder of the Great Napoleon. The scene was a decidedly impressive representation of the marriage of Napoleon and Marie Louise April 2, 1810, and the crowning of his bride as Empress. All of the personages in this historic scene were represented by French dolls, dressed in exact reproductions of the costumes that were worn by those who took part in the ceremonies. The scene was correct in every detail and depicted very graphically this important event in the life of the man who sold Louisiana to America.

Below the coronation spectacle in the same case was a razor once the property of Napoleon I., and used by him during his rule in France. It is of the finest steel with a handle of mother-of-pearl.


EXHIBIT OF ITALIAN SCULPTURES, MANUFACTURES BUILDING.

Many reproductions of toilet articles such as were in use in Napoleon's time were also exhibited. These were careful copies of the original articles and represented some of the luxury which characterized the lives of the wealthy of that period.

## DIVISION CXL.

### Music and Religion at the Fair.

At no previous exposition has music been dignified by being assigned to a distinct department, but instead has been made a junior relative or co-ordinate of some ranking division where its prominence depended almost wholly upon appeals to the ear. At St. Louis music was elevated to a position which it should properly occupy at all expositions, as one of the sublime arts, which, indeed, has been accorded it for centuries, as the equal associate of architecture, painting, and sculpture.

In preparation for the greatest possible representation of music, the Exposition management had made, for use during the seven months' festival, the largest organ in the world, an instrument so large that its tones were equal to the thunder of Niagara, but which in its peaceful moods were as soft as the whisper of a breeze. The building of such a colossal music machine was one of the triumphs of the Exposition, for it was no more a wonder for its size than for its quality, compass, and uniqueness. This most remarkable of all musical instruments was built by the Harris Organ Company, of Los Angeles, Cal., under the

Fleming patents and a description of it is well worth reading, for the instruction no less than for the interest which it affords. Wonderful to state, this Brobdingnagian soul and executant of melody is capable of producing 17,179,869,183 distinct tonal effects, a continuous performance that would last 32,600 years if a different one of these combinations were drawn every minute in those centuries of time.

The wonderful impressiveness of its proportions and its overpowering volume of sound are the least of its remarkable achievements in the realm of instrumental music. That its thousands of pipes sound the profoundest depths of the grand passions as easily as the wind stirs the leaves to fairy cadences, is an infinitesimal part of its accomplishments.

Effects never heard outside the grand orchestra until the manufacture of this colossus, places its expressive powers far in advance of other organs. All of the wood instruments of the full band are contained within its vast compass.

Large as a brick block, 62 feet long, 40 feet high, and 33 feet wide, and possessing 140 stops, 239 movements, and 10,059 pipes, it overshadows all other great instruments of Christendom. It cost approximately $100,000. Only master musicians may command its marvelous volubility.

Two electric motors, each of 10 horse-power, drive this factory of sound, the construction of which required 100,000 feet of lumber and 115 miles of wire. The metal pipes alone consumed 16,000 pounds of zinc and 9,000 pounds of soft metal; its wooden pipes contain 35,000 feet of California sugar pine.

The two pipes drawing the lowest tones are each 32 feet long; two good-sized men, side by side, or a small pony can pass through them. A train of ten cars was needed to transport this monster from Los Angeles, Cal., to St. Louis.

The only organ in the world that even approaches this one is the immense instrument in the Town Hall at Sidney, New South Wales, the masterpiece of famous English builders. The Australian giant has 128 stops, as compared with the 140 stops of the World's Fair champion.

The next organs in rank are those in the Cathedral at Riga, Russia, with 4 manuals and 124 stops; Albert Hall, London, 4 manuals and 109 stops; Garden City, L. I., 4 manuals and 115 stops; Chicago Auditorium, 4 manuals and 111 stops; Leeds Town Hall, England, 4 manuals and 110 stops; Seville, Spain, 3 manuals and 110 stops; St. Sulpice, Paris, 5 manuals and 100 stops; St. George's Hall, Liverpool, 4 manuals and 100 stops, and Ulm Cathedral, 4 manuals and 100 stops.

Five separate organs are combined within this enormous mass of enginery, electrical mechanism, and wind pressure; the first, or Great Organ; the second, or Choir Organ; the third, or Swell Organ; the fourth, or Solo Organ, and the fifth, or Echo Organ. The Echo Organ alone is 18 feet wide, 17 feet high, and 10 feet deep. It has a special bellows, 12 feet long by 4 feet wide, operated by a motor of one and a half horse-power.

Five organs can be automatically played at one time by a double roll self-performing attachment, on a separate console or key-desk. This arrangement draws out the tremendous power and beauty of the five organs, a feat utterly beyond the range of human fingers.

A movable console or key-desk, the only one in the United States, serves the organist in playing the great organ. His fingers must command 5 manuals or keyboards, making a flight of 5 stairs. This console, which is movable, is connected to the organ by an electric cable 150 feet long. When seated before the instrument, the musician must dominate the 5 manual stairs, the 140 draw stop-knobs, 5 tremolant draws, and 36 couple draws, the 46 push buttons belonging to the adjustable combination system and all the feet levers controlling the expressive powers of the whole organ.

The second or self-playing console is stationary. Through the agency of the stationary key-desk the greatest symphony orchestra scores can be played verbatim without having to reduce the scope of the composition to bring it within the range of human fingers. As an illustration of its superhuman compass, it may be said that a full orchestration would call for ten fingers on each hand. The automatic device can perform it just as easily as any smaller number. A double touch used in this connection has never been heard of before, producing effects precisely the same as if the organist had four hands, two of which were playing full harmony scores on one manual while the other two were performing a stately theme on the full organ.

The most sudden changes of tonality are instantly commanded by the double touch. A slightly increased pressure on the keys by the fingers of the virtuoso will add the voices of any stops drawn from the expressive division of the instrument, an addition that can be made to any note or group of notes under the fingers. It is a mechanical expedient obtained in no existing organ in the United States and in no other first-class concert organ in the world.

In its mechanical intricacies, this most marvelous of instruments presents the highest type of organ building. Five swell boxes, enclosing the several organs combined in one instrument, required 7,500 feet of sugar pine, and 5 automatic electrical swell engines operate the shutters of these boxes; 5,000 open circuits connect the various parts; a motor generator supplying the storage batteries was so arranged as to permit the playing of the organ continuously through the entire period of the Exposition. An immense switchboard indicated the voltage and strength of the batteries at all times; an ammeter showed the amount of current being used. There are 1,016 automatic knobs for setting combinations throughout the organ, and the instrument contains 1,300 magnets for both key and draw stop actions.


ILLINOIS COMMISSIONERS.

1. H. M. Dunlap, *President.*
2. C. N. Travous.
3. J. P. Mahoney.
4. J. J. Brown.
5. Walter Warder.
6. C. C. Craig.
7. C. F. Coleman.
8. D. M. Funk.
9. J. H. Miller.
10. Albert Campbell.
11. Jas. H. Farrell.
12. J. N. C. Shumway.
13. W. J. Moxley.
14. W. L. Mounts.
15. Jno. H. Pierce.
16. T. K. Condit.

Five bellows, each measuring 12 feet long by 6 feet wide, are operated by the two 10-horse-power motors of 220 volts, and furnish the wind pressure, which is distributed to the 140 speaking stops and 10,059 pipes through wind chests requiring 20,000 feet of lumber in their construction; the bellows and regulators consumed 8,000 feet, and the wind trunks an additional 2,000 feet.

The organ consists of two departments, manual and pedal, commanded respectively by the hands and feet of the performer. The manual department, comprising 110 speaking stops and 8,907 pipes of metal and wood, is controlled by 5 claviers, or keyboards, of 61 keys each. The 5 claviers command the 5 separate divisions, or organs. The pedal organ is the largest and most complete in the world. It is provided with all the leading varieties of what is technically known as the imitative and unimitative tones furnishing appropriate basses for all classes of musical combinations. Thirty-six couplers when joined to the keyboard produce 28 different relations. There are 8 pedal organ couplers, 11 unison couplers, 7 sub-octave couplers, and 10 octave couplers—an array of couplers never before approached in any organ.

Thirteen speaking stops in the first sub-division of the Great Organ form the foundation tone of the entire instrument. Its second sub-division, including the three important reed stops, is capable of multiplying the tonal effects tenfold.

The third or Swell Organ introduces for the first time the true orchestral element from which the World's Fair organ derived its advanced position among the great concert organs. It possesses the flutes, piccolo, clarinet, oboe, corno di bassette fagotto and contragetto, the horn and violin, besides the human voice. Another division of the swell has no counterpart. It contains 1,281 pipes, every one of which is string tone. Nearly all of these pipes are made of pure tin. It is claimed by the inventor, W. B. Fleming, that the orchestral effects which can be produced by this division of the instrument transcend everything hitherto possible on the largest organ.

The brass-wind division is represented by the Solo Organ. Here are placed such stops as the orchestral flute, orchestral clarinet, orchestral trumpet, trombone, bass trombone, tuba, and bass tuba.

The installation of this mammoth instrument in Festival Hall was a work only secondary to the building, for it involved a study of acoustics and an adaptation which tested the knowledge of the best architects, but experiment and skill accomplished all that was hoped for, and when the voice of the organ responded to the touch of its keys it was as clear as the notes of a nightingale, without jar, confusion, or reverberation. Thereafter, at frequent intervals, concerts were given in Festival Hall at which the most famous organists of the world performed, such as Guilmant, Eddy, Lemare, Dethier, Carl, Smith, Parker, Middleschulte, Wild, Whiting, Galloway, and others.

The highest artistic music expression centered in Festival Hall, but for the masses greater pleasure was probably found in listening to the daily concerts held at band-stands on the Exposition grounds; and it is instructive to know that the greatest bands of all the nations participated in these performances, among which were: The Grenadier Guard Band, of England; the Garde Republicaine, of France; the National, of Mexico; the Royal German Band; Komzak's, Sousa's, Innes', Creatore's, Weil's, and others of lesser fame.

There were many choral contests, in which several of the most prominent choral societies in America participated, and special concerts were given by the Apollo Club, of Chicago; the Ann Arbor Choral Society, and the Kansas City Oratorio Society; in connection with which, and the Choral Symphony Orchestra, there were recitals that introduced a number of the best singers, male and female, in the land.

A notable feature in the music of the Exposition was the convention which was held by the Music Teachers' National Association, June 28th, 29th, 30th, and July 1st. Several of the most eminent musicians in the world were present and contributed their services. Recitals were held in the daytime, and well-known music educators conducted round table meetings and delivered discourses on live musical topics. In the evenings, high-grade orchestral concerts were held in Festival Hall, of which the principal selections were works by American composers.

The school children were represented in the musical program, and arrangements were made for them to appear at the Exposition under suitable conditions upon several occasions under the direction of Mr. Ernst, who also directed at the Saengerfest festival, which proved an epochal incident in the history of music in the United States.

There is kinship between music and religion, because both appeal alike to the soul, to the spiritual aspiration, and make for the encouragement as well as for the uplift of humanity. A song sweetly sung is an orison, and an oratorio is a prayer in which voice and instrumentation unite with passionate effect.

At the St. Louis Exposition there were no religious congresses as at Chicago, but though this was an omission perhaps to be deplored, religion nevertheless was in evidence, and it was a specially pleasing feature, too, because the religious representation included many forms unusual to Americans, and the services and ceremonials were performed by many alien peoples. It was therefore possible for visitors to study, with much profit to their understanding, the spiritual as well as the material side of the Exposition.

While the protestant denominations had not failed to exploit themselves, almost every religion was represented within the precincts of the Fair.

The Disciples of Christ erected a building, not for the


HOSTESSES, ILLINOIS BUILDING.

1. Mrs. H. M. Dunlap.
2. Mrs. C. F. Coleman.
3. Mrs. Albert Campbell.
4. Mrs. Walter Warder.
5. Mrs. T. K. Condit
6. Mrs. J. N. C. Shumway.
7. Mrs. J. H. Miller.
8. Mrs. W. L. Mounts.
9. Mrs. C. N. Travous.
10. Mrs. J. J. Brown.
11. Mrs. C. C. Craig.

purpose of holding services, but in order to show the progress they have made. The Christian Church was represented by a hexagonal shaped edifice patterned after the study of Alexander Campbell, the founder of the sect. The walls were adorned with photos of churches and those of celebrated divines.

The church of the New Jerusalem, or the Swedenborgians, set up a representative building, inasmuch as it was a reproduction of Emanuel Swedenborg's dwelling in Sweden, in which he wrote the Arcana Celestia and other works. The interior was reminiscent of the founder of Swedenborg's manuscripts. Every afternoon there were discussions on New-Church themes, and visitors were enlightened on the essential points of the doctrine. No religious services, however, were held in the building.

The Woman's Anchorage, which is the home of several important woman's organizations, was an interesting place to visit. Here the W. C. T. U.'s, the National Council of Women, the Florence Crittenten Mission and the Woman's Baptist Missionary Society had their headquarters. Of these the latter occupied the entire upper floor, and every afternoon and on Sundays missionary prayer meetings were held.

An exposition of the efficacy of home missions was exploited in the Transportation Building. Surrounded by examples of mechanical skill, stood the Chapel Car of the American Baptist Missionary Society. It was in every sense a chapel, being provided with a lectern and organ and everything necessary for the conducting of services. These perambulating churches are intended for the propagation of the gospel in places where there are no churches. They have been the means of reaching many unprovided people, and have been instrumental in imparting a moral tone to new railroad centers. The railroads in recognition of this fact have found it to their interest to furnish free transportation to these chapel cars and never murmur at the expense. No services were held in the one at the Exposition, although it was at first attempted. It was found that people came to the Fair for the purpose of seeing it and were not in a religious mood.

In the Iowa Building a regular Sunday service was held which was attended by the attaches of the building and others whose homes for the time were at the Fair.

The military branch of the Y. M. C. A. did effective work at the Fair. Its intention was to reach the men whose duties kept them within the grounds. The services, which were held on Sunday and also three times a week, were largely attended by the Jefferson Guards, the chair boys and the visiting military organizations camped upon the grounds. Even men of non-religious bent delighted to come and rest within the roomy tent near the Indian School. Here they found writing tables with free stationery; there was also a free library, the gift of Miss Helen Gould, who was instrumental in the initiation of the work. This branch was under the control of the state and local committees.

When it was decided to bring over a Visayan colony and quarter them in the Philippine Reservation it was discovered that this pious people would never be satisfied out of the sound of church bells. A pretty little church was therefore erected for the use of the villagers, who are very devout in the practice of Roman Catholic observances. It was dedicated by Cardinal Satolli, and the altar was decorated with the handiwork of Visayan women.

Many of the Orientals at the Fair belonged to the Romish and Greek churches. In the walled city of Jerusalem was an excellent replica of the celebrated shrine of the Holy Sepulcher of the real Jerusalem on the site of which the tomb of Christ was discovered. The architecture and the paintings and sculpture were well reproduced. The Romanists and the Greeks held alternate services within these walls. On week days it was used for lectures given by an English-speaking Arab sheik in picturesque raiment, the customs prevailing at the time of Christ being explained by living representatives. After the lectures or Sunday services, young men, employes of the Syrian National Library Association, guided strangers about the buildings, showing the location of the tomb of Christ and other places of interest. The services in the environment of the sacred city of Jerusalem took upon themselves an added sanctity.

The Shinto Temple in "Fair Japan" was not only interesting from a religious point of view, but on account of its antiquity, for it is a venerable wooden shrine, 300 years old. The interior, sacred to the faithful, may only be approached by the devotees of the mystic cult, who leave their shoes outside before bowing at the shrine of Buddha, who, calm and serene, occupies a place upon the altar. Akita, the Buddhist priest, conducted worship within this holy fane, known as the Temple of the Two Kinks. Akita is a learned and pious young man, whose ambition it is to translate the religious books of Japan from the Sanscrit into English.

The Mosque of Omar, in Jerusalem, stood for the faith of Islam, as did also the mimic mosque in the streets of Cairo. In neither of these edifices was worship held, for the reason that no Mahommedan priest could be found in St. Louis. The pious Egyptians, Hindoos, Singalese, and Moros were compelled for lack of priests to forego all forms of public worship, resorting to the privacy of their chambers in order to offer up their orisons. These devout people pray five times a day. "Christians pray only once a week," sententiously declared a fanatical Egyptian, "that enough for him god."

There were no Parsees at the Fair, but there were Sun worshipers. The Cocopa Indians and the Patagonians revere the Sun as a Deity, and do homage to him with a number of strange rites. Many of the American Indians bow down to animals, birds, and reptiles, while still others

## *THE GIANT FLORAL CLOCK.*

ONE of the most unique and decorative features of the Exposition grounds was the great Floral Clock on Agricultural Hill, the joint product of the St. Louis Seed Company and the Johnson Service Company of Milwaukee. The former supplied the flowers and the latter furnished the mechanism to operate the timepiece, the motive power being electricity and compressed air. The diameter of the clock was 120 feet, with numerals 15 feet in length, traversed by two hands that weighed nearly 25,000 pounds each. The hours and half hours were struck on a bell that weighed 5,000 pounds. The dial of the clock was aflame with color, covered as it was with 18,000 flowering plants, tended with such care that the blooms were always fresh and the fragrance all-pervading over a large section. Although it was the largest clock ever built, the mechanism was so perfect that it told the time with the greatest accuracy.

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revere the elements. Nearly every form of devotional exercise might be seen; the giddy whirl of the dancing dervish, the slow moving dance of the Hindoo temple girls, the prostration on knees and elbows of the Turk, with the deferential salaam of superstitious Mahommedans, the touching of the floor with the forehead of the devotees of the Russian religion, the setting on all fours of other fanatics, and the humble kneeling posture of the Christians, all were represented.

Just outside of the grounds were the Fraternal tents, where Dr. Green and the disciples of the New Thought held their meetings. Here occultism, spiritualism, and every description of mystical belief was exploited. The platform was free to all, and sometimes interesting lectures were delivered by liberal speakers of more or less distinction.

# DIVISION CLI.

## Representation of our Southern Neighbors.

A majority of the South American republics were represented at the Exposition, some in a small way, it must be admitted, while others, notably Mexico, Brazil, and Argentine Republic, made large appropriations and exploited their productions in an elaborate and effective way.

Venezuela was in the showing with examples of her natural and manufacture resources, but was not represented by a national pavilion, nor were her exhibits confined to any single building. This country has recently come into very marked prominence by reason of certain international questions in which the United States is interested, and information respecting the Venezuelan Government and the country's productions has special value, accordingly.

From the minister, the Hon. N. Veloz Goiticoa, the following statements were obtained, as a contribution to this work:

Recent and conflicting difficulties with which the Venezuelan Government had to contend did not prevent the Chief of the Federal Executive Power, who always has his country's welfare at heart, from making an effort and exhibiting the principal products of the vast natural wealth of Venezuela. The great number of prizes awarded to the Venezuelan exhibit, which was not large, showed how successful his effort proved.

Since Gen. Cipriano Castro came into power he has constantly made strenuous efforts in favor of the progress and prosperity of Venezuela. He was born forty-one years ago in the Western State of Merida, of the Venezuelan Federal Union and after receiving a good education became a merchant and acquired considerable personal means. When still very young he began to be a staunch supporter of the Liberal party. He fought against the revolution called *"legalista,"* and later, in 1899, after a succession of victories, fighting always against superior numbers and with inferior armament, he took city after city until he was installed in Caracas as Provisional President of the Republic. The nation approved, without restriction, all his acts since 1899 and on February 20, 1902, the National Constituent Assembly held at Caracas, which carried out the new political division of the country and established six years as the presidential term of office, confirmed General Castro as Provisional Chief of the Federal Executive Power and nominated him President for the period of 1905 to 1911. This proves that he enjoys the full confidence of his fellow citizens due to the brave and patriotic manner in which he has always defended his country and firmly maintained his government whenever occasion has arisen.

A synoptical sketch of Venezuela is given hereunder showing the great possibilities which the country offers from several points of view.

Venezuela is bounded on the north by the Caribbean Sea, on the south by the United States of Brazil, on the east by British Guiana and the Atlantic Ocean, and on the west by the Republic of Colombia. This territory measures nearly 1,000,000 square miles, and its climate is peculiarly adapted to all classes of cultivation, as the extreme hot and cold temperatures are practically unknown, although the country is divided into cold, temperate, and hot lands. There are but two seasons, the dry and the rainy, corresponding to summer and winter. Three principal chains of mountains cross the country, namely, a branch of the Andes, the coast range, and that of Parima, the intervening regions forming vast fertile plains. The soil is well watered by 1,059 rivers and brooks, 70 of which are navigable and form 8 principal hydrographical basins. The coast line extends 2,000 miles and contains 5 gulfs, 32 ports, and 50 smaller bays. For these reasons Venezuela possesses one of the richest faunas and floras of the world.

Venezuela remained loyal as a Spanish colony for 239 years, namely, from 1567 to 1806; on July 5, 1811, the Republic was proclaimed and after a war lasting ten years independence was definitely established. At that time, Venezuela formed part of Greater Colombia, but in 1830 it separated and became an independent nation. The constitution now in force was sanctioned on April 27, 1904. The form of government is popular, elective, federal, representative, alternative, and responsible, and the territory of the United States of Venezuela is divided into districts and federal territories. The districts are grouped and form thirteen federal states each of which has its own constitution based upon the same principles and modeled after the national constitution.

The government consists of the legislative, the federal executive, and the judiciary powers. All legislative power is vested in a Congress which consists of a Senate and a House of Representatives. Each state and the federal district elects one representative and one alternate for every 40,000 inhabitants and another for a surplus of 20,000. The Senate consists of two senators, chosen by the legislatures of each state. Both senators and representatives hold office for six years and must be natural-born citizens of Venezuela. Congress assembles every two years, without convocation, and holds sessions for ninety days. Federal executive

1. Louis B. Goodall, President Maine Commission.

2. M. T. Davis, President Missouri Commission.

3. J. H. Hawthorne, Treasurer Missouri Commission.

power is vested in the President of the United States of Venezuela, together with the cabinet ministers who are his representatives. Judiciary power is vested in the Supreme Federal Court and in such inferior tribunals and courts as may be established by law. The laws of Venezeula are binding upon all persons residing within its limits, whether citizens or foreigners.

The agricultural zone covers an area of 349,481 square kilometers. Twenty per cent of the population is engaged in agricultural pursuits. The principal agricultural products are coffee, cacao, sugar, tobacco, india rubber, tonka beans, cotton, corn, vanilla, wheat, etc.

The forest zone covers 797,640 square kilometers and its principal products are: Precious, ornamental, dyeing, and tanning woods and barks, fiber plants, resins and medicinal plants and shrubs in great variety and quantity.

The pastoral zone covers 245,000 square miles. There is no other region where live stock can feed the entire year exclusively on a great variety of green grasses growing naturally on the fertile soil, which does not require any tilling.

The mineral resources of Venezuela consist of gold, silver, copper, iron, tin, lead, quicksilver, asphalt, petroleum, coal, sulphur, asbestos, and precious stones. There is scarcely a mineral product known that can not be found in some part of the vast expanse of territory of Venezuela. The existing mining code, promulgated on June 23, 1904, contains special features on the subject of mines.

Industries producing articles of food, clothing, and other necessities of civilized life are numerous, steam and electricity being generally employed as motive power. Imports of Venezuela for 1902-1903 amounted to $6,115,813 and the exports to $7,930,315. The United States leads both in the imports and exports of Venezuela. Revenue for 1903 was $6,898,882; expenditures, $6,865,884. The public debt amounted, in 1903, to $49,925,701.

Banking operations are carried on by the most important business houses, but the bulk of such transactions is effected through the Venezuela, Caracas, and Maracaibo banks and their numerous agencies. These three banks will cease to issue banknotes as soon as the *"Banco Nacional de Venezuela"* is established, which shall be the only one entitled to issue them. The monetary system of Venezuela is based absolutely on gold. Silver currency and banknotes exchange at par with gold and there has never circulated before, nor is there in circulation at present, any depreciated fiduciary currency of any kind whatever. The regulation of the standard, value, fineness, weight, and coinage of national gold and silver coins, *gold being the monetary standard,* are fixed by Congress.

High roads cross the territory of Venezuela in every direction. The seventy navigable rivers are plied by steam and sailing vessels, and communication is maintained with foreign countries by means of American, British, French, Dutch, German, and Spanish steamship lines. Railroad transportation is effected through fourteen different lines with a mileage of 842 kilometers and an aggregate capital of $38,659,575. The telegraph system is owned and operated by the government, the total length of the lines being 4,000 miles. There are twelve telephone companies in operation in different parts of the country.

Education in Venezuela is gratuitous and compulsory since 1870. It is ruled by the code of Public Instruction promulgated April 2, 1904, and is classed under public and private instruction, the former being supported by the nation.

Immigrants are divided into five classes, according to the contract under which they come, and the government makes specified transportation allowances and allots them certain land grants according to the immigration and colonization laws.

The most interesting exhibit in Venezuela's representation was a collection of over 200 varieties of fibers manufactured under different processes and taken from different altitudes. Nearly all were prepared by a machine invented by Dr. J. Lameda, a member of the Commission, who gathered and took the greatest interest in the exhibit. From the coarsest to the finest were to be found among these fibers. The longest belongs to the Musa variety, a coarse grass that grows to the length of ten feet. The *Annasassa Sativa,* a fine fiber, attains a length of five feet. This was the only collection of the kind at the Exposition or ever shown at any national exposition.

There was exhibiteoa magnificent exhibition of hardwoods from the government states of Carabobo, Zulia, and Guayana, each comprising more than 600 specimens of native logs, woods for cabinet work, for building construction, lumber, staves, dyewoods, tanning, resinous, oil, rubber, and fragrant woods.

A most unique and complete collection of forest plants, roots, herbs, leaves, barks, seeds, fruits, resins, gums, dyeing, flavoring, and condimenting used by herbalists and pharmacy, etc., was collected, prepared, and classified by E. M. Ambard, who was also a member of the Commission.

A complete collection of all the minerals and precious stones found in South America was prepared, classified, and catalogued by Dr. Louis Plazard, a gentleman who has devoted nearly all his life to this work.

The exhibit included also a display of cocoa beans from different regions of Venezuela, the product of which country is considered to be the best and most nutritious cocoa in the world, and has always obtained a far higher price than any other; there was also a large assortment of native coffee from different altitudes, considered by experts to be of very fine flavor and high grade.

Though the total government appropriation for the exploitation of Venezuela's resources at the Fair was only $30,000, the total valuation of the exhibits was $105,000, so that the showing was a most creditable one.

Colonel F. M. de Souza Aguiar, President of the Brazilian Commission, contributes the following article on the exhibits made by his country:

The improvement of transportation industry in Brazil has been great in the last few years. There is a large amount of railroad material being manufactured at the present time, but Brazil must yet depend upon the large industrial center for her supplies in this line. The Brazilian Government and different companies own and operate a great number of plants in various cities, where the latest methods of modern industry in regard to machinery are carried on. In Transportation Building, occupying 4,158 square feet of space, Brazil was represented by thirty-four exhibitors. Different kinds of saddlery of the best manufacture and highly artistic commanded attention. A prominent feature was the large wagons and harness exhibited by the Fire Department of Rio de Janeiro for the transporting of material and tools, all made in their own shops. There was shown also the model of a raft such as was originally used on the northern coast of Brazil for deep-sea fishing. Several canoes were exhibited, one of which is made of a single log of peroba. This wood is abundant in Brazil and has been used in naval construction with better results than teak wood. This canoe is fifty-seven feet long and three feet wide and of perfect construction. Over two tons of merchandise can be transported by it.

A large map of Brazil gives the correct representation of the railroads, telegraph lines, navigable waters and roads of the country, while in frames were large photographs of important railroad scenes, bridges, stations, viaducts, maps of different railroads, traffic statistics, and many highly interesting drawings.

Brazil had 1,333 square feet of space in Liberal Arts, and was represented in twelve groups by 343 exhibitors. Among the important features in this display were models, plans and drawings of public works, sea-ports, channels, railroads, bridges, water supplies, irrigation, and buildings.

Building materials, lime, cement, plaster, artificial stone, metals, and ceramics from the prominent industries of Brazil were placed on exhibition, also natural stones and woods for building purposes.

A large field of study was offered in the way of works of typography, lithography, engraving, and numerous other printing processes, together with specimens of books, newspapers, reviews, sheet music, and all kinds of stamps; printing machines and appliances, various kinds of types, vignettes, ingots, galvanographic and stereotypic plates. In the way of smaller articles, there was an abundance of drugs, pharmaceutical and chemical products, candles, soaps, perfumes, and extracts, and a large assortment of paper, wallpaper, printing-ink, etc.

Brazil was prominently represented by musical instruments, process of manufacture and variety of finished products, such as stringed and wind instruments of familiar and others of curious make.

The display also included scientific and mathematical instruments, scales, medicinal and surgical apparatus, and dental prothesis work. There was a large display of books and other publications on the processes of preparing different building materials and methods of using same; also statistics and varied and valuable publications showing real advancement of civil and military engineering.

With 4,641 square feet of space and a display provided by 982 exhibitors, her agriculture exhibit was one of the best sections of the Brazilian participation. Here were to be seen in magnitude all her valuable products, which proclaim the richness of her soil, the progress and activity of her people, and the extensiveness of her resources. Photographs, drawings, plans, and models showed all the various implements and processes connected with her agricultural pursuits; also machinery used in coffee preparation.

The display of coffee alone was represented by 422 exhibitors. In this product Brazil exceeds all other coffee-producing countries, in its flavor, aroma, and in its physical and chemical properties. It is well to mention that a complete display of coffee was installed in the Brazilian Pavilion where coffee trees were to be seen in actual growth, and machinery operating to demonstrate the different processes through which the coffee passes in preparing it for table use. Brazil may boast of the largest production of coffee in the world. For the years 1901 to 1902 all countries produced a total of 19,588,000 sacks of 132 pounds each, of which 16,246,000 sacks bore the name of Brazil. This quantity of coffee was received into 142 ports of different nations. In the United States the port of New York received 4,563,047 sacks, New Orleans 718,309 sacks, and Baltimore 274,697 sacks. Santos is one of the most important shipping ports in Brazil, sending out 10,000,000 sacks. Rio de Janeiro is prominent and exports 5,496,000 sacks, while Bahia and Victoria contribute 750,000 sacks. Figures from the best statistics are authority for the assertion that a great amount of Brazilian coffee is sold in America and Europe under the assumed name of Mocha and Java.

A highly interesting display was also made of cigarettes, cigars, and tobacco in endless varieties and of the highest grade of perfection in cigar-makers' art.


Strauss Photo.

OFFICERS OF THE KENTUCKY COMMISSION.

1. A. Y. FORD, *President.* 2. C. C. SPALDING, *Vice-President.* R. E. HUGHES, *Secretary and Director*

Her showing of sugar, tea, matte, beans, cocoa-beans, corn, fecula, and other agricultural products commanded attention, as did her exhibit of syrups, cordials, beer, grape wines, champagnes, rum, alcohol, etc.

There were products of bakeries, canning and preserving factories, in the way of meats, fruits, candies, and biscuits, the quality of which compared most favorably with similar products from other countries and clearly showed the advancement of agriculture industries in Brazil.

For her display in Varied Industries, Brazil erected a beautiful pavilion, corresponding with her National Building, in a space assigned in the west court of the building. This space covered an area of 6,084 square feet, and was fully occupied by 225 exhibitors. The exhibits, artistically arranged, proved a surprise to the visitors who were not cognizant of the development of Brazilian industries.

Here were to be seen various products, all of finest material and workmanship. Different factories displayed all classes of cotton fabrics from the cheapest to the best that can be produced; these fabrics in particular ranked with the best manufactured by other countries by reason of the excellent quality of cotton produced in Brazil. The growth of cotton is sufficiently large to supply all domestic factories and is an important staple of exportation. Woolen goods and other material manufactured from vegetable fibers of Brazil were shown in such manufactured articles as felt and straw hats, fine shoes, ladies' and gents' clothing, etc. In the exhibits were also articles of iron and copper, ceramics, china, glassware, extracts, and many other articles of ordinary use. There were specimens of native manufacture of finer and more artistic finish, such as work in feathers, laces, embroideries, tapestries, and bags, mats, rugs, etc., made of Araminia fiber. This is a newly discovered vegetable fiber of exceptional quality and the industry is growing rapidly in the State of St. Paulo. The products of the Rio Grande do Sul woolen mills, principally intended for army and navy uniforms, are of a quality of manufacture not to be surpassed.

Ceramics formed an interesting display, were original and artistic in design, and the special quality of Brazilian clay gives them a remarkable solidity.

The display of furniture was of interest, Brazil being aided in this industry by the beautiful woods which alone would make the furniture attractive. Elegant bedroom sets in light and dark woods, chairs, etc., showed perfection in furniture making.

Two hundred and sixty exhibitors from almost all of the States of the Republic occupied 3,897 square feet of space in the department of Mines and Metallurgy. The St. John del Rey Mining Company (Morro Velho), Ouro Preto Gold Mining Company (Passagem) Rotulo Limited, Companhia Auriefra de Minas Gereas and Caethe, all in the States of Minas Gereas and Vellozo Tassasos, Lavras in the State of Rio Grande do Sol, exhibited specimens of gold ore. An interesting feature in the plan and section of the mines of the St. John del Rey Mining Company showed the working of their mines at a depth of more than 3,000 feet.

There was a valuable collection of iron, copper, and zinc ores, a large variety of rich samples of asbestos, crystal, graphite, plumbagin, mica, talc, soapstone, argillites, diamantiferous and platiniferous sands, galena, cinnabar, calcareous, feldspar, argill, salt, colored stones, and other minerals. Several different companies exhibited blocks of manganese ore, in which manganite, pyrolusite, and psilomelane predominates. A block of this ore, weighing more than two tons, was exhibited by the Morro de Minas Company, one of equal size by the Empreza Gonsalves Ramos. The exportation of this ore from Brazil began in 1897, 2,500 tons being shipped that year. The production has steadily increased to 183,000 tons in 1903. The value of this ore is in its high metallic percentage, always over 50 per cent, and the absence of phosporus and sulphur; silica being found only in very small quantity.

In the exhibit were iron ores in a large variety, from the compact peculiar oligiste and manganite of the highest metallic value because of their purity, to the hematites, limonites, itabirites, and jacutingas, pulverized ores of easy reduction. Notwithstanding the quantity of this valuable ore in Brazil, sometimes found in large mountains of incalculable tonnage, the siderurgical industry has not been sufficiently developed by reason of the incompleteness of the coal mines, these industries having to resort to charcoal for fuel. Pig iron has been sent from Ipanema and Esperana mines.

Coal in large blocks was shown, which came from the States of Rio Grande do Sul and Santa Catharina; coal has been found in all the southern states, but exploited only on a small scale as yet for the lack of capital.

Monazitic sands, found in great deposits along the coast of the States of Bahia and Espirito Santos, constitute a rich and important product for exportation from Brazil. Cerium and thorium, extensively used in manufacturing veils for the Auer incandescent lights, is extracted from this sand.

There was an abundant display of bituminous schists, rich in oil and paraffin, and beautiful specimens of cinnabrium, with the sandstones in which they are found in rich veins, which are impregnated with the mineral. The exportation of cinnabrium is becoming of importance in Brazil. Quantities of mineral water of value in diseases of the liver and stomach, have come from the springs of Cachambu, Lambary, and Cambuquira.

It is clearly demonstrated that Brazil is one of the foremost countries in the world as regards the mineral kingdom, in the large display made of blocks of beautiful marble, granite, diorite, and specimens of amethyst, chalcedonies, topaz, turmalines, crocoite, stolzite, scheelites, smyiphanes, triphanes, dirthenis, stomatites, besides calcarium, wavellite, graphite, blende, galena, chalcopyrite, and sands containing diamonds and platinum, all of which are found in large quantities in that country.

The Brazilian section in Forestry Building contained 2,499 square feet of space, and was occupied by 258 exhibitors. The many samples of wood in fancy designs was of special interest, and one quickly realized the truthfulness of the assertions of Agassiz, Humboldt, St. Hilaire, Wallis Greeseback, and many other celebrated naturalists, who consider the Brazilian forests the largest and most luxuriant in the world. On account of her vast territory, the position of her immense valleys, the elevation of the country, and the direction of the mountains, Brazil has a peculiar flora, which is rich, varied, and unsurpassed.

The vegetation in the forests changes with the climate, altitude, and geographical situation, being varied and peculiarly characteristic. Combined with the gigantic trees in the equatorial region, the beauty of the forests can not be described. In the south tropical region it is even more richly colored. One thousand one hundred and ninety-three samples of different woods represented eleven of the Brazilian States, from the Araucaria Brasilieuse, growing in the States of Rio Grande do Sul, Parana, Minas Gereas, S. Paulo, and Santa Catharina, to the valuable Pao-brazil (*Coesalpinia echinata*), from the northern states, and the Jacarandas, growing abundant in the woods of Bahia, Rio de Janeiro, and Espirito Santos.

There was also displayed, in addition to the raw material, finished articles of cabinet work, etc., showing the real merit of Brazilian woods for artistic woodwork. In this space there were 256 specimens of bark, roots, resins, seeds, and leaves for medical use, dyeing and tanning purposes, for the manufacture of oils and varnishes, 98 varieties of fibers, vines, rushes, and canes, valuable in the making of ropes, baskets, hats, brushes, brooms, mats, tissues, and divers other articles.

In the immense forests of the States of Amazonas, Para, and Matto Grosso, all irrigated by the majestic river Amazon and its tributaries, there is an inexhaustible supply of rubber (*Simphones Elastica.*) These three States alone produced, in 1904, 30,000 tons of this valuable product, of which the United States received 14,566 tons. Magabeira and Manicoba rubber is exported from the States of Ceara Bahia and Matto Grosso. This product, in various stages of preparation, was artistically displayed.

Manel D. Diaz, Secretary of the Cuban Commission, submitted the following contribution, descriptive of the representation of his country:

In the department of Education, Cuba had a complete exhibit of the primary system of education now in use. It afforded a good illustration of the advancement made in primary education from the kindergarten to the high school in the last few years, including with the exhibit a showing of the different departments of the University of Havana and the work of students of manual training schools in the island.

This educational exhibit was classified in Groups 1, 2, 3, 4, 6, and 8, which leaves only two groups, 5 and 7, in which Cuba was not represented.

Group 1 was represented by the Normal School and Kindergarten of Habana, and by kindergarten public schools of Habana, Guanabacoa, Matanzas, Cardenas, Sagua la Grande, and Cienfuegos; by elementary public and private schools from most of the school districts of the country; by a teachers' academy and by training and correctional schools for boys and girls.

In Group 2 the six public secondary schools of the country were represented by photographs, reports, collections of shells and butterflies, and pupils' work.

In Group 3 the National University and Teachers' Training School, of the School of Pedagogy, had exhibits of photographs, pupils' work, and reports.

The "San Alijandro" School of Painting and Sculpture of Habana appeared with a report and photographs in Group 4.

In Group 6 the School of Arts and Trades, of Habana, had a very good display of manual training, shown by photographs.

Correspondence schools, the Academy of Science, meteorological and magnetical observations of the Belen Observatory, geological collections, text-books, school appliances, and a collection of the text-books used at present and of those used under the Spanish government in the public schools, were all classified in Group 8.

One of the most important features of the exhibit was undoubtedly the display of photographs showing over 500 views of school-rooms, school buildings, groups of teachers and children, institutions of secondary education, institutions for special education, and the University. In these photographs the department has shown the best schools, such as "Luz y Caballero," of Habana, and the "Escuela Modelo" of Santiago de Cuba, and the worst rural schools, located in thatched-roof huts, twenty or more miles from the nearest town. The exhibit also represented not only the great increase in the last few years in the number of schools and in school expenditures, both of which are on an average of about one to ten, but the great change undergone in the methods of teaching, which, at present, are perfectly up-to-date, the old methods having been entirely abolished from the public schools.

Cuba is not generally known to be rich in minerals, but many specimens were shown, that made a very complete exhibit of the iron ores, copper, manganese, lead, zinc, and other minerals found on the island; also samples of asphalt and clays used for the manufacture of Portland cement.

In Manufactures there was an exhibit of Cuba's new in-

WYOMING COMMISSIONERS.

1. C. B. Richardson.
2. B. B. Brooks, *President.*
3. Geo. E. Pexton, *Vice-President.*
4. W. C. Deming.
5. J. L. Baird.
6. W. H. Holliday.

dustries, such as tiles, bricks, leather, cordage, rope, and shoes, and in the department of Liberal Arts Cuba showed several products, such as soap, candles, books, periodicals, and reviews, engravings, photographs, perfume, and many other things.

In the department of Forestry Cuba was at her best with a splendid exhibition of native woods, used in engineering construction and for the manufacture of furniture, house decorations, etc., in which her resources are almost infinite, and ready for the developing aid of capital.

Cuba occupied two sections in the Palace of Agriculture, in one of which her tobacco industry was displayed, and in the other her agricultural products were on exhibition, such as sugar, cacao, corn, beans, cotton, beer, rum, and cordials, that illustrated the great possibilities which Cuba offers to tillers of her soil.

People of the United States are deeply interested in knowing what is being done by the Cuban government to prevent the spread of the yellow scourge, and it is reassuring to learn that the most persistent and intelligent efforts are being exerted to that end. Havana is to-day free from yellow fever, and with the sanitary laws and regulations now in force there is apparently immunity from its reappearance, and certainly so from an epidemic. Habana is especially well prepared to deal with the contagion. There is a hospital for infectious diseases, known as "Las Animas" Hospital, which is well equipped with every convenience suitable for this kind of institutions; one of its main features is that it is entirely mosquito-proof. This hospital has been conspicuous in the eradication of yellow fever from Havana, and in it are admitted the imported cases from Mexico and other countries with complete safety for the city.

As Havana is entirely free from yellow fever to-day, the work in connection with this disease is limited to the cases found in the steamers coming from Mexico or from other places abroad, and to those developed in quarantine where non-immunes are kept during the period of incubation of the disease. These cases are transferred to "Las Animas" Hospital, and all the means of transportation (ambulance, stretcher, etc.) are made mosquito-proof. Any case reported in town as suspicious of yellow fever is dealt with in the same manner as in time of epidemics.

The role of the mosquito having been recognized in the transmission of yellow fever, malaria, and filariasis, the department has established a section known as the "Mosquito Division," dedicated to the destruction of the mosquito at its different stages of development. There are two brigades, the Stegomyia brigade, and the Anopheles brigade, which, as their names imply, are devoted to the persecution of those species.

When other infectious diseases have to be dealt with, the plans are modified according to the characteristics of each; so, for instance, in typhoid fever, the examination and analysis of the water supply and other sources of infection, diagnosis by Widal's reaction, disinfection of faeces and urine, distribution of literature concerning the disease, etc., are carefully attended to.

Such is, in substance, the general organization of the Public Health Service in Cuba.

The complete success which has been the result of the strict compliance of the methods outlined above, with reference to yellow fever, after thirty-six months of uninterrupted exemption from that disease, as well as from smallpox (since four years ago) all over the Cuban territory, is too well known to require further emphasizing. But it is very satisfactory for the Cuban Sanitary Department to be able to quote the following appreciation of its antimalarial work, by such an authority as Col. W. C. Gorgas, U. S. A., who had charge of that department until the end of May, 1902.

"I am obliged for your reports, which I receive regularly, and congratulate you upon the excellent showing you make in every direction. * * * Havana is the only city that is doing anti-malarial work, and your results are very remarkable."

The main feature of the exhibit, of course, is the conclusion now accepted by the world all over, of the theory initiated since 1882 by Dr. Charles J. Finlay, of Havana, at present Chief Sanitary Officer for the Island of Cuba, and afterwards demonstrated by the American Commission, that the mosquito, *"Stegomyia Fasciata,"* is the only transmitter agent of the yellow fever germ.

Mr. N. Hermandez, Secretary of the Porto Rican Commission, contributes the following, respecting the history and participation of that island:

In the Agricultural Building, not very far from the main entrance, Block No. 118, was located the Porto Rican section in the form of a pagoda of two floors. The lower one was dedicated to the agriculture, mines, forestry, and a few of the manufactures exhibits. It was also dedicated to the free distribution of coffee, the most important aim of the Porto Rican Commission. In the second were the liberal arts and manufacture exhibit, the offices, and the needle-work display, collected and exhibited by the Women's Aid Society, San Juan, and the Benevolent Society, Ponce.

Porto Rico is the smallest of the Greater Antilles. Its area is approximately 3,600 square miles. Most of the area of Porto Rico is held as farms; and a large portion, more than one-fifth, is under cultivation. The forest areas are confined to the higher parts of the mountains. Here are found small tracts of primeval forest, composed of large trees of a variety of species, several of which are of great value, such as Spanish cedar, ebony, and sandalwood, besides many others as yet unknown to the American markets. The annual temperature at San Juan, on the north coast, ranges from 78° to 82° F. The maximum temperature on record is 99°, and the minimum 57°.

The island was discovered by Columbus, Nov. 19, 1493. He took possession in the name of the reigning sovereigns of Spain.

On July 21, 1898 (Spanish-American War), Major-General N. A. Miles, with a force of United States troops, landed in the bay of Guanica without serious opposition, and on the 27th occupied Ponce. Since then Porto Rico has been under the American flag.

It is at present under a civil government, by the Act of Congress of April 12, 1900. It consists of a Governor and an executive council, to be appointed by the President for four years, and a house of delegates of thirty-five members, to be elected biennially by the qualified voters. The executive council is composed of the insular cabinet and five persons of good repute. The cabinet includes a secretary for civil affairs, an attorney-general, a treasurer, an auditor, a commissioner of the interior, and a commissioner of education, all appointed for the term of four years. The executive council and house of delegates comprise the legislative assembly of Porto Rico. On May 1st this government was inaugurated by Hon. Charles H. Allen. The present Governor is Hon. Beekman Winthrop.

The population of Porto Rico is 953,243 inhabitants, about 264 persons in a square mile.

The Commission appointed to the Louisiana Purchase Exposition was composed of Messrs. Jaime Annexy, President: Gustavo Preston and Antonio Mariani, Commissioners. Mr. Annexy is an industrial engineer, and occupies a prominent position in his country. He was educated in Spain, and for many years was the director of the most important school in San Juan, under the Spanish rule, where he lost three of his fingers teaching mechanics.

The recompenses obtained for Porto Rico are enough to show the future increase of business between the United

States and that island. The Porto Rican coffee is considered the best in the world, and was awarded the highest honors. The coffee produced in Porto Rico is almost all exported to Europe, as its superiority is not well known in the United States. In the year 1902 to 1903 there was exported from Porto Rico to European countries products valued at $3,252,043, and to the United States $718,531, while the following year the exports to foreign countries were $3,956,893 and to the United States $10,909,147. The importations in the same year were, from foreign countries $2,203,441, and from the United States $12,246,225.

Next to coffee, sugar is the most important product, and was awarded a gold medal. The sugar exports in the year 1902 to 1903 were $376,757, and to foreign countries $2,-543. If the sugar exports in the last seven years are studied they show a great increase of exports to the United States, and at the same time the development of sugar factories in the island. The molasses exportation in same year was, to the United States $376,757, and to foreign countries $288,-243. The statistics also show an increase of exports to the United States in the last years. Factories are situated not very far from the shore, and different steamship companies take molasses and sugar from same to be landed direct in the United States. Many millions of dollars have already been spent to establish the latest machinery for the production of sugar and all modern improvements in transportation.

Tobacco, in the leaf and manufactured, also deserves notice. The trade with the United States is improving every day, but in the year 1902 to 1903 there was exported to this country tobacco valued at $1,890,391, and to foreign countries, $68,529. Different American concerns have undertaken in the last seven years the introduction of Porto Rican cigars and cigarettes into the United States, and there is no place in America where they can not now be found. Cigars and cigarettes rank with Cuba in superiority.

Porto Rican cotton, exhibited at the Exposition, was considered of superior quality and awarded a grand prize. It is wonderful the development of the cotton growing industry in the island, and growers are demanding the best machinery that is used in the United States. Porto Rico also received the highest award in straw hats, needle-work, rice, beans, pharmaceutical products, etc.

In the Educational Building was the Porto Rican public school exhibit; the development of this branch of the administration in the last seven years can be easily appreciated. At the present time the total number of schools is about 1,100, which is more than twice the number maintained under the Spanish Government. At the same time, it is woefully true that the public schools are now able to accommodate less than one-fourth of the pupils who ought to be there, and this in spite of the fact that more than 25 per cent of all the revenues of the island, both insular and municipal, are expended for educational purposes. In addition to the elementary schools there are now established four high schools. Teachers are both natives and Americans. The English language is being taught as far as possible.

The insular revenues were in the year 1902 to 1903 $2,473,748.

After the information above given, it can easily be appreciated that important work was performed by the government and commission of Porto Rico to obtain the splendid results shown at the Louisiana Purchase Exposition. An appropriation of $30,000 was made by the Porto Rican legislature for this purpose. The Porto Rican pagoda was designed by the Porto Rican architect, Mr. Armando Morales, and cost $5,000.

## DIVISION CXLII.

### The Live Stock Exhibit.

By Charles F. Mills, Chief of the Department.

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The managers of the World's Fair, early in the history of the Universal Exposition, determined to give full recognition to agriculture, the basis of the wealth of the Louisiana Purchase Territory.

The chief city in the center of the most productive and prosperous farming section of the world had been wisely selected as the most suitable place for celebrating the one-hundredth anniversary of the most important event in the nation's development.

The promoters of the Exposition were fully apprised from the outset of the importance of having a full and creditable representation of all the products of the farm and orchard, including the studs, herds, and flocks. The fact was apparent to the management that the prosperity of the farmer depends upon the horses, cattle, sheep, swine, and poultry, and it was determined that the exhibit of live stock should be deserving of especial and exceptional recognition and encouragement in the way of large cash prizes.

It was not questioned that the honor of recognition as the primary exhibit of the Universal Exposition should be accorded live stock, which next to agriculture is the leading wealth-producing agency of the Louisiana Purchase.

The major portion of our agricultural products is utilized in meat, dairy, wool, and other animal products, and our commerce is mainly dependent upon the horse for cultivation and transportation to and from the railroad, the factory, the farm, and its final destination for manufacture and consumption; acknowledging the importance of the industry, live stock, for the first time in the history of World's Fair management, was accorded by the Louisiana Purchase Exposition its well-merited prestige of a separate department with an independent chief.

The live stock classification was given subordinate consideration at former expositions designed to summarize the world's progress. This was true, at least in theory, at the World's Columbian Exposition, where the live stock awards were on a much greater scale than at any international fair that had preceded. The scope of the Louisiana Purchase Exposition of itself called for the placing of the live stock exhibits upon an independent basis, but this was urged forward by the present greatness, and the possibilities of the industry in the Louisiana Purchase Territory, and in all the area of which St. Louis is the geographical center. The reciprocal importance that here prevails is especially significant. Independent nations occupying the territory which we now know as the United States might have built


NEW MEXICO COMMISSIONERS.

1. Gov. Miguel Otero.
2. Chas. A. Dalies.
3. Arthur Seligman.
4. W. B. Walton.
5. M. W. Porterfield.
6. Herbert J. Hagerman.

up manufacturing or mining or agriculture in general to prosperous proportions, but improved stock-breeding, the summit level of farming, could never have reached its present status in America under such conditions. The live stock interests accordingly had a peculiar concern in the commemoration of the Louisiana Purchase.

The pre-eminent recognition given this industry by the managers of the Universal Exposition of 1904 was evinced in the very generous appropriation made for cash prizes for live stock, which amounted to $438,702.25, or more than double the sum heretofore given for stock exhibits at any previous World's Fair. At Chicago the prizes amounted to $130,000.

The structures provided for the shelter and exhibition of the live stock at the World's Fair were ample in size with attractive architecture, in keeping with the vast prize fund and the beauty and grandeur of the Exposition palaces. The buildings provided for the live stock show consisted of the Live Stock Forum, the Live Stock Congress Hall, and thirty-two large live stock and dairy barns, covering nearly forty acres of space. The exhibitions, if all had been held at one time, would have required accommodations covering at least 150 acres of space, or thirty-five acres more than the combined floor space (115 acres) of all the Exposition palaces provided for the other exhibits at the World's Fair.

The leading breeders, noted for the excellence of the various breeds of improved animals, from all the sections of the world, responded to the cordial and hearty invitation of the Exposition with the best specimens of all the popular breeds of domestic animals and the exhibit in extent and quality made a new record that is not likely to be nearly approached during the present generation.

The enterprise of the stockmen, the unprecedented liberality of the cash prizes offered and the much coveted honors attending awards stimulated ambitious breeders to the utmost in a commendable endeavor to secure and perfectly fit the best obtainable representatives of the respective breeds. Animals of exceptional excellence and such as were exhibited at the World's Fair, like men of the highest attainments, are rarely produced and are of priceless value.

The present and prospective benefits to man to be derived from the incomparable stock exhibit at the World's Fair can not be computed and so far as relates to our future material prosperity, and taking into consideration the fact that the stock can not be duplicated in quality, it is safe to say that it far exceeded in value the combined exhibits displayed in all the other departments of the World's Fair.

President Francis, in an address to the exhibitors in the Live Stock Forum, spoke in part as follows:

I beg the privilege of extending the heartiest congratulations to all the exhibitors who have bred, fitted, and exhibited with a master art the largest and best collection of all the improved breeds of live stock from all the breeding districts of the world ever assembled together.

Authorities in such matters, who are familiar with the statistics and exhibition of live stock, have unanimously declared that the display in extent and high quality established a new standard that is not likely to be even nearly approached during the next quarter of a century, if ever.

You have not only filled the stalls provided for this exhibit with the highest class of all breeds, but you have crowded the space under this vast amphitheater with additional stock.

Director of Exhibits Skiff, in presenting the Premier Championship honors to the successful exhibitors, spoke in part as follows:

All agree that the exhibit you have presented on this occasion has not been nearly approached in number and quality at any previous show. You are entitled to a full measure of congratulations on the entire success that has attended your efforts in the breeding, fitting, and exhibition of this incomparable display. It has been my great pleasure to personally meet many of the exhibitors and to receive from each the unqualified endorsement of the able, impartial, and satisfactory manner in which the show has been conducted by Chief Mills.

A new record, I am sure, has been made by the Universal Exposition in the matter of competent and just awards, and in this connection, as the Director of Exhibits, I desire most heartily to assure each juror who has passed upon the displays, of my high appreciation of his able and eminently satisfactory awards.

Gentlemen, you have more than met the high expectation of the Exposition in the number and high quality of your exhibits, and I can not wish you a brighter and more useful future than that you may continue to maintain the same high standard of excellence of your flocks and herds, and that you will spare no thought or effort necessary to keep pace with the improvement characteristic of the new century.

The most successful breeders of horses, cattle, sheep, swine, and poultry, with residence as follows, were represented in the exhibits made at the Universal Exposition of 1904, namely:

HORSES—Arabia, Belgium, Canada, England, France, Germany, Holland, Ireland, Scotland, Connecticut, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Minnesota, Missouri, Montana, Nebraska, New York, Tennessee, Vermont, and Wisconsin.

CATTLE—Canada, England, Holland, Ireland, Isle of Guernsey, Isle of Jersey, Scotland, Connecticut, Delaware, Illinois, Indiana, Indian Territory, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, Nevada, New York, New Mexico, New Jersey, New Hampshire, North Carolina, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, West Virginia, and Wisconsin.

SHEEP—Canada, England, France, Germany, Persia, Scotland, Arkansas, California, Idaho, Illinois, Indiana, Iowa, Kansas, Maryland, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New York, New Mexico, New Jersey, Oregon, Pennsylvania, Texas, Utah, Washington, and Wisconsin.

SWINE—Canada, England, Scotland, Arkansas, California, Illinois, Indiana, Iowa, Kansas, Kentucky, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New York, New Jersey, North Carolina, Oklahoma, Pennsylvania, South Dakota, Tennessee, and Wisconsin.

POULTRY—Austria, Canada, England, Ireland, Scotland, Alabama, Arkansas, California, Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New York, New Jersey, New Hampshire, North Carolina, Oklahoma, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Vermont, West Virginia, and Wisconsin.

In summing up, it may be said briefly that the Live Stock Show, in numbers, exceeded by more than one hundred per cent any previous exhibition, while the quality was in keeping with the extent of the show and most creditably represented the best living specimens of the several breeds; that the highest standard was reached in the matter of competent and just awards; that the Exposition provided the best accommodations for the shelter and showing of the stock; that the Exposition more than fulfilled all of its promises to exhibitors and that all competitors had expressed their unqualified approval of the management and were profuse in their thanks for the prompt payment of the munificent cash prizes.

## DIVISION CXLIII.

### Forestry and Fish and Game Exhibits.

By Tarlton H. Bean, Chief of the Department.

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The Department of Forestry was associated for exhibit purposes with the Department of Fish and Game in the building described in connection with that department. The space devoted to forestry was insignificant when we consider the importance of the forest industries, which are valued at $1,000,000,000 annually. As a matter of course the building was far too small to accommodate the exhibits which were offered, and the amount of space set aside for outdoor exhibits of Forest Management, Tree Planting, and such displays of forest products as were too large for installation in the building, aggregated more than fifteen acres.

Nearly all of the great States contributed to the forestry exhibit, as well also a great many important foreign countries; indeed, it was impossible to provide nearly all of the space required for forest exhibits. The displays were not limited to forest products, but related also to forest policy, and to the practical work of tree planting.

The distribution of forests and of the genera and species of trees and plants formed part of the scientific exhibit; also the anatomy and structure of woods as shown by sections of various degrees of thickness. The diseases of forest trees, the peculiarities of forest growth, statistics of forest industries, and the relation of forests to climate, formed interesting features of these exhibits.

A special object of the selected display in the Forestry Building was the complete illustration of the economic uses of valuable trees, such as yellow-pine, loblolly-pine, cedar, cypress, redwood, spruce, hemlock, and other coniferous trees, as well as hard woods. The economic history and utilization of these woods were shown in great detail.

The secondary products of the forest, such as woodenware, cooperage, basketry, etc., the great industries based upon wood-pulp, and other objects of forest resources, notably alcohol, turpentine, resins, etc., helped to complete the forest installation.

The United States Bureau of Forestry occupied a central large location in the west end of the building, and its display covered almost the whole of the first group of the Forestry Department. The salient features of the United States Forestry Bureau's exhibit at the World's Fair, St. Louis, consisted of an indoor and an outdoor display. The indoor exhibit required some 5,000 square feet of floor space which was set aside in the spacious Forestry and Fish and Game Building. This display included as most conspicuous features magnificent large colored and uncolored transparencies, illustrating forest trees, typical natural and planted timber forests, forest conditions, and forest topography in the United States. The various typical methods of lumbering were illustrated, as well also the baleful destruction of forests by fire, insects, and other enemies. The transparencies showing these features were installed in an artistically constructed arcade, illuminated by natural light. Other important parts of the indoor exhibit comprised a full exposition of the character and extent of government forest work in the United States. Special account was taken of methods and results of timber testing, the preservation of railroad and other construction timber by artificial treatment, practical forest management, and tree planting on public and private lands, turpentine orcharding, and the naval stores industry. Graphic illustrations were given of the origin, yield, and consumption of American timbers. The distribution of forests in different forest regions, and the location and extent of State and Federal forest reserves were exhibited on a large relief map of the United States.

The outdoor forest display, while simple, was exceedingly important and instructive from educational and practical points of view. It comprised operations in the management of forest and farm woodlands and methods of economic forest tree planting. A timber tract of some ten acres carried demonstrations of the principles and practice of conservative forestry which the bureau is now applying to public and private timber lands. An extension of the established boundaries of the demonstration forest as prepared from


ARRIVAL OF MAORIS IN NEW ZEALAND.
NEW ZEALAND EXHIBIT IN FORESTRY, FISH, AND GAME PAVILION.

the World's Fair Commission included a bit of virgin timber, which enabled the bureau to demonstrate principles and methods not otherwise possible.

The demonstrations and methods of tree planting for profit on farms, denuded and treeless lands, were shown on a separate tract adjoining the forage and other farm crop exhibits of the United States Bureau of Plant Industry. This tree planting display showed actual practice in the formation of timber farm wood lots and proved a most instructive lesson to farmers and others interested in tree planting.

So much popular interest has been enlisted in behalf of modern forest management that many of the wealthiest lumbermen of the United States are now practicing the methods of the Forestry Bureau and treating the forest as a perpetual crop.

The Department of Fish and Game was associated with the Forestry Department in a pavilion 300 feet wide and 600 feet long, which was universally regarded as the best building ever constructed at an international exposition for the purpose for which it was designed. Its location was admirable, and scarcely a single class of the entire department was lacking in full representation by means of worthy exhibits.

A characteristic feature of this building was its central nave, 85 feet wide and 430 feet long, entirely free of posts, and so well lighted that no display was in the least obscure to visitors. The east and west ends of the building were also 85 feet wide, 300 feet long, and free of posts.

The chief interest in this department undoubtedly centered in its live fish and game, which were displayed by a number of States, as well as by some private individuals.

The aquarium was located in the east end of the building, where it occupied a space 190 feet long and 35 feet wide. It had two lines of tanks, separated by an aisle 15 feet wide. This wide aisle communicated through an illuminated grotto with the aquarium of one of the States in which were displayed black bass, pike-perch, crappie, rainbow trout, and other well-known food and game fishes. A pool occupying the center of the space in this State exhibit contained immense catfishes and other characteristic species. The west wall was handsomely decorated to represent the forest and its game. The nave contained two pools for the display of live beaver, which were shown, as far as possible, in their natural surroundings, and engaged in their characteristic work of tree cutting. The central pool, 40 feet in diameter and 5 feet deep, was provided for a State display of marine fishes.

Groups of living game birds, suitable for display indoors, added materially to the attractiveness of this building, and the live fish and game were supplemented by the choicest collections of the best art of the taxidermist.

Every class of the Fish and Game Department was fully covered by domestic as well as foreign exhibits, and these displays included a range of country from the Atlantic to the Pacific, and from Alaska and Canada to the Gulf of Mexico. The displays of hunting equipment from foreign countries were unusually complete and interesting. They included native weapons, as well as the best equipment of the modern hunter. The various implements employed by sportsmen, decoys, gun cabinets, tents, camping and hunting utensils, etc., were shown in great variety.

Among the illustrations shown were oil paintings, photographs and drawings, specimens of taxidermy, furs, game trophies, products of hunting and fishing, literature, fishing equipment of all kinds, such as native appliances, modern netting, fishery rigged boats, artificial flies, reels, and all other tackle, the exhibits being the most nearly complete and attractive of any that have ever been assembled at a great exposition.

To give a good idea of the extent of the participation in this department, it is sufficient to say that a single country had 300 exhibitors, and another foreign country had nearly 9,000 separate items forming its collections.

Many of the States showed their fish and game resources, most of them by means of mounted specimens and groups, but several of them supplemented taxidermy by living game. The great salmon fishery of the Pacific coast and the methods of hatching salmon were illustrated in the most comprehensive and vivid manner. The methods of fish culture and its results formed principal items of the displays of several States.

So great was the desire to show the game resources, that a single State was desirous of obtaining at least five acres of outdoor space upon which to show about thirty species of its animals. The area available in the Forestry and Fish and Game Building for the Department of Fish and Game was about two acres, but additional outside space was used for live exhibits, amounting in all to seven acres.