

walks back to warn any approaching train. It is quite problematical how far back he may go. He may seek the shelter of a station *en route*, thinking all is safe. He may be but a few car lengths back when an approaching train appears, in a few seconds colliding with the other one. An engineer may follow up a long line of hundreds of block signals, and when weary with their endless recurrence, may pass the critical one. Signal tower operatives may fail in giving the proper signal.

It certainly seems as if there was room for invention in the elimination of the personal element from railroad signaling. It should be possible to devise some rational system by which a danger signal would absolutely stop a train, should the engine runner fail to do so. The electric current which is employed in the automatic block system might be made to do this, thus avoiding the clumsier mechanical methods.

If a train is unexpectedly forced to stop, some efficient system of warning another train approaching from the rear should be practicable. It has been proposed to provide a little car to run upon a single rail, which car is to be driven by a rocket attached to it. It would carry a torpedo. On the stoppage of a train for an accident it would be dispatched from the rear. In a few seconds it would be a thousand feet or more away. An approaching train would run over it and explode the torpedo, thus warning the engineer. But to-day the slow-moving brakeman is the usual agent. Before he would reach a point even a thousand feet distant, an express would run several miles.

One recent invention accepts the liability to collision, and constructs cars on a principle specially designed to withstand a shock, and not to telescope. Our inventors and engineers should go a step further, and make accidents all but impossible. To-day a rear-end collision should be an impossibility. But sad experience, involving many deaths and injuries, continually shows that it is a constantly menacing danger. The double-track road with fast and heavy traffic is now as dangerous as was the old-time single track with its limited number of slow trains.

The Olympia.

The Olympia, one of the finest protected cruisers ever constructed, is rapidly approaching completion at the Union Iron Works, San Francisco. The Olympia is the largest unarmored cruiser built for the navy, except the Columbia and the Minneapolis. She has a displacement of about 5,600 tons and a coal capacity of 1,300 tons, which gives her a radius, at 10 knots, of 13,000 miles. The guaranteed speed of the Olympia is 20 knots. She has already sustained a sea speed of 19 knots, which is far ahead of what is generally found in vessels of her class. The Olympia is 340 feet long, beam 53 feet, and 21½ feet draught. She has three complete decks and a large superstructure amidships. The vessel is provided with two masts with fighting tops and an electric light on each. She has a complete protective deck of 4¾ inches of steel on forward slope and 2 inches on the flat throughout. All around the ship is a belt of water-excluding substance. Coal is so stowed that the machinery will be protected as much as possible. The machinery consists of twin screw, vertical inverted, direct-acting, triple expansion, three cylinder engines, in two watertight compartments. The cylinder diameters are 42, 59, and 92 inches respectively, with a 42 inch stroke. The air and circulating pump engines are driven independently. The total horse power of the propelling and pump engines is expected to be 13,500 at 129 revolutions per minute of the screw engines.

The main battery consists of four 8 inch and ten rapid-fire 5 inch guns, as well as a secondary battery of fourteen 6 pounder rapid-fire guns, six 1 pounders, and four Gatlings. There is a fixed torpedo tube in bow and stern, as well as two training tubes in each side. The Olympia is a fine vessel of the commerce destroyer type, and her high sea speed and her prolonged radius of action make her a valuable ship for use in the Pacific Ocean.

A Large Day's Sawing.

At the sawmill of M. T. Jones & Co., of Lake Charles, La., recently, 191,323 feet of lumber were cut in eleven hours. This is said to be the largest amount of lumber ever turned out of a single circular sawmill in that number of hours. The saw was driven by a Corliss engine, having a cylinder 22 inches in diameter by a 40 inch stroke, the drive wheel being 20 feet in diameter with a 30 inch face, the engine making 65 revolutions per minute, with an average steam pressure of 100 pounds. The mill was provided with a steam log turner and a twin feed engine, 14 x 24, and steam log trippers. The saw mandrel was 4 inches in diameter, with water-cooled journal boxes. The saw was 54 inches in diameter, No. 6 gauge, with 80 teeth. The steam was generated by sawdust taken directly from the saw.

The credit of this feat is largely due to Mr. W. N. Elliott, saw filer, and Mr. Ed. Bullock, sawyer.

We are indebted for these facts to Mr. W. S. Whitman, chief engineer of the mill.



THE MARVELOUS CAVERN OF THE BLACK HILLS.

BY H. C. HOVEY.

The glazed dome of the Horticultural building is one of the most imposing of the numerous elegant structures to be seen at the World's Fair. It is 180 feet in diameter and 144 feet high and is approached through pavilions, halls and galleries adorned by countless exotics. Directly under this huge dome arises a miniature mountain that artistically conceals the heating apparatus. Along its flanks and crest grow the largest palms, tree ferns, bananas and bamboos that will bear transplanting. Amid this tropical greenery bloom hundreds of gay flowers and twine a myriad clinging vines.

Underneath this floral wealth extends a marvelous reproduction of one of our most recently discovered and brilliantly decorated American caverns. Perhaps without sufficient reflection the owners have styled it "The Mammoth Crystal Cave," which really trenches on the name for generations appropriated to the great cavern of Kentucky. But as no map or guide book has yet been published, and all the names of the new cave may be regarded as tentative, the ingenuity may wisely be taxed for wholly novel and suitable names. Even "Columbus Cavern," or "Colossal Cavern," would be an improvement on the present plagiaristic title, which for want of any other will have to be used in this article.

The idea of rock work under the dome originated with the directors, but the cave proprietors hit on the bold and original conception of substituting for mere rock work a reproduction of their subterranean marvel. These gentlemen, Messrs. Keith and Allabough, who are also on the grounds to look after their interests, assured me that they began preparation two years ago by setting some seventy men at work in unfrequented parts of the cavern, collecting materials in such a manner as should not mar or rob the cave of its embellishments. The conditions forbade blasting. The crystals had to be patiently cut from the rock by pick and chisel. Thus 300,000 pounds were obtained of stalactites, stalagmites, onyx, geodic crystals, dog-tooth spar and sparkling botryoidal masses; of cave pearls, flos ferri, aragonite and dripstone stained by oxidation in as many colors as the rainbow. Having gathered these materials, it was a question what to do with them. At first the directors of the Fair were inclined to regard the exhibit as a show and to relegate it to the Midway Plaisance. But this was firmly withstood by the proprietors, who finally, after a delay of five months, obtained, through the intervention of parties interested in growing plant life by electric light, the concession of the present admirable location.

When the grotto was first opened, admission was free and continued to be so for a month. But such crowds flocked to see it as to make it actually necessary to restrain them by fixing the nominal fee of five cents for admission; and even this small sum is refunded in case the visitor buys specimens. Although the exhibit was not intended to be remunerative, the fees and purchases made by a million visitors have already reimbursed the proprietors for their original outlay of nearly \$50,000 and met running expenses. As many as 20,000 persons explore the grotto daily, and the general expression is that of wonder and delight.

The grotto as constructed is in no sense a model of the original cavern, except as displaying specimens of its contents and some of the conditions under which they are found. It includes seven rooms with arched approaches and tasteful alcoves and ample space, every square foot of which is embellished by the brilliant crystal masses already described, varying in size from mere marbles to blocks weighing 600 pounds. This unique assemblage was the result of repeated experiments, as no skilled labor in the line of cave making was to be had. Lighted as it constantly is by a profusion of electric lamps, the place is certainly an attractive and instructive feature of the Fair.

The Mammoth Crystal Cave itself was discovered in South Dakota many years ago by miners for the precious metals. But it has never till recently been entered for more than 1,700 feet. In 1889 explorers began to break into new chambers, one after another, the process going on gradually, until now 1,490 halls and rooms have been opened. Some of them are low and muddy, while others are spacious and dry. The largest room of all is estimated to be 600 feet long, 300 feet wide and 100 feet high. The walls and floors of all the rooms and passageways are composed of

crystals. What digging and blasting has been done only serves to bring more of this crystalline mass to view, or to break through into new apartments, or to open pockets like huge geodes.

The actual extent of the great cavern is unknown. Mr. Allabough assured me that about one-third of it had been accurately surveyed by chain, compass and level with reference to its being possibly lighted by electricity before long. This work was done by Mr. George S. Hopkins, United States mining engineer, of Deadwood, by whom a map was also prepared, which for prudential reasons has not been published, although I had the privilege of inspecting it. The total length of measured passageways approximates twenty miles. This seems to justify the statement that the whole caveway, as far as explored, is from forty to fifty miles long. There are eight different levels, or galleries, in the cave. The upper ones are extremely dry, the lower ones damp, and the lowest of all are so very wet at all seasons as to be styled "the rainy rooms." The owners are satisfied, however, that drainage level has not yet been reached. There are numerous pools, and three running streams, one of which has a waterfall sixty feet high—not a plunging fall, but a cascade flowing down a steep incline of travertine.

The formation in which this remarkable excavation is made is the corniferous limestone, judging from the fossils displayed. It is supposed to owe its origin to a small stream named Elk Creek, which sinks at a point seven miles above, and emerges again about four miles below, thus having eleven miles of subterranean flow. This theory gets confirmation from the fact that, in digging for the railroad along the banks of Elk Creek, crystal masses and pockets of dog-tooth spar were found like that to be seen in the cavern. Some of the specimens taken out were very fine, individual crystals of dog-tooth spar exceeding eight inches in length and of remarkable purity of material. The station of the Chicago and Northwestern Railroad being vertically 413 feet below the cave entrance, the theory given above would indicate a corresponding depth of the cave. And this is not incredible, for at places the hills are known to rise as much as 1,800 feet above the galleries already explored.

The surrounding region is densely wooded and highly picturesque. No interior vegetation of any kind has yet been noticed, nor any true cave fauna; nor have any Indian relics been found. Heaps of minute bones abound here and there, seemingly the remains of rats, mice, bats and other intruders from without. The temperature is cool, being said to be as low as 45° Fahr., which is hardly credible, as that would be 10° lower than the ascertained temperature of other great American caverns.

By whatever name this new and splendid cavern is to be known, it certainly combines the grandeur of the Mammoth Cave with the loveliness of Luray, besides having peculiar features of its own. It is worthy to be counted among the wonders of the world.

The total number of paid admissions for August was 3,515,493, and total number to date 10,000,906.

The Fair is wonderful to the wisest, and when you see the farmer just come out of the woods, with his large lunch box, strapped up with a piece of a harness, examining a string of sleigh bells or a patent cow bell, you might hear him remark: "What the thunder is that thing for?" for he was positive he knew something about cow bells. He cares nothing about style; he left his paper collar at home, and brought his long whiskers. He also wears the squeaky boots and carries the seven days' layers of dust on the uppers. Next you might see him standing in front of the Electrical Welding exhibit; then if you could see the astonished expression, as he knows he sees a man dip a cold piece of iron in a pail of water and it immediately turns red hot, while under water. It is comical to watch him; even his whiskers seem to absorb wonder, as you hear him say "Gosh!"

The Russian Government Pedagogic Museum displays scientific and other educational apparatus, together with cases of stuffed birds and animals; pictures of Russian life and specimens of mineral resources. The St. Petersburg School of Design contributes many fine specimens of lace and needle work done by girls, also samples of work done by boys in the Manual Training division. The Russian government displays in adjoining booths many sketches and diagrams of public engineering works. In the Imperial Post booth the various methods of carrying the mails is picturesquely shown. There is a model representing five men carrying the mails over the mountains through the snow in the Caucasus, where the footing has to be chopped out of the ice step by step. Another model represents three horses abreast in the usual Russian style attached to a two-wheeled mail cart. Near this three horses attached to a sleigh show this same route in winter. There is also a model of a mail cart drawn by two yokes of oxen; a special mail boat used in the Archangel district, rowed by women; a camel that carries the mail on his back in the deserts of the southeast; a mail sled drawn by reindeer as in

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Notes from the World's Columbian Exposition.
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the extreme north; and a mail sled drawn by a dog team, as in Siberia. The rest of this exhibit comprises a full set of government postage stamps and post office supplies.

Several special days have been observed recently, but none have been more full of novelty or more picturesque than was the celebration by the Turks. A large number of representatives of this nation were present, and the procession from the Turkish village in the Midway Plaisance to the Ottoman building in the Exposition grounds was gorgeous and unique. It was made up largely of Bedouins mounted on spirited horses bedecked in their brightest garments and carrying their long, villainous-looking weapons. There was also quite an escort mounted on camels and donkeys. Nearly every man in the procession wore a fez, and many officials were dressed in the bright-colored insignia of their offices. The day was the seventeenth anniversary of the accession of the present sultan to the throne.

In the Mines building the "Statue of Salt" commands a wondering throng. It is said not a few elderly ladies go away believing that they have actually seen a replica of Lot's wife.

The model of the United States Treasury in the Administration building is another object of unfading attraction. It is built of Columbian half dollars, and considerable ingenuity has been displayed in its construction. The coins for the model were minted under an act of Congress, August 5, 1892.

The model of a prairie farm commands admiration. It was designed and partly executed by an Illinois girl, seventeen years of age. The principal materials entering into its construction are grain and grasses, and these have been handled with no small deftness and effect.

In the Anthropological building are some of the most important prehistoric relics from Carson, Nevada, from a quarry in the north end of a low sandstone ridge, a short spur of the Pine Nut Mountains. They consist of casts and in most cases the originals of footprints discovered in 1882. There are mammoth tracks, human tracks, horse tracks, and bird tracks. The quarry excavation is about 4,950 feet above the sea level. The formation is thus described: First, sandstone, forming the walls of the quarry and from 22 to 32 feet in height; second, the strata containing the prints; and third, the bed rock. There were also found mammoth teeth in good condition, and portions of the tooth and two jaw bones of a horse. The deposit where these remains were discovered is supposed to be Quaternary or Upper Pliocene, for in the opinion of Dr. Joseph Le Conte there are no indications of "the tall horse or elephant in the American Miocene."

The great liberty and peace bell for the Columbian Exposition, weighing 13,000 pounds, cast at Troy, N. Y., lately reached the Exposition.

It is one of the largest bells ever cast in this country, is seven feet in height, seven feet four inches in diameter at the mouth, and the tongue and bolt weigh 700 pounds. Every ounce of the metal of which the bell is made has a historic value as having been connected with the deeds of the Revolution and of other great struggles in the field of war in which the honor of the country was at stake. There are in it, among other things, bullets taken from the battlefield and from the bodies of men who were wounded; wedding rings, thimbles, spoons, the remains of swords, bayonets, cannon and rifles, jewelry, coin and plate, and the pennies of more than a quarter of a million of American boys and girls.

This bell is the outcome of an idea of the Sons and Daughters of the Revolution, and commemorates the celebration of this Columbian year. There are some inscriptions on the bell: "Proclaim liberty throughout all the land unto all the inhabitants thereof," "A new commandment I give unto you that ye love one another," and "Glory to God in the highest and on earth peace, goodwill toward men."

The Tiffany Chapel in the Manufactures building is a grand exhibit. The altar is made of white mosaic inlaid with mother-of-pearl and jewels. The columns and windows are all of mosaic glass, in the style of the thirteenth century. The cross on the altar is of gold set with jewels. The altar window has a setting of peacock feathers in gold and natural colors. There are 280,000 pieces in the altar, which glisten in the subdued light of the candles which are kept burning on the altar.

WASHINGTON'S RED CEDAR VASE.

In the Washington building at the World's Fair is exhibited the largest piece of wood turning in the world. It is the work of J. L. Nygren, of Tacoma, an employe of the Tacoma Lumber and Manufacturing Company. Mr. Nygren spent about three months of his time making a special lathe and turning from a single log of cedar a huge vase, six feet high and four feet across the top. The vase is highly polished, and

shows to splendid advantage the coloring and graining of the red cedar.

World's Fair Awards.

In the Department of Artistic Manufactures the judges have passed upon nearly all of the exhibits, and medals have been awarded to many foreign as well as home exhibitors. The list is so long we can only find space for the American medalists as follows:

New York—Brown's Amber Manufacturing Company, Bell & Barber, Leon Favre, M. J. Powers, Beyer & Schultzer, Tiffany Glass and Decorating Company, Tiffany Glass and Decorating Company, S. Strauss & Sons, Tiffany Glass and Decorating Company, Tiffany Glass and Decorating Company (5), S. Klobner & Co., Tiffany & Co., Ed. Jansen, Sypher & Co., B. & W. B. Smith, Ed. Jansen, Hertz Bros.

Chicago—Columbus Manufacturing Company, Winslow Bros., Healy & Millett, Wells Glass Company, Miss M. Heinnermaux, L. M. Hamline & Co., Mrs. W. M. Clarke, Mrs. B. B. Jenkins, F. Winter Co., Miss S. R. Little, A. E. Richter, Gensch & Hartman, E. B. Clarke Co., J. C. Wemple & Co., Winslow Bro. Co., Ehman & Simon Manufacturing Company, Bensinger Bros., Wind Folding Bed Co., Th. Kane & Co., George E. Androvetti, Rawson & Evans, McCully & Miles, Flanagan & Beidemorg, Horn Bros., Henry Dibblee Co., Dean & Co., A. H. Andrews & Co., American Bronze Company.

Providence, R. I.—F. F. Pearce & Co., Gorham Manufacturing Company (several), O. C. Devereaux & Co., R. L. Griffith & Son, S. & B. Lederer, Reynolds & Co., J. H. Fanning & Co., New England Manufacturing Company, Arnold & Steere, Charles F. Prons, Payton



LARGEST TURNED VASE IN THE WORLD.

& Kelley, W. E. Webster & Co., Kent & Stanley Company, Otsby & Barton.

Philadelphia—William Reith, J. W. Boughton, William Galloway.

Toledo—Libby Glass Company, Gendron Iron Wheel Company.

Boston—H. R. Plimpton & Co., Derby & Kilnor Company.

Denver, Col.—Miss J. R. Pickney.

Lyons, N. Y.—Manhattan Silver Plating Company, Manhattan Silver Plating Company.

Meriden, Conn.—Meriden Britannia Company, Meriden Britannia Company.

Newark, N. J.—Whitehead & Hoag, Stewart Hartshorn Company, Nymble.

Geneva, N. Y.—Miss F. Crittenden.

Kansas City, Mo.—F. D. Koehler.

East Liverpool, O.—Knowles, Taylor & Knowles, Knowles, Taylor & Anderson.

Cincinnati, O.—Reuld Moulding Manufacturing Company, Andrew Messwell & Co.

Phoenix, Ariz.—F. E. White Cactus Manufacturing Company, F. E. White Cactus Manufacturing Company.

St. Paul, Minn.—Drake Manufacturing Company.

Grand Rapids, Mich.—Gun Folding Bed Company, New England Furniture Company, Sligh Furniture Company, Royal Furniture Company.

Milwaukee, Wis.—Miss A. S. Lodge.

Freeport, Ill.—G. Dickens Filigree Company.

Allegheny, Pa.—Conroy, Puigh & Co.

Rockford, Ill.—Royal Mantel Company, Middlecomb Company, Rockford Standard Company.

Hartford, Conn.—Wm. Rogers Manufacturing Company (3).

Attleboro, Mass.—R. F. Simmons & Company, W. & S. Blankington.

Bridgeport, Conn.—Holmes & Edwards Silver Company.

New Bedford, Mass.—Pairpont Manufacturing Company.

Washington, D. C.—Mary and Emily Healy.

Detroit, Mich.—George Le Roff.

Columbus, O.—Kimmear & Yager Company.

Pittsburg, Pa.—U. S. Glass Company.

Trenton, N. Y.—Burroughs & Mountford Company.

Baltimore, Md.—Edwin Bennett Pottery Company.

Pawtucket, R. I.—G. H. Fuller & Son.

Miscellaneous.—J. Hoare, William K. Potter, Aladdin Terra Cotta Company.

The Money of the World.

Acting Director of the Mint Preston has prepared a table of the monetary systems of the world. The table shows that the aggregate stock of gold is \$3,582,505,000; silver, \$4,042,700,000; uncovered paper, \$2,635,873,000.

Stock of gold possessed by principal countries is as follows: United States, \$604,000,000; Great Britain, \$550,000,000; France, \$800,000,000; Germany, \$600,000,000; Russia, \$250,000,000. The stock of silver is as follows: United States, \$615,000,000; Great Britain, \$100,000,000; France, \$700,000,000; Germany, \$211,000,000; Russia, \$60,000,000.

The stock of silver is divided as follows: United States, \$538,000,000 full tender, and \$77,000,000 limited tender; Great Britain, no silver full tender, \$100,000,000 limited tender; France, \$650,000,000 full tender, \$50,000,000 limited tender; Germany, \$103,000,000 full tender and \$108,000,000 limited tender; Russia, \$22,000,000 full tender and \$38,000,000 limited tender.

The ratio prevailing in nearly all principal countries between gold and legal tender silver is 1 to 15½. The ratio between gold and limited tender silver is, as a rule, 1 to 14.38. The respective ratios in the United States are 1 to 15.98 and 1 to 14.95.

The various monetary systems as divided among countries: Gold and silver—United States, France, Belgium, Italy, Switzerland, Greece, Spain, Netherlands, Turkey, and Japan. Gold—United Kingdom, Germany, Portugal, Austria, Scandinavian Union, Australia, Egypt, Canada, and Cuba. Silver—Russia, Mexico, Central and South America, and India. Of the uncovered money, South America has \$600,000,000; Russia, \$500,000,000; United States, \$412,000,000; Austria, \$260,000,000; Italy, \$163,000,000; Germany, \$107,000,000; France, \$81,000,000; and Great Britain, \$60,000,000.

The per capita circulation of gold is: United States, \$9.01; United Kingdom, \$14.47; France, \$20.52; Germany, \$12.12; Russia, \$2.21. Per capita of all classes of money is: France, \$40.56; Cuba, \$31.00; Netherlands, \$28.88; Australia, \$26.75; Belgium, \$25.53; United States, \$24.34; United Kingdom, \$13.42; and Russia, \$7.16.

The Ruins of Ang-Kor.

Recent events have attracted attention to the great lake between Cambodia and Siam, Toule Sap, and to the two Siamese provinces of Ang-Kor and Baltambong which adjoin it. A few months ago the *Progres de Saigon* issued an account, illustrated by native wood engravings, of this great lake of the two provinces and of the famous ruins of Ang-Kor. The region is described as lying to the north of Cochin-China, between Siam, the ocean and the unknown Laos districts, and although now but thinly populated, it was in former times the abode of a race which was great among the peoples of the East, and which for long centuries was governed by a famous line of sovereigns. The great lake is formed during the rainy season by one of the branches of the Mekong, and is then navigable by large steamers, which go to Siemreap, at the head of the lake, and near the ruins of Ang-Kor, the greatest remains of Khmer civilization. These ruins were discovered by the Portuguese and Spaniards in 1564, and they were first described in a volume published in Barcelona in the following century. There are Chinese accounts of a much earlier period, and one of these, written in the thirteenth century by an ambassador sent to the Cambodian court, was made known to Europe by Abel Remusat. It includes descriptions of the two famous temples of Ang-Kor Wat and Ang-Kor Thom, which correspond with the ruins of the present day. Since then they have been investigated by French savants, and quite a splendid work on the subject has been published by M. Fournereau. It is thirty hours' steam to Pnom-Penh, the capitol of Cambodia, and thirty more to Siemreap. Ang-Kor Wat, or Ang-Kor the Great, the royal pagoda, is the best preserved of all the Khmer remains. Mouhot, who visited it in 1862, says it is more majestic than any other monument of antiquity that we possess. It occupies a large rectangular park, 1,087 m. long and 827 broad. The illustrations show numerous towers, vast terraces, several subsidiary temples, innumerable figures of fantastic mythological animals, galleries, colonnades, avenues, lakes, bridges, etc. The surface of the large stones employed in the buildings are covered with pictures and engravings. These huge blocks are believed to have been conveyed to the great heights at which some of them are found by means of inclined planes. Ang-Kor Thom, which is a few miles away, is still more ancient, and around it are the ruins of the old Khmer capital, Preathong, which have been invaded by the forest, giant banyans having their roots below the foundations and their branches among porticoes and pillars covered with bass-reliefs. These latter, which are especially well preserved in the underground galleries, represent the national sports, sacred ceremonies and historical events of the Khmers. These are the two main Khmer monuments, but there are hundreds of others scattered over a large area of the country in the midst of what looks like a primeval forest.—*The Architect.*