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THE GREAT EARTHQUAKE.

Day by day, for the last week, earthquake shocks of gradually decreasing intensity have disturbed Charleston, and at last it seems as if the earth has approached its condition of repose. The total number of disturbances has been very large, but the great damage was done by the first one. Mayor Courtenay, of Charleston, returning from Europe, received from the pilot that boarded the Etruria his first news of the disaster that had befallen his city. The loss has been estimated very differently by different authorities. The general consensus places it in advance of the figures given by us last week; $5,000,000 is the amount of damage to buildings and $500,000 to furniture and personal property, according to the estimates of Mr. William Aitken Kelley, the City Appraiser. Mayor Courtenay coincides substantially with this estimate. The death list has not been greatly changed; several additional deaths from exposure have slightly increased it. According to all authorities, no more shocks of any severity need be apprehended. The latter disturbances bear somewhat the same relation to the original that the last ripple caused by a passing steamer bears to the first violent waves. The first shock indicated the progress of the earth toward settlement; and subsequent shocks have marked the dying away of the agitation. From the above comparison, it must not be surmised that each movement represents a wave of the same series. All we know is that, as a rule, the first or an early shock is the worst. No tidal wave at this late date is at all to be anticipated.

The present dread is of rain; the need is for shelter. Tents are in great demand and seem to be hard to obtain. The return of confidence is rapidly doing away with this necessity. Buildings are being repaired, and masons and carpenters are hard at work everywhere. Soon the houses will be reoccupied. Recurrence of rain is, however, greatly to be feared, as it will cause great suffering among those who are without shelter, or who have only tents to live in.

The fact having been established that the earth movement was not of sufficient intensity to quite destroy the majority of houses, many have suggested that the proper course to pursue in an earthquake is to remain within doors, and take shelter in an inner doorway, so as to be secure from falling plaster. As it is merely a question of degree how far the destruction will go, it is to be doubted if this is good advice.

Naturally, the greatest damage was done to brick buildings. Their inelasticity caused them to be cracked and overturned. Brick chimneys, in falling, were also a source of loss and damage. Hitherto, a statute has forbidden the erection of wooden houses. A movement now is impending to petition the legislature to do away with this restriction. The demand upon the real estate agents is for wooden houses, people fearing to establish themselves in brick buildings. The fire of August 31 seems to be forgotten by those who advocate this plan. Had the houses of Charleston been built of wood, there would be little left of the city, in all probability, to-day. The fire that destroyed so many buildings, if wood had been the prevailing material of construction, would have spread everywhere unchecked, as no efficient work could have been anticipated from the fire department during the scenes of panic.

Even the animals were affected, and, in some cases, were more frightened, to all appearances, than were human beings. The horses from one of the engine houses ran away in the wildest terror, and were not found again until the next morning. The surrounding country has furnished similar accounts of the behavior of domesticated animals.

A sensible departure in rebuilding the city, is suggested in the substitution of terra cotta for brick in the construction of chimneys. These would be more resistant, and, if destroyed, would do less damage in falling.

One of the difficulties of the situation has been to determine which houses could be reoccupied, and which ones required demolition. To meet this need, a committee including W. E. Speir, architect and inspector of public buildings, United States Treasury Department; Captain W. H. Bixby and Lieutenant F. V. Abbott, United States Engineers' Department; Louis J. Barbour, City Engineer; and John Devereaux, architect and superintendent of the United States Custom House wharf, Charleston, has been appointed chiefly to examine and condemn dangerous houses and property.

As was to have been expected, contributions are pouring in from all sides, and with her natural resources and manufacturing industries the city will soon be on the road toward a recuperation of her losses. The city has shown great increase in prosperity recently. From 1880 to 1883, manufacturing capital increased from $1,718,300 to over $6,000,000, while production and hands employed nearly quadrupled in amount and number. Charleston rock, the great natural phosphate of this country, was the basis of this advance, most of the factories being devoted to the production of superphosphates and other artificial fertilizers. The city is fortunate in having her own deposits of phosphate to draw upon, being thus a producer as well as a manufacturer of her great staples.

On the evening of Wednesday, September 1, Prof. Dawson, Principal of McGill College, Montreal, read a paper touching on earthquakes before the British Association for the Advancement of Science, then in session in Birmingham, England. It consisted of an exhaustive review of the geological formation of the bed of the Atlantic, with especial reference to its bearing upon the question of earthquakes. The paper was highly praised and regarded as a valuable contribution to the discussion, but within a day came the full account of the Charleston upheaval, and Prof. Dawson immediately made the following confession:

"The phenomena of the present earthquake convulsions in America and elsewhere, but particularly in America, are extremely puzzling, and completely upset some of the conclusions set forth in the address I read last evening."

The high standing of Prof. Dawson, recognized as one of the leading geologists of the world, and the retraction, in the light of natural events, of his views expressed a few hours before, forcibly illustrate our ignorance as regards earthquakes. If they could only be considered in the correct light, as infinitesimal disturbances of the earth's surface, speculation concerning their origin would be less freely indulged in. A depression of the land enough to have submerged Charleston into the sea would only have involved a lowering of surface equal to about one three-hundred-thousandth of the earth's diameter. Making the same comparison with reference to what did take place, it will be found that the surface was agitated far less than one fifty-millionth part of the diameter. A proportional dimension on a twenty inch globe would be about one-fifteenth or one-twentieth the thickness of a piece of gold leaf, or, referred to a sheet of paper, a thousandth of the above fraction.

In other words, regarded as cosmical disturbances, earthquakes are almost too small to be intelligently theorized about. Their disastrous effects on humanity may be very great; but referred to the earth's dimensions, they amount to very little at the present day.

From general reports and the observations of the Government scientists, Director Powell concludes that the earthquake had its center in North and South Carolina, to the northeast of Charleston. The land area of the earthquake was one-third of the total area of the United States, and the maps which have been prepared show that the shock traversed this distance in fifteen minutes.

RARE MONKEYS.

Five new members of the monkey collection were placed on exhibition last week in the Museum of Natural History in the New York Central Park. All of these are rare, as may be judged from the fact that the Rochester agency, which contracted to furnish specimens of each known variety, and is paid only as it delivers them, has been four years getting the curious group of the family *Simiadæ* now for the first time on exhibition here.

The ring-tailed lemur (*Lemur catta*) is from Madagascar. It has thick gray fur, slightly shaded with brown along the shoulders and flanks, and mostly white on lower surface. The tail is two feet long, prehensile, heavily furred, and spotted with white. The specimen is two feet exclusive of tail, and has a rather pointed, fox-like nose.

No. 2 embraces a group of very variable lemurs (*Propithecus verreaux*). The coloring of these is from a pure white to a deep red.

No. 3 is a black monkey with a brown head (*Semnopithecus johnii*), three feet long, tail slender and as long as body. It is from India, and was captured by Taxidermist Hornaday, of the National Museum at Washington.

Nos. 4 and 5 are rare specimens of the little marmoset or quircal monkey of Brazil.

Those unfamiliar with the monkey family, who are sufficiently interested to visit this collection, will discover that while none of the Old World monkeys have short tails, American members of the family are not thus restricted to the one fashion, some wearing long and some short tails.

They will observe, further, that the Old World monkeys have cheek pouches for the temporary storage of food, and callosities on either side of them, while those of the New World have neither the pouches nor the callosities, but are characterized by the width between their nostrils.

Peroxide of Hydrogen.

The use of peroxide of hydrogen, commonly called oxygenated water, is extending for bleaching purposes. It will be remembered that some years ago the fair sex rendered this product somewhat popular by partially bleaching their hair with it, but the product has now emerged from this fashionable employment into the more common and perhaps more useful application for industrial purposes, being now employed for the bleaching of feathers and also of tussah silks, for which it is admirably adapted.

Inland Navigation.

Canals, so long relegated to the background, appear now in a fair way of coming to the front again, additional interest having been lent to the subject by the passing of the Manchester Ship Canal Bill, and by the subsequent permission to pay interest out of capital. At a congress on inland navigation, held last summer in Brussels, the Belgian Minister of Agriculture, Industry, and Public Works observed that canals had been too long neglected, and that public attention was now being turned to them, not with that impetuosity which, fifty years ago, created an immense iron network, but with a wise maturity which augured well for their future. In a paper on the eventual prospects of the canal, M. Van Drunen, one of the secretaries of the congress, and engineer to the Societe Generale des Chemins de Fer Economiques, came to the conclusion that the true transport arrangements of a country should include both railways and canals, each taking its share of the traffic according to its aptitude, to the great advantage of trade and manufacture. The canal would not take from the railway either passengers or goods sent by *grande vitesse* in small quantities, while the water transports would comprise substances forwarded in large quantities at low tariffs, and on which the profit is insignificant. The canal would thus free the railway from a clog upon its action, and enable it the better to organize its fast passenger service, to its own profit and the public advantage. Reduction in the cost of transport is the remedy suggested for the present stagnation in trade, it being indispensable that the transport of raw materials be cheapened both for industry and agriculture. Ship canals only enable the capital of a country to engage in commercial operations, because capital is not so easily displaced for commerce as it is for industry. A canal system of moderate section should be supplemented by a few ship canals of sufficient depth, where the probable traffic warranted the outlay.

The economical side of the question was well brought out by Mr. Daniel Adamson, who energetically pleaded the cause of the Manchester Ship Canal and others in a similar case. Cotton imported from India to London cost less for ship transit over 4,000 miles than by railway from London to Manchester, a distance of 200 miles; and manufactured goods, sent by through rate from Manchester to Bombay, paid 12s. 6d. for the 40 miles by rail to Liverpool, and only 10s. for the remaining 4,000 miles. Water carriage was the carriage of the future for heavy and not necessarily fast traffic; and the legitimate province of the railways, with their handmaids, the telegraph and telephone, was for quick speed and light weight. The railways should be content to carry passengers, 14 to the ton, at 14 pence per mile, rather than minerals and other heavy goods at 1d. per ton per mile, including the loading and unloading. Mr. E. Leader Williams, C.E., engineer for the Manchester Ship Canal, wished it to be put on record that it was he who first suggested the idea of lifting vessels vertically by hydraulic power, having argued that, if there had been no difficulty with a vertical, there need be none with a horizontal water joint. The late Mr. Mulvaney, formerly Commissioner for Public Works in Ireland, insisted on the advisability of taking the sea as far into the interior of a country as possible; and the Antwerp delegate complimented the English for carrying out public works by private enterprise instead of courting the favor of government.

Three important ship canals, the Suez Canal, the Cronstadt and Petersburg navigation, and the canalized River Main between Mentz and Frankfort, to be opened on October 1 next, formed the subject of several interesting communications.

THE SUEZ CANAL.

M. Dirks, engineer to the Dutch Waterstaat, and member of the Suez Canal International Committee, gave the results of the inquiry that had been conducted as to the deepening and widening of the canal, the captains having, on an average, voted for a width of 85 meters and the pilots for 76 meters, with a depth, respectively, of 3 feet and 3½ feet under the keel; while four captains estimated the speed that could be attained under the improved circumstances at 8 knots an hour, one at 9, two at 10, and two sailing full speed. The Committee had unanimously declared for enlarging the existing canal, with a provisional depth of 8½ meters, and a final depth of 9 meters. This would permit of a speed of 8 knots an hour, so that steamers could pass through in a single day, or half the time now required. For protecting the banks, masonry facing was recommended.

Commander Di Gioia, delegate of the Italian Government, and also a member of the Suez Canal International Committee, considered that planting the banks down to the water's edge constituted the best and most economical protection. The action of the waves was felt 2 meters below the water line, and not more than 1 meter above it, so that the banks must be protected for a vertical height of 3 meters.

ST. PETERSBURG CANAL.

M. Tcharnomsky, engineer, of St. Petersburg, gave some particulars of the Cronstadt and Petersburg ship canal, 28 kilom. or 17 miles long, generally 84 meters or 275 feet wide, and 22 feet deep, which cost £1,200,000, and will, by saving the transshipment of goods, prevent a loss of about £800,000 per annum on a traffic of 2,700,000 tons. The Goutonieff dock, 365 meters long by 214 meters wide, and the two supplementary docks have a total area of 174 hectares, or 430 acres. The foundations of the quay walls, laid in treacherous ground, consist of caissons, formed of fir logs, about 10½ inches in diameter, and filled with sea pebbles, on which is a layer, about 3 feet high, of concrete, carrying the granite faced masonry, and braced together by half logs and tie bolts. The timber is always under water, so that it is not liable to decay; and there are no teredos in the Baltic.

THE RIVER MAIN CANAL.

Herr Dusing, engineer in chief for the canalization of the Main between Mentz and Frankfort, contributed some information concerning that work, which is being carried out by the Prussian Government at a cost of £275,000, and will permit the largest vessels—1,000 tons burden—that navigate the Rhine to get up to Frankfort. The depth of the Main will be increased from 0·9 meter to 2 meters, while the locks, etc., are being constructed for an ultimate depth of 2½ meters. The distance to be regulated is 36 kilom., or 22 miles; and the total fall is 10 meters, or 33 feet. There are five weirs with locks, dividing the length into five reaches. The needle weirs are in the middle of the stream, the masonry sill being at low water level, excepting the central opening, where it is 0·meter lower, to allow boats to pass freely when the weir is down. The locks on the left bank are 80 meters, or 262 feet, long by 10½ meters, or 34 feet, wide; and the raftpasses on the right bank are 12 meters, or 39 feet, wide, the shoot having an inclination of 1 in 200. Particulars of the works at Frankfort were added by Herr Stahl, delegated by the Municipality in the absence of Mr. Lindley, engineer in chief. The works, which were begun in 1884, and are to be completed at the end of the present year, are being carried out by the Frankfort Municipality at a cost of £200,000. The harbor of refuge, 570 by 70 meters=1,870×230 feet, and 2·8 meters=9 feet deep on the right bank, is formed and protected by an outer dam parallel with the shore line, and will also be fitted out for loading and unloading goods. Besides this harbor of ten acres area, which will be capable of receiving fifty of the largest Rhine boats (of 1,000 tons), the commercial harbor on both sides of the river between the Main-Neckar Railway and the State Railway bridges will have an area of thirty acres. There will also be 5 kilom., or 3 miles, of quay above the Main-Neckar Railway bridge along the reach of the river dammed by the Frankfort weir. Sidings will run from the goods stations all along the quays, so as to facilitate the direct transfer of goods from water to rail, and *vice versa*. It is intended to erect hydraulic cranes and lifts supplied from a central hydraulic station, utilizing the fall of 2·7 meters=8 feet 10 inches at the needle weir to drive turbines giving out from 280 to 500 horse power.

OBSERVATIONS CONCERNING CANALS.

M. De Saint-Hubert, of Namur, advocated the making of canal locks as uniform as possible, so that the governments of adjacent countries might agree upon a system of through working, as was the case on railways. He also expressed the opinion that the service should not be interrupted during the night, and to this end he would utilize the fall of water over the weirs to generate electric current for lighting the locks and shores. He gave an outline of his scheme for connecting all the large rivers of Central Europe, the Elbe, the Rhine, the Danube, the Oder, and the Weser, thus forming one vast system of waterways, connecting the North, Black, and Baltic seas, and making Berlin and Vienna seaports. There would be a length of 1,000 kilom., or 621 miles, of canal to cut, at an estimated cost of £11,000,000, requiring a capital of £14,025,000; but he estimates the traffic at 2,400,000 tons per kilometer (0·62 mile). Taking only half of this to begin with, and putting the dues at half a kreutzer per kilometer, there would be an immediate revenue of £600,000, yielding more than 5 per cent on the capital.

The quays of the Ghent docks, which were visited, have two lines of way in front and four behind the warehouses, which are to have cellars and an upper story. The hydraulic principle has been chosen for the traveling cranes, which will run on the first line of way. These additional works are estimated to cost 12,000,000f., or £480,000, which has already been raised by loan. There is a scheme for making Bruges a seaport, by cutting a ship canal to the nearest point on the coast, a distance of 7½ miles, and making a deep-sea harbor inclosed by piers at Heyst, and docks at Bruges. An English company offered to carry out the work for a 99 years' concession, if the Belgian Government would guarantee 3 per cent on the outlay.

During the deliberations on the technical portion of the programme of questions, M. Casse gave it as his opinion that in cutting a canal, the *debris* should be put on the banks in as direct a manner and with as little intermediate mechanism as possible; and he described an excavator that he had devised for effecting this object. It consists of a hollow jib, movable along the bottom by chains and pulleys, carrying at one end a revolving cutter, giving blows like those of a pickax, and at the other an exhausting fan. The *debris* is drawn through the hollow jib and delivered by tubes on to the banks, with a great saving in cost.

M. A. Huet, of Delft, gave particulars of his water locomotive, by means of which he feels warranted, by trials on a small scale, in expecting as great speed on the water as is now attained on railways. The vessel's keel is fitted with plain drums of sheet zinc, steel, or iron, caused to revolve at a great speed by a pitch chain and belt from the pulley of a motor. The speed is to be increased by immersing a greater number of drums, or more of their surface, or by increasing the speed of the motor. In support of his project, M. Huet cited the experiments made by M. Bazin at Paris in 1874, when disks made to revolve at a great velocity presented the remarkable phenomenon of a richochet motion directly they touched the surface of the water.

Sig. J. Rigoni contributed a paper dealing with the various methods of traction on canals, in which he referred to the system of towing vessels by an endless cable, constantly running, supported on pulleys in the tops of posts, placed on the banks in a somewhat inclined position toward the stream. The advantages of this system are high speed, regularity of traffic, optional starting and stopping, prevention of injuring the banks, and great economy in a canal where the traffic is great. The cost of installation is put at between 6,000f to 7,000f. per kilometer, and the working expenses at about 1,000f. per kilometer per annum. —*The Engineer*.

Progress of Locomotive Building.

The Baldwin Locomotive Works recently completed and shipped engine numbered 8,000. The first locomotive built at these works was turned out in December, 1832, and it took 20 years—until November, 1852—to build 500 engines. The second 500 engines were built in 8 years, number 1,000 being finished in February, 1860. The next 6 years saw the third 500 built, number 1,500 leaving the shop in July, 1866. The fourth 500 were built in 3 years, by October 30, 1869; the fifth 500 in 2 years; and the sixth and seventh 500 each in 1 year, engine number 3,500 leaving November 20, 1873. Business then slackened, 3 years being required to build the next 500, and two years the following 500, engine number 4,500 leaving December 17, 1878. Then trade improved, 500 engines being built in 15 months, and 1,000 more engines in 22 months, while 500 more engines were finished in 10 months, number 6,500 leaving December 6, 1882, and marking a half century for the works. The next 8 months saw 500 more built, and before the close of 1884, number 7,500 was turned out. Work again slackened, and 19 months were required for the final 500 locomotives, number 8,000 having just left the establishment. It is noteworthy that one-half the whole number, and these by far the heaviest and most elaborate engines that have been built, were turned out within the last 10 years, the first 4,000 requiring 44 years to build.—*Philadelphia Ledger*.

A Bullet Post.

The Museum of the Berlin General Post Office received a few days since an interesting addition to its treasures. This is a parchment letter found in the city archives of Cologne, and which had been inclosed in a hollow bullet and fired out from the beleaguered town of Neuss in 1475, to let the friendly forces of Cologne know of the terrible plight to which the citizens were reduced. Charles the Bold of Burgundy was carrying on war against the town of Cologne and other Rhenish confederated cities, and had hemmed in Neuss so closely that the inhabitants were brought to the last extremity.

An army of observation of the confederates, posted beyond the Rhine, watched Charles' operations, hoping to get an opportunity of relieving the town. The letter is from the commander, the Landgrave Hermann of Hesse, who describes how the besieged are destitute of food and ammunition, and have only stones for weapons and water to live upon. They have no medicines or surgical appliances, and so the sick and wounded die without assistance. Some are for a surrender, and he fears that traitors may betray the place. They had a few days before lost 100 men in repulsing an assault of the Burgundians. The letter mentions that the besieged had previously fired off several other letters, some of which had fallen into the Rhine; and they were expending their last powder in firing off this one.

IN the description of the drawer check and support in our issue of August 21, the name of the inventor was spelled S. J. Frazer; it should have been S. J. Fraser.