ner, except in certain cases where upon elevated continents there appears to be a veritable defect of attraction instead of the excess which might be expected. Indeed, the observations are sufficiently striking to seem to point to the supposition that not only under every great mountain, but even under the whole of every large continent, there were enormous cavities. More than this, the attraction at the surface of all the great oceans appear too great to agree with the distribution presumed by Clairant's formula, which is exact enough for most purposes. Sir G. Airy's suggestion that the base of the Himalaya range reaches down into the denser liquid interior, and there displaces a certain amount of that liquid, so that the exterior attraction is thereby lessened, is one which, inherently improbable, fails to have any application in explaining why the attraction above the seas should be greater than over the continents. M. Faye propounds the following solution to the difficulty: *Under the oceans the globe cools more rapidly and to a greater depth than beneath the surface of the continents.* At a depth of 4,000 meters (13,000 feet) the ocean will still have a temperature not remote from 0° C., while at a similar depth beneath the earth's crust the temperature would be not far from 150° C. (allowing 108 feet in depth down for an increase of 1° in the internal temperature). If the earth had but one uniform rate of cooling all over it, it would be reasonable to assume that the solidified crust would have the same thickness and the same average density all over it. It is therefore argued that below the primitive oceans the earth's crust assumed a definite solid thickness before the continents, and that in contracting, these thicker portions exercised a pressure upon the fluid nucleus tending to elevate still further the continents. This hypothesis, M. Faye thinks, will, moreover, explain the unequal distribution of land and sea around the two poles, the general rise and fall of continents being determined by the excess of density of the crust below the oceans, and by the lines or points of least resistance to internal pressure being at the middle of continents or at the margin of oceans.

How the Pyramids were Built.

Brugsch Bey, the eminent Egyptologist, says, in his work on Egypt:

From the far distance you see the giant forms of the pyramids, as if they were regularly crystallized mountains, which the ever-creating nature has called forth from the rock, to lift themselves up toward the vault of heaven. And yet, they are but tombs, built by the hands of men, which have been the admiration and astonishment alike of the ancient and modern world. Perfectly adjusted to the cardinal points of the horizon, they differ in breadth and height, as is shown by the measurements of the three oldest, as follows: 1. The Pyramid of Khufa—height, 450·75 feet; breadth, 746 feet. 2. Pyramid of Khafra—height, 447·5 feet; breadth, 690·75 feet. 3. Pyramid of Menkara—height, 203 feet; breadth, 352·78 feet.

The construction of these enormous masses has long been an insoluble mystery, but later generations have succeeded in solving the problem. According to their ancient usages and customs, the Egyptians, while they still sojourned in health and spirits, were ever mindful to turn their looks to the region where the departing Ra took leave of life, where the door of the grave opened, where the body, well concealed, at length found rest, to rise again to a new existence, after an appointed time of long, long years, while the soul, though bound to the body, was at liberty to leave the grave and return to it during the daytime, in any form it chose. In such a belief, it was the custom betimes to dig the grave in the form of a deep shaft in the rock, and above this eternal dwelling to raise a superstructure of sacrificial chambers sometimes only a hall, sometimes several apartments, and to adorn them richly with colored writings and painted sculptures, as was becoming to a house of pleasure and joy. The king began his work from his accession. As soon as he mounted the throne, the sovereign gave orders to a nobleman, the master of all the buildings of his land, to plan the work and cut the stone. The kernel of the future edifice was raised on the limestone soil of the desert, in the form of a small pyramid built in steps, of which the well constructed and finished interior formed the king's eternal dwelling, with his stone sarcophagus lying on the rocky floor. Let us suppose that this first building was finished while the Pharaoh still lived in the bright sunlight. A second covering was added, stone by stone, on the outside of the kernel; a third to this second, and to this even a fourth; and the mass of the giant building grew greater the longer the king enjoyed existence. And then, at last, when it became almost impossible to extend the area of the pyramid further, a casing of hard stone, polished like glass, and fitted accurately into the angles of the steps, covered the vast mass of the sepulcher, presenting a gigantic triangle on each of its four faces.

More than seventy such pyramids once rose on the margin of the desert, each telling of a king of whom it was at once the tomb and monument. Had not the greater number of these sepulchers of the Pharaohs been destroyed almost to the foundation, and had the names of the builders of these which still stand been accurately preserved, it would have been easy for the inquirer to prove and make clear by calculation what was originally, and of necessity, the proportion between the masses of the pyramids and the years of the reigns of their respective builders.

ALUM and plaster of Paris, well mixed in water and used in the liquid state, form a hard composition and also a useful cement.

Correspondence.

Protection from Lightning.

To the Editor of the Scientific American:

In your paper of August 28 is an article written by Professor Kirchoff, on connecting lightning rods with gas and water mains, in which, after citing a case of lightning destroying several lengths of cast iron water pipe in Basch, he proceeds to state that if the said pipes had been joined with *lead* instead of pitch, no mechanical effects could have been produced.

That the assumption of Professor K. is not justified by the facts is proved by the following cases:

A church in Terre Haute, Indiana, was struck by lightning, the rod knocked down, after which the electricity followed the gas pipes in the church to the mains in the street, and melted the *lead* joints for upwards of one thousand feet.

Another church in Iowa City, Iowa, received a heavy discharge, which damaged the rod, ran on the gas pipes, and thence to the main, and for a distance of several hundred feet every particle of the *lead* joints was burned out.

Other cases might be cited, but these are sufficient to prove that *lead joints* do not prevent mechanical effects when lightning passes over gas pipes.

Another correspondent, in the same issue of your paper, J. C. M., of Bradford, Pa., writing on the subject of protecting oil tanks from damage by lightning, says:

"We would only be too glad to learn of some method other than the old theory, by which we could protect our property from lightning, as that has been demonstrated beyond a doubt to be a failure. We want information on the subject."

J. C. M. is only one of many thousands seeking such information, and it certainly should be forthcoming from some of our scientists. Of what practical value to the human family has been the vast amount of knowledge accumulated on the subject of atmospheric electricity within the last forty or fifty years? Our scientists have studied its modes of action until all agree upon the laws which govern it; yet, so far as protection from lightning is concerned, this knowledge has not helped us forward one single step. The scientific world has demonstrated clearly, and have taught us by their writings for half a century, that what is known as *electric induction* is a universal mode of electric action.

Scientists have also clearly proved that Franklin knew nothing of this law of electric induction, hence that his theory regarding the action of atmospheric electricity was erroneous. Is it not strange, then, that our scientists should to this day countenance a system of lightning protection (so-called) suggested and recommended by Franklin, and which, by him, was based upon what has been so clearly proved to have been an erroneous theory? Is it reasonable or logical to expect protection from a system founded upon such a basis? Had the great Franklin understood electric induction, his wonderful intuition would have enabled him, without doubt, to suggest the proper method of constructing apparatus for protecting our property from lightning.

Electric induction is theoretically acknowledged and taught by all scientific authorities, yet when the subject of devising some practical system of protection from lightning is under consideration, these same authorities as completely ignore this law of electric induction as did Franklin, who, they prove, knew nothing about it.

Before we can hope for any efficient system of protecting our property from the dire effects of the lightning stroke, it must be clear to inquiring minds that we must no longer ignore this wonderful law of electric action known as electric induction, but must keep it ever before us and recognize it as an all-important and indispensable factor in our investigations. Any other course must result in the future, as it has in the past, in total failure. J. H. A.

Cleves, Ohio, September, 1880.

REMARKS.—Our correspondent's letter is chiefly valuable in reporting the two churches that were struck, the rods of which were connected with the underground gas pipes. It is undoubtedly true that lead is a poor conductor, and that when a heavy discharge of electricity passes along leaded pipe joints, mechanical effects will sometimes be produced. The object in connecting the rods with the gas pipes is to enlarge the connection of the rods with the earth, and thus to protect life and property in the building. If this is accomplished (and it seems to have been done in the cases cited by our correspondent) then the temporary mischief resulting to the lead joints is of no importance, as it may be readily repaired. The connection of the rod with water or gas pipes is recommended, although lead joints are known to be electrically bad, because such pipes usually form the best available means of connecting the rods with the ground.

Our correspondent assumes that Franklin was an ignoramus in respect to atmospheric electricity, and that his system of protection by lightning rods is good for nothing, not being based, as he supposes, on the "wonderful law of electric induction."

We think the probable difficulty is with our correspondent and not with Franklin, who was not, as our correspondent assumes, ignorant concerning atmospheric electricity. Franklin's original instructions relative to lightning rods have been proven by experience to be substantially correct; furthermore, they agree with the theory of "electric induction," and are as sound and good in practice to-day as they were when first published by the illustrious inventor in 1753. Franklin taught that in order to protect buildings the rod should be carried down into moist earth; and the proper inference from his instructions is that he considered it essential that the bottom of the rod should always be well grounded in the earth. All experience with rods since Franklin's time proves the correctness of this idea; and in almost every case where rods are used and damage is done, it is found that the earth connection of the rod was bad, and that Franklin's directions were not followed.

When our correspondent can produce an authentic example of a properly-rodded building, having its rods and metals thoroughly connected with the earth, that has been seriously damaged by lightning, then it will be time enough for him to assume that Franklin knew nothing about the subject, and that his lightning rods are of no account.—EDS. SCI. AM.]

COUNT LOUIS FRANCOIS DE POURTALES.

Science has recently met with a heavy loss in the death of Count Louis François de Pourtales, which occurred at Cambridge, Mass., July 18. His strong frame and temperate mode of life gave hope of a long period of usefulness, for he was only fifty-seven, and in the prime of his powers; but, stricken by an obscure internal disease, he succumbed after some weeks of suffering, and thus followed his teacher and companion, Louis Agassiz, after seven short years. Count Pourtales was a Swiss representative of an old family, which had branches also in France, Prussia, and Bohemia. He was educated as an engineer, and in early manhood emigrated to the United States at nearly the same time as his subsequent fellow worker, Agassiz, to whom he was warmly attached. He entered the government service in the department of the Coast Survey, and continued in it many years. Almost from the beginning of his duties therein he deeply interested himself in deep sea questions, and some of the earliest observations on the nature of the deep sea bottom and of Globigerina mud were made by him. By the death of his father, Pourtales succeeded to the title and received a fortune which enabled him to devote himself entirely to his favorite studies, and to do much in continuing the great work of Louis Agassiz. Receiving the appointment of Keeper of the Museum of Comparative Zoology, he devoted himself untiringly to carrying out the arrangement planned by his friend and master. Dividing the task with the curator, Alexander Agassiz, he pushed forward his part of the work with the easy power of a strong and highly trained intellect, and was the very model of an administrative officer. In 1871 he published (in Catal. Mus. Comp. Zoology, iv.) what is probably his best known work—"Deep Sea Corals"—a memoir containing valuable disquisitions on the affinities of various genera, notes on the distribution of species, and the nature of the bottom on which the dredgings were made. A second memoir on the same subject was contributed by him to the account of the zoological results of the Hassler expedition, and many others in this and other zoological subjects are to be found in the Bulletin of the Harvard Museum of Comparative Zoology. His last work is a description of the plates of corals in the Report on the Florida Reefs by the late Professor Agassiz, which has just been published by Alexander Agassiz, through the permission of the Superintendent of the Coast Survey. These plates are the most perfect and beautiful representations of corals that have as yet been published anywhere, and were drawn under the immediate direction of Professor Agassiz. Count Pourtales' name is indissolubly connected with deep sea zoology by means of the genus *Pourtalesia*, which was dedicated to him. The *Pourtalesia*—a sea urchin allied to *Ananchytes*—was found by the Challenger expedition to be one of the most ubiquitous and characteristic of deep sea animals, and numerous species new to science were obtained by the expedition.

Pourtales' range of learning was very extensive, and his command of it perfect. Nor was it confined to mathematics, physics, and zoology. He did not scorn to read novels and light poetry, and was knowing in family anecdotes and local history. It was a common saying in the museum that if Count Pourtales did not know a thing it was useless to ask any one else.

RECENT INVENTIONS.

An improvement in hoppers in which grain or middlings, etc., are placed to be fed to crushing rolls, purifiers, or other milling machinery, has been patented by Mr. John T. Cook, of Jordan, Minn. One side of the hopper is hinged and movable, and the invention consists in the combination, with the hinged part, of devices, which allow it to yield to the pressure of the grain or middlings and swing outward, but restrict its movement within certain limits, so that the grain shall not discharge too rapidly.

An improved thread case, which exhibits the thread to the greatest advantage, and permits of getting any desired kind of thread instantly and easily, has been patented by Mr. Eugene L. Fitch, of Breda, Iowa. The invention consists in a case with a glass front and top, and with a floor inclined from front to rear, and provided with a series of drawers, each containing a number of spools of thread which are held by spring catches at the end of the drawer, so that if a button on the drawer is pulled a corresponding spool will drop from the drawer and roll down the inclined floor toward the salesman.

A combined door plate and letter receiver, patented by Mr. Henry Free, of Lewiston, Me., is so constructed as