

is partially a non-conductor, and an explosion is the consequence.

The cardinal mistake with our friend, Mr. Boyden, seems to be in his regarding electricity as though it were an ordinary material substance, which might be brought down to the earth on rain-drops until it was entirely exhausted in the clouds. As well might he talk of exhausting all the heat of the clouds in the same manner. As far as we know, electricity, like heat, pervades all nature wherever there is a material substance to which it may attach itself. Whether it exists in void space, we have no means of determining.

Like heat, also, its tendency is to diffuse itself, and to become everywhere equalized. It rises from the earth with the vapor which subsequently forms the rain-cloud. If nothing takes place in that cloud to give it any new development or to disturb its equilibrium, it falls to the earth silently with the drops of the shower, still preserving its proportion to the mass of matter to which it is attached.

But, in some unascertained way, its quantity is increased in the storm-cloud and the general equilibrium is destroyed, and, when sufficiently accumulated, it bursts its way through the intervening atmosphere towards the earth or some other cloud whose electricity is negative in relation to its own, and a disruptive discharge is the result.

And now comes in the office of the lightning-conductor. To say that such a conductor exerted no influence at all upon the descending discharge, would be saying, in effect, that such a conductor was of no use at all; for if the rod only conveys to the earth the bolt which would otherwise have struck on the very point where the rod is located, it would be necessary to cover building with metal in order to ward off the lightning, just as completely as it needs to be covered in order to keep out the rain or the snow.

This may be said, however, in regard to lightning-rods. They do not cause a disruptive discharge when one would not have been made if the rod had not been erected; but if such a discharge would otherwise have fallen within a circle, the diameter of which is four times the height of the rod, it is attracted to the conductor and passes harmlessly into the earth. Its attraction may even extend beyond that limit; but experience has shown that its efficacy cannot be relied upon at a greater distance, and, consequently, its protective power is limited by that rule. Suppose, then, a vertical cone, with its apex at the point of the conductor, and having for its base a circle whose diameter is four times the height of the cone; the conductor will attract to itself any discharge which would otherwise have struck upon any point beneath the surface of that cone, and will consequently protect every such point; but nothing more, with any reliable certainty.

It is evidently a mistaken notion that there is any special attraction in the metal itself. A cast-iron pavement would attract the lightning no farther than though it were of brick. A pile of cannon balls would be as harmless as a cart load of pumpkins, as to its tendency to invite a visit from the electric messenger.

Nor does a lightning-rod possess much efficacy unless its electricity communicates freely with that of the earth. When a highly-charged thunder-cloud is impending over any particular point, the positive electricity beneath it is expelled to a distance. If a lightning-rod were standing there, so arranged as to be electrically disconnected from the earth, its own electricity would be decomposed; its lower extremity would be positive and its upper negative. But the intensity of that negative electricity would be slight, in comparison with what it would have been had the electricity of the rod been enabled to pass freely into the earth, and its attraction to the descending discharge would be weaker in the same proportion. And even after the lightning shall have struck such a rod, if there is any better conductor from any point of the rod to the great reservoir of negative electricity—the earth—than is formed by following the earth farther down, it will leave the rod at that point, and take the more attractive route.

This accounts for the fact that buildings are sometimes struck by lightning, though protected with conductors, just as roofs fail to furnish protection against rain if not properly shingled. But while the rod is so arranged that it shall furnish the readiest electrical access to the earth, the lightning will no more leave the

rod and pass through the building than the water will leave the gutters and flow upwards to and through the roof. The laws of electrical action are as unvarying and reliable as those of gravitation.

It follows, from what has been said, that the glass insulators generally used in supporting lightning-rods are wholly useless and unnecessary, provided the rods themselves are properly constructed and their connection with the electricity of the earth is complete. The lightning will never leave the rod to follow an iron staple into the building, unless in that way it finds a better conductor all the way to the earth's electricity than that furnished by the rod itself.

POLYTECHNIC COLLEGE COMMENCEMENT.

The annual "commencement" of the Polytechnic College was held on Thursday evening, June 28th, in the lecture room of the building on Penn Square, Philadelphia. The exercises consisted of the reading of an inaugural thesis by Mr. Charles G. Willcox, of the graduating class; an address by Dr. A. L. Kennedy, President of the Faculty, and the conferring of the degrees of the college, by Matthew Newkirk, Esq., President of the Board of Trustees, upon the following gentlemen:—

Bachelors of Mechanical Engineering—Charles G. Willcox, Philadelphia; Edward S. Colwell, of Philadelphia.

Bachelors of Civil Engineering—Frank J. Firth, Germantown; Charles M. Burchard, Philadelphia; H. Harlan Carter, Texas (Lancaster county).

The Master's degree was conferred upon the following graduates of three years' standing:—

Master of Mine Engineering—Charles W. Bodey, of Norristown, Pa.

Master of Mechanical Engineering—Robert Scott, Jr., of Philadelphia.

The following are the subject of the theses presented by the candidates for graduation:—

Mr. Willcox:—Iron-works; their location, arrangement and construction, illustrated by plans and drawings. Mr. Colwell:—Plans and description of a hot-blast furnace, with a pneumatic lift and the means of using the waste gases. Mr. Burchard:—Plans and description of a single arch iron truss bridge. Mr. Carter:—Glass: its history, composition and manufacture. Mr. Firth:—Description and plans of a three-arch cast-iron bridge.

The success of an institution which thus professionally educates young men for the practice of those great scientific and industrial pursuits upon which the prosperity of our country depends, and which are among the most honorable and lucrative of human employments, is a subject of general congratulation. We have carefully examined the thesis of Mr. Willcox, and shall soon present it to our readers, with the engraved plans on an extensive scale. It is a subject which will interest many of our readers.

RECENT AMERICAN INVENTIONS.

The following inventions are among the most useful improvements patented this week. For the claims to these inventions the reader is referred to the official list on another page:—

SILK STRETCHING AND STEAMING MACHINE.

The object of this invention is to obtain a simple, compact, and portable silk-stretching and steaming machine, the manipulation of which will be simple, while the power may be increased or diminished at pleasure. This invention consists in suitably combining with a stretching and steaming box, wherein the hanks of silk are placed to be stretched, a cylinder enclosing a piston which is to be operated by steam or hydrostatic power for giving a direct action upon the stretching bars over which the hanks of silk are placed, and thus perform the operation of stretching and steaming at the same time. The inventor of this improvement is Lucius Dimock, of Hebron, Conn.

ANATOMICAL LAST.

This invention is an improvement in constructing lasts for boots and shoes, so that shoes produced from these lasts will correspond to the bones and ligamentous structure and conformation of the sole, back, and heel of the natural foot; the invention provides for preventing distortions and deformities of the foot, or joints of the foot, callouses upon the toes, and for relieving and correcting such dislocations where they already exist. This improvement was designed by John C. Plumer, of Portland, Maine.

INDUSTRY—MANUFACTURES—COMMERCE.

The Great Eastern.—The number of visitors to this great vessel has increased steadily from the day the price of admission was reduced to 50 cents. About 10,000 have been admitted daily during the past week. It is her great mass that produces such an influence upon the mind; the funnels of small steamers which come alongside reach only to her bulwarks. The vast unoccupied space inside gives the vessel an empty appearance; and there is certainly an unfinished look about most of the apartments. There is no no grand, spacious upper saloon, like those on most of our steamships, to show-off her capacities and accommodations for passengers. It seems to be too much cut-up into separate apartments by the bulkheads being carried up so high above the water line. Giffard's feed apparatus is attached to the boilers of the paddle engines. It consists of a jet of steam carried through a narrow nozzle into an open, trumpet-mouthed tube, situated below the water line in the boiler. At the entrance of this tube, it meets with the column of feed-water, and the steam rushes into the boiler, carrying some feed-water with it. It answers very well when feeding with cold water, but not when the water is taken from the condenser in which a portion of air is set free, which retracts the necessary vacuum for this feeder. No pump whatever is required for this apparatus; it is a French invention, and is both simple and novel, and for locomotives it is beginning to be extensively applied in England. In comparing the size of the parts of the paddle-wheel engines of the *Great Eastern* with some of those on our American steamers—such as the *Adriatic*—we have been impressed with their apparent lightness. Thus: the shaft of the *Great Eastern* is only 24 inches in diameter; while that of the *Adriatic* is 26 inches. The piston rods, connecting rods and valve rods also appear to be very slender in proportion for such a large ship. Each paddle float on the wheel is 13 feet long and 3 feet broad; the circumference of the wheel is 150 feet. The dip of the wheels were four feet on the voyage out, but the floats were reefed-up some distance from the extremities of the arms. One thousand tons causes a displacement of only six inches; 10,000 tons will only sink her five feet deeper in the water. There are no less than 33 engines on board—such as donkey engines for feeding boilers, hoisting, &c.—thus making 25 for minor operations; the eight large engines being employed for propelling. Each oscillating cylinder, with its piston rod, weighs 26 tons; thus making 104 tons for the four cylinders. On Monday next—the 30th—the *Great Eastern* will proceed on the grandest marine excursion that has ever taken place on our waters. She will take several thousand passengers, at \$10 a head, and proceed to Cape May, where she will meet with a large delegation of Philadelphians; thence she will steam down to Cape Hatteras, and return to New York on Wednesday. A splendid band of musicians has been employed for the occasion, and a grand time is anticipated. It is now concluded, we understand, that she will leave to return to England on the 16th of next month; therefore, all those at a distance who desire to visit her should do so at the earliest date.

Steam Plow.—The State Agricultural Society of Illinois offers a premium of \$1,000 for the best steam engine that can be practically substituted for animal power in plowing and other farm work. This prize is simply for a farm locomotive which may be applied to do general work. It is expected that several of such engines will be entered for competition this year. Much dissatisfaction has been felt, heretofore, with the action of the committee of this society in not awarding the full prizes at the former exhibitions of Fawkes' plow. We hope no cause for such blame will be allowed to rest on the Committee on Premiums at the next fair.

The law has gone into force in this city forbidding any person to sell or give any poisonous substance without making a record of it in a book, taking the name and residence of the person to whom it was given, and the name and residence of a witness to the sale. This good act is applicable to all cities in New York State. The penalty for disobeying it is \$50 in each case.

Darius Davidson has published a long article in the *New York World*, condemning the model and build of the *Great Eastern*. His views on the subject belong rather to the speculative than the positive in science.