Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

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NEW YORK, SATURDAY, AUGUST 23, 1884.

REMOVAL.

The SCIENTIFIC AMERICAN Office is now located at 361 Broadway, cor. Franklin St.

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THE EARTHQUAKE OF AUGUST 10.

Very few people living in the United States, except residents of the Pacific Coast, had ever felt a decided earthquake shock previous to the afternoon of Sunday, Aug. 10, when one was experienced on the Atlantic seaboard from Maine to Virginia, extending as far inward as West Virginia, and over the greater portion of Pennsylvania and New York. The shock was most severely felt on the south shore of Long Island, near New York city, and in the southern part of the city itself, and the adjacent coast of New Jersey, between 2:5 and 2:7 P.M. The length of its duration is variously given at from five to twenty seconds, the latter interval probably including the beginning and ending of the tremor, not so plainly perceptible as the very violent shaking so plainly perceived by every one for from five to seven seconds. There was no damage done of any consequence anywhere—only some glass and crockery broken, ceilings cracked, and loose chimney bricks dislocated—but the most massive buildings in New York were shaken to their foundations, and those who happened to be in third or fourth stories, or higher, felt that only slight additional force would have been needed to bring down many structures and cause great loss of life. As it was, in several parts of New York city, and at the points near by where the shock was most felt, people rushed from the houses in fright, which it took some time to allay.

The state of the weather just preceding the shock—in the particulars of which are found so many portentous omens and neglected warnings in the great earthquakes of history—excited no comment here. It was simply a continuation of the rather unseasonably cold and damp air we have had for several weeks, while Western Europe seems to have been getting our ordinary proportion of high temperature. There was a fresh northeast wind blowing, and the sky was cloudy, the thermometer registered 68° F., and the barometer 30·082 inches. The motion of the shock was lateral, not vertical, as has been more or less the case with the most destructive earthquakes, and its general direction was northeast and southwest. There was no observed tidal effect, vessels on the water not feeling it at all, except some tied up at docks broke their hawsers. A heavy rumbling sound, as of subterranean thunder, was almost everywhere heard, with greater or less distinctness, but in the city this was generally attributed to the rolling of heavy trucks on the pavement, or some similar cause, until after investigation showed the true cause.

The particular place where the earthquake originated affords room for no little speculation. We really know nothing about it, but in accepting any set of facts we are partially, also, adopting a certain theory as to the cause. The most prevalent opinion is that the starting point was not far from due east of New York city, and probably under the bed of the Atlantic. There are no facts to disprove, and many to support, the assumption that the interior of the earth is in a very highly heated state. If it is not in a fluid condition so largely as to interfere with its rigidity, which is counted equal to that of a ball of steel, this is said to be because of the great weight with which the exterior presses toward the center. Nevertheless it is steadily cooling, geologists claiming that it has required twenty-five millions of years to acquire its present externally solid form, and that during this period the mountains were formed and the hollows of the seas made, by a sort of wrinkling of the surface as the globe of liquid fire and heated gases contracted to its present shape. According to this idea the solid crust of the earth extends down from ten to forty miles, there being beneath that a greater or less thickness of plastic material, from melted rocks, etc., under high pressure, while the crust of the earth is all the time in a high state of tension, from the gradual cooling of the interior causing cavities, and allowing the superincumbent earth to crowd down closer to its heated core. The access of water, also, by percolation from the earth's surface to these subterranean ovens, it is thought, may in some cases cause explosions, dislocating vast quantities of material, and perhaps, by opening communication with the still hotter portion yet lower down, be the cause of some of the most destructive volcanoes. These explanations are largely hypothetical, but they accord with all we know of the earth's surface, and they afford the best theory we yet have to account for earthquakes and volcanoes, as well as to explain the present structural condition of the earth's surface. This crust of the earth we have hardly made a pin scratch upon; but we know that the further we go down the warmer it is, the artesian wells which supply the city of Paris from a depth of nearly 1,800 feet yielding water of 82° Fah., and the lower levels of the Comstock Mines having an almost uniform temperature of 130° Fah. It is estimated that the heat increases at the rate of one degree for every fifty feet, and this would give a temperature to melt the hardest rocks in less than ten miles.

On this theory the present volcanic and earthquake regions of the globe are located along the axis of these supposed wrinkles or corrugations from the contraction of the crust thought to be at present in the state of greatest tension. The most marked of these are down the east coast of Asia, including the Japan and Philippine Islands, and extending to Java, where the great earthquake of last year occurred. Another also extends down the Pacific coast of North and South America, the manifestations of which have been very light in the northern part since the commencement of historic times, but of whose presence in South America we have had many striking proofs. One also extends on an irregular parallel between the Himalayas and Indian Ocean; another near the coast line of South America on the Caribbean Sea; and another, which gives every evidence of having not many ages since been a region of most terrific activity, extends northward along the western coast of Africa, the Azores, Madeira, Canary, and Cape Verde Islands, largely consisting of extinct volcanoes, and suggesting that they may be the surviving surface of the fabled island or continent of Atlantis, once said to connect Africa with America. A smaller volcanic and earthquake region is found near the southern part of the Italian peninsula. All of these localities have been the scene of violent eruptions within comparatively recent times.

The great Java earthquake of August, 1883, was perhaps the most severe, when the Island of Krakatoa was almost bodily carried away, a part of it seemingly having been used to form two small new islands at some miles distant, and an indefinite portion sent into the atmosphere in such an atomized condition as to afford the best explanation we have had of the anomalous sunsets of the last year.

Italian earthquakes have been numerous enough to make a catalogue, one of the earliest recorded having been that which partially destroyed Herculaneum and Pompeii sixteen years before they were finally covered with lava from an eruption of Vesuvius. From 1773 to 1776 there were no less than 947 shocks, 500 of which were of the first degree of force. One in Calabria in 1783 was estimated to have caused the death of 100,000 persons, and was felt in a great part of Europe. The latest considerable one, at Ischia, was confined in narrow limits, causing only about 150 deaths. In 1857 a severe earthquake visited the kingdom of Naples, doing little damage in the city, but much in the provinces, and this earthquake was made specially memorable by the investigations relating to it made by Professor Mallet, of the British Association.

By using the fissures in buildings, the disturbance of heavy objects, etc., as natural measurers, he fixed, from 177 determinations, the focus of the disturbance as being beneath the village of Caggiora, finding the mean depth of the cavity at 5¾ miles. He also deduced the general form of the focal cavity as a curved fissure, 3 miles high, 9 miles long, and of very small thickness, the velocity of transit of shock being between 658 and 989 feet per second.

The great earthquake at Lisbon in 1755 was probably the most severe one felt in Europe outside of the Italian peninsula. The shock was felt in the Alps and on the coast of Sweden; 60,000 persons perished, and a part of the city permanently engulfed 600 feet beneath the bay. Among many others felt in Europe in 1878 was one which seems to have in many respects resembled the recent one here. It occurred on August 26, and was not remarkable for its violence, but for the great extent of territory affected. It is estimated to have covered over 2,000 geographical square miles, ringing bells and swaying houses and making cracks in the walls, and was accompanied by a dull subterranean noise; the workmen on the towers of the Cologne Cathedral saw the scaffolding oscillate and feared for their lives, yet not one of 1,100 miners working 1,000 feet below in the mines noticed the disturbance. This was not so severe even as the shock felt in England last Spring, when some chimneys were thrown down, and many walls so twisted as to be rendered unsafe.

In South America there have been numerous earthquakes within the last fifty years. Caraccas, in Venezuela, was entirely destroyed by three shocks, within fifty seconds, in 1812. The city of Quito, in Ecuador, was almost destroyed in 1859, and in 1868 a large part of Ecuador was devastated by a great earthquake, several shocks from the 13th to the 16th of August occurring over nearly all South America. This was the date also of the earthquake at Iquique, Peru, when the U. S. war ship Wateree was lifted and left stranded two miles inland by a great tidal wave. The latter earthquake caused a wave more than 2 feet high at San Francisco, and California itself has had many quite severe earthquake shocks. One that occurred there March 26, 1872, occasioned general alarm, and did a good deal of damage in San Francisco, cracking the walls of many fine buildings.

The nearest region of earthquake activity to our Eastern shores, however, is found in the West Indies. Here, on March 19, 1873, the city of San Salvador, about 300 miles due east of the southern part of Florida, was totally destroyed; three successive severe shocks were experienced, but the inhabitants had been so well warned by the previous noises that only some 500 lives were lost. The Atlantic States of the Union are thus, it will be seen, not very far removed from a region of recent volcanic activity, and belong to a section whose probable axis of seismic disturbance lies about as indicated by the recent earthquake, *i. e.*, between the West Indies and Bermuda on the one side and the Appalachian range on the other, somewhat according to the course of the Gulf Stream. The number of minor disturbances in this region has been considerable, but far the largest proportion of them have been so slight as almost to escape notice. The earthquakes already catalogued number about 9,000, and it is estimated that one occurs on an average twice a week somewhere in the world, but our section of the world has contributed very little to this list, nor does the earthquake of August 10 afford any idea that we are more likely to have such disturbances in the future, except as it suggests the ever present possibility, for us as well as all other people on the globe.

Proctor says: "The lifetime of a world like ours may be truly said to be a lifetime of cooling. Beginning in the glowing vaporous condition which we see in the sun and stars, an orb in space passes gradually to the condition of a cool, non-luminous mass, and thence steadily onward toward inertness and death. Regarding our planet's state as that of mid-life, we may call that stage death in which these conditions have entirely disappeared. Among these conditions is the action of the subterranean forces by which the earth's surface is continually modeled and remodeled. Only by the action of her vulcanian energies can the earth maintain her position as an abode of life. She is then manifesting her fitness to support life in those very throes by which, too often, many lives are lost. The upheavals and downsinkings, the rushing of ocean in great waves over islands and seaports, by which tens of thousands of human beings lose their lives, are part of the evidence which the earth gives that within her frame there still remains enough of vitality for the support of life during hundreds of thousands of years to come."

SMELTING AND CASTING OF IRON.

The metallurgical processes employed in the extraction of iron produce a metal which contains carbon, silicon, manganese, and other substances. Pure iron, having a very high fusing point, is not well applicable to foundry purposes; the material we have to examine is iron combined with carbon. The presence of carbon, it being combined and disseminated as graphite through the iron, causes a lowering of the fusing point. When pig iron is molten in a cupola furnace, the air comes in contact with particles of the liquid metal and the carbon thereof; the metal is partly decarbonized. The impurities, silicon, manganese, and small quantity of iron are converted into oxides, producing the slag.

Other products of oxidation, carbonic oxide and iron oxide, are dissolved in the molten iron. The air blown into the furnace generally contains aqueous vapor, and by its action upon burning coke hydrogen is generated. Molten iron, possessing the property of dissolving three times its volume of hydrogen, as has been shown by latest investigations, is thus charged with carbonic oxide, hydrogen, and iron oxide. On cooling of the metal the gases are emitted; they are the cause of the spongy, pumicestone-like surface structure observed on solidified metallic masses.

Iron being molten at a low temperature, and then tapped off and poured into moulds, liberates the dissolved gases within the mould. The structure of such a casting exhibits the presence of cavities and a high degree of porosity. Such cavities have pease-like shape near the surface, and assume that of a sphere toward the center of the metal; they are sometimes connected with each other by small channels. When heated more rapidly and far above its fusing point, iron becomes more applicable to foundry purposes. The molten metal remaining for some time in the ladle and being agitated by the aid of a bar before it is poured into the moulds, permits a free eliberation of dissolved gases.

The property of iron of absorbing gases and iron oxide is increased by remelting of iron; for homogeneous castings iron must be used which has not previously served the same purpose. The spongy structure of a casting is also caused by the moulding material. When the orifices of a mould become gradually filled with molten metal, the escape of gases depends on the physical nature of the moulding material. The latter containing moisture and organic substances generates aqueous vapor and other gases, which cause the formation of surface cavities. These cavities are covered with a film of oxidized metal, while those produced by dissolved gases have a bright metallic surface.

The difficulties involved in the casting of homogeneous articles are partly overcome by the use of a suitable porous sand. Another class of cavities is that called druse. The cavities of a druse are studded with iron crystals of a dendritic form. The formation of these cavities is caused by an abnormal shrinkage during solidification. Another phenomenon generally called sucking must be assigned to the same cause; it is generally observed on parts of castings where a large quantity of metal has been collected. It is therefore advisable in the manufacture of castings to give them an equal wall thickness, which has the advantage that the tension is most equally distributed throughout the mass. On cooling of the liquid metal within the mould, the particles which are in contact with the mould are sooner solidified than those more distant, and promote a motion of the liquid material from places of greatest to such of less accumulation, thus forming druses.—*Metallarbeiter.*

COOLING BY EVAPORATION.

The principle of cooling by evaporation is one on which some ice making machines are constructed; ether or aqua ammonia applied to the skin when heated produces a cooling effect by its rapid evaporation; a playing spray fountain in a room will sensibly cool the air from the same cause. Under favorable circumstances this principle may be economically applied to the cooling of overheated rooms. Many years ago the proprietor of a summer boarding house in eastern Massachusetts cooled his upper rooms in summer by spraying water through an air duct, the plan being almost identical with that described in an exchange as being employed in the composing room of the New Orleans *Picayune.* In this case a vertical wooden box was constructed in the corner of the room, with openings at the floor and ceiling, and furnished with a pipe for supplying water at the top, and a pan and drain at the bottom for receiving the flow and carrying it safely away. The supply pipe was bent over the upper end of the shaft, and fitted with a nose like that of a watering pot, so as to deliver a shower of spray instead of a solid stream. On connecting it with the service pipe the movement of the water was found to cause an active circulation of the air in that part of the room, which was drawn in at the upper opening of the shaft and issued again cool and fresh from the one at the floor level.

The relative temperatures of the water, the air at the top of the room, and the cooler air that had passed the water bath were: Water, 84°; air in the room, 96°; cooled air, 74°; showing that the air was cooled ten degrees below the temperature of the water which cooled it. This refrigeration was due to the rapid evaporation of the water by the heated air, the water being in the form of a fine spray.

THE EFFECT OF HARDENING ON STEEL.

A correspondent, in referring to an article on the "Contraction of Steel," in the SCIENTIFIC AMERICAN of July 12, says that steel workers differ as to the effect of fire and water on cast steel; some insisting that hardening expands the steel and others being certain that the process contracts it. Both of these conditions after hardening were alluded to in that article, and on these varying facts was based a suggestion that workers in steel keep a record of the behavior of the metal of the same bar, the same lot, and also of different makers.

The correspondent suggests that the managers of this paper institute and carry on to completion a comprehensive series of experiments to determine what changes, if any, are made in cast steel by the process of hardening. It is obvious that the proposition is not a feasible one; the duty of recording mechanical experiments is entirely distinct from the opportunity of making them or of conducting the processes of the trials.

But such trials and tests are being made by those who have not only all the ready means to make them, but are financially concerned in their results. The facts upon which the article in the July 12 issue was based were taken from very comprehensive tests made by a large manufacturer of steel tools, some of them necessarily of the most exact character. The variations in the behavior of steel from the same makers were almost incomprehensible, if the belief in the uniformity of the product was allowed; and the exact tests and records of the action of hardening on the steels of five of the foremost makers of steel in the world demonstrated the fact that at present there is no certainty in the homogeneousness of steel, so that it retains its certain and absolute character in the after workings. Of this general fact there can be no question; and producers of cast steel and workers of cast steel are acting quite in harmony, to the end that a uniform product may be obtained. The difficulties in the way of this desirable success are obvious enough; it is almost impossible, at present, to know the actual qualities of the iron and of the other added ingredients that go to make up the steel.

Not only do the ores from the same mine differ, but their after handling differs in quality of fuel and degrees of heat. And even the chemical products employed are not always the same in quality. When to these invitations to variation is added the carelessness of the forger and temperer, it is easy to see that only a long continued series of tests, carefully recorded, can ascertain the causes of difference and suggest the remedies. But there is going on a gradual improvement; and one of its evidences is the mechanical intelligence that demands special steel for special purposes. That this demand is met, at least in part, is evidence that an improvement in the methods of producing determinate qualities and similar, if not exact, results is possible.

Chemical Nature of Starch Grains.

Dr. Brukner has contributed to the "Proceedings of the Vienna Academy of Sciences" a paper on the "Chemical Nature of the Different Varieties of Starch," especially in reference to the question whether the granulose of Nägeli, the soluble starch of Jessen, the amylodextrin of W. Nageli, and the amidulin of Nasse, are the same or different substances.

A single experiment will serve to show that under certain conditions a soluble substance may be obtained from starch grains. If dried starch grains are rubbed between two glass plates, the grains will be seen under the microscope to be fissured, and if then wetted and filtered, the filtrate will be a perfectly clear liquid, showing a strong starch reaction with iodine. Since no solution is obtained from uninjured grains, even after soaking for weeks in water, Brukner concludes that the outer layers of the starch grains form a membrane protecting the interior soluble layers from the action of the water. He was unable to detect any chemical differences between the amidulin of Nasse, the portion of the starch grain soluble in water, and the granulose of C. Nägeli, which he extracted by means of saliva. The soluble filtrate from starch paste also contains a substance identical with granulose. Between the two kinds of starch—the granular and that contained in paste—there is no chemical but only a physical difference, depending on the condition of aggregation of their micellæ.

W. Nägeli maintains that granulose, or soluble starch, differs from amylodextrin in the former being precipitated by tannic acid and acetate of lead, while the latter is not. Brukner fails to confirm this difference, obtaining a voluminous precipitate with tannic acid and acetate of lead in the case of both substances. Another difference maintained by Nägeli, that freshly precipitated starch is insoluble, amylodextrine soluble, in water, is also contested; the author finding that granulose is soluble to a considerable extent in water, not only immediately after precipitation, but when it has remained for twenty-four hours under absolute alcohol. Other differences pointed out by W. Nägeli, Bruckner also maintains to be non-existent, and he regards amydulin and amylodextrin as identical.

Brucke gave the name erythrogranulose to a substance nearly related to granulose, but with a stronger affinity for iodine, and receiving from it not a blue but a red color. Brukner regards the red color as resulting from a mixture of erythrodextrin, and the greater solubility of this substance in water. If a mixture of filtered potato starch paste and erythrodextrin is dried on a watch glass, covered with a thin pellicle of collodion, and a drop of iodine solution placed on the latter, it penetrates very slowly through the pellicle, the dextrine becoming first tinctured with red, and the granulose afterward with blue. If, on the other hand, no erythrodextrin is used, the diffusion of the iodine causes at once simply a blue coloring.

With regard to the iodine reaction of starch, Brukner contests Sachsse's view as to the loss of color of iodide of starch at a high temperature. He shows that the iodide may resist heat, and that the loss of color depends on the greater attraction of water for iodine as compared with starch, and the greater solubility of iodine in water at high temperatures.

The different kinds of starch do not take the same tint with the same quantity of (solid) iodine. That from the potato and *Arum* gives a blue, that from wheat and rice a violet tint; while the filtrate from starch paste, from whatever source, always gives a blue color.

Salicylic Acid in Beer.

Some interesting experiments by Heinzelmann have been published, which offer additional proofs of the value of salicylic acid as a preservative agent, for they show that this antiseptic, when used judiciously, really strengthens and encourages the growth of yeast. The author's experiments show that, although the vitality of yeast is completely destroyed by the presence of 0·03 per cent of salicylic acid, the addition of only 0·01 per cent actually favors its greatest activity, and further, that the yeast cells developed in the presence of this proportion of salicylic acid are stronger and larger than those produced in a solution free from this acid; moreover, the production of alcohol in a given time is said to be greater. The addition of 1 part of salicylic acid to 10,000 parts of the mash is said to favor fermentation, especially when sugar is used.

In two series, each of three experiments, Ladureau employed (1) beer alone and beer mixed respectively with (2) 100 and (3) 200 grains per barrel. The three beers were exposed to the air for two weeks, and subsequently closed up for a month, after which period they were examined. The beer 1 without salicylic acid was sour, beer 2 was only slightly sour, and beer 3 not at all. To complete the investigation, the salicylated beer was employed for dietetic purposes for several weeks without any deleterious effect on the health of the experimenter. It is therefore clear that the addition at most of 250 grains (about one-half ounce) per barrel preserves the beer without affecting its use as a beverage. The author defends the use of salicylic acid, and maintains that a prejudicial amount would never be added, owing to the facility with which salicylic acid may be accurately estimated.

The Antiquity of Mercury.

A recent writer in the *North China Herald* discusses the part played by mercury in the alchemy and *materia medica* of the Chinese. Cinnabar was known to them in the seventh century before the Christian era, and its occurrence on the surface of the earth was said to indicate gold beneath. Their views on the transformation of metals into ores and ores into metals by heat and other means took the form of a chemical doctrine about a century before Christ, and there is now no reasonable doubt that the Arabian Geber and others (as stated by Dr. Gladstone in his inaugural address to the Chemical Society) derived their ideas on the transmutation of metals into gold and the belief in immunity from death by the use of the philosopher's stone from China. Among all the metals with which the alchemist worked, mercury was pre-eminent, and this is stated to be really the philosopher's stone, of which Geber, Kalid, and others spoke in the times of the early Caliphs. In China it was employed excessively as a medicine. On nights when dew was falling, a sufficient amount was collected to mix with the powder of cinnabar, and this was taken habitually till it led to serious disturbance of the bodily functions. In the ninth century an emperor, and in the tenth a prime minister, died from overdoses of mercury. Chinese medical books say it takes two hundred years to produce cinnabar; in three hundred years it becomes lead; in two hundred years more it becomes silver, and then by obtaining a transforming substance called "vapor of harmony" it becomes gold. This doctrine of the transformation of mercury into other metals is 2,000 years old in China. The Chinese hold that it not only prolongs life, but expels bad vapors, poison, and the gloom of an uneasy mind.

MINERAL wool is used for a packing to deaden the sound between floors in buildings, and being incombustible it is now pretty generally used between the floors and ceilings in new houses. Mineral wool is obtained from the slag from blast furnaces, and is produced by throwing a jet of steam against the stream of slag as it flows from the furnace.