vapor spheres were well worthy of the fullest investigation.

ACTION OF LIGHTNING.

In the summer of 1827, a hay stack in the parish of Dun, in this county, was struck with lightning. The stack was on fire, but before much of the hay was consumed the fire was extinguished by the farm servants. Upon examining the hay-stack, a circular passage was observed in the middle of it, as if it had been cut out with a sharp instrument. This circular passage extended to the bottom of the stack, and terminated in a hole in the ground. Captain Thomson, of Montrose, who had a farm in the neighborhood, examined the stack, and found in the hay stack, and in the hole, a substance which he described as resembling lava A portion of this substance was sent by Captain Thompson to Dr. Brewster, of Craig, who forwarded it to Sir D. Brewster with the preceding statement. The substance found in the hole was a mass of silex obviously formed by the fusion of the silex in the hay. It had a highly greenish tinge, and contained burnt portions of the hay. Sir D. Brewster presented the specimen to the museum of St. Andrews.

A NEW ELECTRIC MACHINE FOUNDED ON INDUCTION AND CONVECTION.

By Sir William Thomson.—The princple of the machine (a model of which was exhibited) wasthat of the "Successful Merchant" who commenced life with a capital of ½d., and after a month's persevering industry, realized the handsome sum of £1 and continued to goon increasing his capital at a compound rate of interest. The object of theinstrument referred to was not to increase money but electricity, and that increase was at a compound rate. Precisely in conformity to the law which applied to compound interest and the increase of the successful merchant's capital was the increase of electricity by this machine. Given the smallest quantity of electricity, and the instrument increased it at the rate of compound interest, and this increase went on at a perfectly uniform rate. But just as the capitalist finds that he cannot always go on getting higher and higher interest for his money, but must ultimately, perhaps, be content with 4½ per .cent., instead of 5, so was it to some extent the case with this machine. When a very high charge was reached, the increase of the quantity of available electricity was not so great, owing to sparks passing in various parts of the machine, preventing the operator from retaining the full quantity of electricity which was got by it. There was great necessity for an easy-going electric machine, and that now shown fulfilled this condition.

NEW MAGNETIC AND ELECTRIC MACHINE.

By Wm. Ladd.—Two plates of iron, both ends of each plate fixed to a portion of a hollow cylinder; these plates are then placed a certain distance apart, and insulated from each other in such a manner that the cylindrical pieces will form the two hollow circular passages; into these spaces two armatures are placed. The plates are surrounded by a quantity of stout copper wire connected together, the two terminals of which are brought into connection with the commutator of the smaller armature, so that each change of polarity in the armature will augment the magnetism. If the armature in connection with the electro-magnet is made to rotate, there will be a very feeble current generated in it; but this passing round the electro-magnet will increase its power with every additional impulse. The only limit to the power of the machine is the rapidity with which the armature is made to rotate. The great improvement in this invention is the introduction of a second armature. The machine in the Paris Exhibition measures about 24 inches in length, 12 inches in width, and 7 inches high, and Mr. Ladd found that though not perfectly constructed, its power would keep 50 inches of platinum wire .01 in diameter incandescent, and when a small voltameter was placed in circuit with the second armature it would give off 250 cubic centimeters of gas per minute, and in connection with an electric regulator would give a light equal to about 35 Grove's or Bunsen's element, the driving power expended being less than one horse.

USE OF LICHENS AS DYE STUFFS.

Dr. Lindsay said it had been expected that the aniline dyes—a product from the distillation of coal tar—discovered a few years ago, would supersede the lichinous dye stuffs previously in use, in consequence of the breaking up of the Highlands by railways, and the improvement of the communication between Glasgow, Edinburgh, and the south. To him, however, it seemed that all such predictions were at least premature. He had come to conclusions favoring the belief that lichens would not be superseded, at least, for a long time to come. He then proceeded to give numerous details of the use of lichen dyes for commercial and domestic purposes.

Mr. R. Pullar said: It is very important to investigate the question of the value of lichen products, as many more districts might be found where the lichens are produced, and a certain market for them. Orchill or cudbear will not, I think, be replaced by coal tar or aniline colors for many purposes, and especially for rich crimson or claret shades on woollen goods. I think there is every likelihood of this material being used to a greater, instead of less extent, and the introuction of the coal tar colors has rather increased than dimdnished its use. I do not think the lichen products will ever compete with the coal tar colors for light shades. It is a well-known fact, which can be corroborated by the ladies present, that purples, violets, and other shades produced in former days by the orchill or cudbear, gave way very much sooner than those produced from coal tar. A violet dress or ribbon was formerly stained red so easily by exposure to the atmosphere or the slightest acid, that very few persons thought of having such colors; while, since the introduction of the coal tar shades, however, which, some say, are not so fast as the old colors, there is now an enormous sale, because they can be worn with impunity, and the colors, in most cases, stand well for a long time. This is an extraordinary fact, but can be corroborated by every person of experience.

INFLUENCE OF AIR ON VITAL ACTION.

In this paper Dr. Davy described a certain number of experiments, the result of which showed how much longer some animals are capable of resisting privation of air than others. In one instance an egg, an inchoate animal, so to speak, was hatched, producing a healthy chicken, after having been acted upon by an air pump twenty-six days; a young bird expired in about half a minute, a fish—the minnow—in about half an hour, the frog and toad in about the same time, the earth worm in about an hour and a-half; the insects, such as the dragonfiy, butterfly, after the apparent death for more than an hour, recover on exposure to the air, and that repeatedly. By other experiments on birds by means of submersion in water, he showed that different species varied greatly in ability to bear exclusion of air; thus while all the snake birds of which he had made trial expired under water in about a minute or less, the buzzard lived about twenty minutes and a half, the common fowl about four minutes and half, the goose and duck about ten minutes. Reasoning on the results, he infers that each individual animal has something peculiar in its organism determining its peculiarities of function or action, peculiarities more readily described than accounted for. He holds the subject to be in a great measure mysterious, nor is he sanguine, referring to the new and ingenious views on the genesis of species, that they will tend, except partially, to enlighten the subject, considering that life itself is a mystery, and the origination of life, as regards natural science, an unsolved problem.

THE BORING OF LIMESTONE BY ANNELIDS.

By Mr. E. Ray Lankester.—The author stated that, in the discussions concerning the boring of molluscs, no reference had been made to the boring of annelids—indeed they seemed to be quite unknown—and brought forward two cases, one by a worm called Lencodore, the other by a Sabella. Lencodore is very abundant on some shores, where boulders and pebbles may be found wormeaten, and ridled by them. Only stones composed of carbonate of lime are bored by them. On coasts where such stones are rare they are selected, and all others left. The worms are quite soft and armed only with horny bristles. How, then, do they bore? Mr, Lankester maintained that it was by the crabonic acid and other acid excretions of their bodies aided by the mechanical action of the bristles. The selection of a material soluble in these acids is most noticeable, since the softest chalk and the hardest limestone are bored with the same facility. This can only be by chemical action. If, then, we have a case of chemical boring in these worms, is it not probable that many molluscs are similarly assisted in their excavations? Mr. Lankester did not deny the mechanical action in the pholas and other shells, but maintained that in many cases the co-operation of acid excreta was probable. The truth was to be found in a theory which combined the chemical and mechanical view.

AMERICAN INSTITUTE FAIR.

The exhibition of the American Institute may now be fairly said to have reached its full glory. The confusion so characteristic of the earlier days of the Fair is no longer apparent. The sound of saw and hammer no longer blend with the dulcet tones of the orchestrion, and the musicians have now to contend only with untiring buzz saws, and machinery incessantly and loudly calling for lubrication. The articles have been classified in a catalogue, but implicit reliance placed upon the statements of this important document would be ap to lead the unsophisticated into some serious errors, or convey some ideas respecting their nature and construction entirely at variance with his previous conceptions. A revised edition which is promised before many days will, it is hoped, in some measure remedy this evil.

The most novel and attractive feature of the exhibition is by general consent conceded to be the Pneumatic Railway, erected by Mr. A. E. Beach, of the Scientific American, and every one visiting the Fair seems to consider himself specially called upon to visit, and, after actual experience, to pronounce his verdict upon this mode of traveling. Having accomplished this feat, descending from the mouth of the tube to the main floor, the visitor immediately enters the "Department of Intercommunication," a brief glance at the articles exhibited in which shall be the subject of this notice.

The group most naturally suggested by the title is the telegraph and its kindred applications, and under this grouping, the fine display made by the Bishop Gutta-percha Company first attracts attention. Prominently hung upon the eastern wall of the hall are samples of deep-sea cables, including pieces from cables which have been actually laid in different parts of the world. In a show case is to be seen a specimen of the first submarine cable ever made in which gutta-percha was used as an insulator, being a piece of the identical cable laid across the Hudson River for the Magnetic Telegraph Company in 1848. The conductor consists of a single iron wire of No. 9 gage, insulated with two coatings of gutta-percha, the outer one much oxidized from contact with the air, but the inner coating still perfect. Insulated air-line cables, water pipes, photographic baths, acid pitchers, bottles and vessels in great variety, make up quite an interesting collection. Proceeding on our journey of observation, the telegraphic apparatus of Dr. L. Bradley next deserves attention. In addition to a creditable assortment of relays, keys, etc., the Doctor exhibits a rheostat of superior workmanship, a tangent galvanometer, and other instruments of like character.

A larger and more varied collection of telegraphic instruments fills the show-cases of Tillotson & Co. All the neccssary equipments for a well-ordered office are here to be found. A Morse apparatus in full operation at this stand has undoubtedly given to many observers their first insight into the mysteries of telegraphy. On the same table is to be seen Gardiner's machine for lighting illuminating gas by frictional electricity. By its side the electro-medical apparatus of Dr. Jerome Kidder, forms always the center of a crowd of the curious, each anxious to experience the effects of the magneto-electrical shock.

Needham's pneumatic way for transporting packages and mail matter comes next in order. It is claimed that this arrangement possesses marked advantages over the ordinary tube designed for carrying passengers. In the latter the air acts on but one side of the car at once, consequently, it is said, the momentum of one half the air set in motion is lost, but in Needham's model the tube is made continuous, the inclosed column of air being then isolated from the atmosphere, and the whole force is utilized. Classed under the same group, though of a somewhat different character, is Hall's electric switch, so arranged that the continuous ringing of a bell gives evidence of the misplacement of the switch.

Having now introduced the subject of railroads, we pass next to a consideration of the group under which all articles relating to railways are classed.

A locomotive head light of handsome proportions, manufactured by Radley, McAlister & Co., of this city, is prominently posited. The burner of this lantern appears to combine many meritorious points. It is made wholly of brass, its parts being screwed or brazed together so as to be easily removed, repaired and replaced. By the employment of air chambers, the burner is kept perfectly cool, thereby giving a flame of uniform brilliancy and steadiness; a great saving in the evaporation of the oil, and furnishing a sure preventive against the almost universal liability of explosion. A head light manufactured by this firm, we are informed, graces the famous Grant Locomotive, now on exhibition at the Paris Exposition. A handsome head light is also exhibited by Peter Budenbach. The Metropolitan Transit Company show the model of their proposed plan for a three-tier railroad. A contrivance for removing obstructions from, and cleaning the tracks of, street railways, is the invention of John B. Read. The plan is undoubtedly feasible, but we fear that a legal enactment alone would induce the car companies to adopt any plan, however meritorious, for saving life and limbs of their passengers. The subject of bridge building, according to the classification, belongs to this group, but the sole exhibitor seems to be the Moseley Company, who exhibit a model four feet long, which they advertise will support the weight of thirty-five persons weighing one hundred and thirty-five pounds each. They propose to make good the truth of this assertion before the Fair closes. Persons of the proper weight anxious to distinguish themselves, will govern themselves accordingly.

In the group including vehicles and harnesses, the steam carriage for common roads, the invention of P. H. Rocker, of Boston, seems to be the chief attraction. The carriage is an ordinary buggy, with an upright boiler mounted on springs, behind. The cylinders are beneath the carriage body, in front, the pistons acting directly upon the crank serving as the rear axle and which turns the hind wheels. What success the vehicle has met with, we were not able to ascertain, no person seeming to have charge of it, and, as was the case in innumerable other instances, inventive imagination must supply, in great measure, the place of reliable information. Near the steam carriage, the arrangement of C. Ducreux, for instantaneously detaching horses from carriages, is illustrated by a working model. The object to be attained cannot be too highly commended, and providing some means for easily releasing running horses from vehicles, should be enforced by law, if in no other way it can be brought about. In this arrangement a lever under control of the driver loosens the trace and other connections, and instantly frees the horses. Colburn's method of effecting the same result is quite simple and equally valuable for the readiness with which the horse may be attached or detached from the carriage. A spring bolt on the harness saddle fits into a socket on the shafts; this is the only attachment, tugs, traces, whiffletrees, and breeching being entirely dispensed with. Should the horse run away with the carriage, or, slipping on a treacherous pavement, fall down, the driver pulls a cord connected with the spring bolt, when the animal is instantly detached. Mr. John Raddin, of Lynn, Mass., the exhibitor of this latter contrivance, presents to the public an elastic carriage wheel which is bound to make glad the heart of every member of the riding community who has ever occasion to ride over the cobble stone style of street pavement. The wheel is rendered elastic, so as to relieve the jar and rattle in striking against, or passing over, stones or inequalities, by applying to the end of the spokes a packing of india-rubber in a box or socket fitted to the felly. By this arrangement such riding, if we are to receive the assurances of the inventor, is rendered an absolute pleasure, the degree of the enjoyment being, we suppose, proportionate to the amount of jolting experienced. An elastic car wheel of the same inventor has between the hub and web, a ring of rubber pressed in by bolts and flange, to take the load and jar. The hub being separate from the web, it can be replaced when required with small expense. Turning again to carriage wheels, we willingly make a note of Stuart's metallic hub, whose peculiarity consists in dovetailing each spoke separately inside the hub, so that, while they can never get loose or work, they may be easily removed and new ones inserted without removing the tire.

In the group of which vessels are the characteristic type, we notice first an application by Mr. Montgomery of his corrugated iron to the construction of ships' ribs. Near by is a tank in which swims one of Golding's combined mattress

and life-saving raft. Each mattress bas a buoyancy sufficient to support one person in case of necessity, and is provided with compartments for holding water and provisions. By means of hooks, any number can be fastened together so as to make a raft of any required size. Of that almost endless variety of devices for boat detaching, brought forward consequent upon an act of Congress in July, two years since, making it incumbent upon all vessels to carry such apparatus, we find but three on exhibition, of which the pioneer in this class, Brown & Level's, is manifestly the best. The bronze medal awarded for this tackle at the Paris Exposition is placed in a prominent position.

The Union power capstan claims for itself superiority over all others, working forward and backward as a simple capstan, and with a purchase of four and one-half to one, also forward and backward. It can be taken apart on shipboard with no other tool than its own parts supply. Spaulding & Coffin, of Boston, are the exhibitors.

The fifth group is devoted to implements and materials used in printing and engraving. Messrs. Hoe & Co. take the lead in this line, exhibiting sets of printers' materials, and a variety of forms of copying and embossing presses. The Novelty printing press is a Boston notion, and is designed to furnish a cheap, simple, job printing press for business men to amuse themselves with during leisure moments, and for a merely nominal sum furnishing the source for a rare combination of convenience, pleasure and profit. The bed of the press is stationary and nearly vertical, and against it the platen is brought by the power of a toggle joint with treadle attachment.

In group No. 6, is placed the differential pulley of T. A. Weston, of Buffalo, N. Y., and Doyle's Empire power tackle, the latter apparatus being the especial favorite of the youthful visitors, who, apparently, firmly believe that its sole purpose is the early development of the juvenile muscle. Without attempting to explain the course of reasoning of the committee in assigning burglar-proof safes to the "department of intercommunication" especially, as is the case with those now on exhibition, when said safes are securely locked, we would speak very favorably of the external appearance of the bankers' safes of Terwilliger & Co. We confess ourselves also unable to explain exactly in what way steel cannon fall under the same classification, unless considered as a means of intercommunication, in which case we would in conclusion draw attention to the model made by Thos. Prosser & Son, of an eight inch cast-steel breech-loading rifled cannon.

THE PNEUMATIC RAILWAY.

It is an interesting sight to stand at the mouth of the great tube and observe the arrival and departure of the car with its loads of passengers. The car fits the tube like a piston and travels both ways with the utmost regularity and steadiness. Nothing can be more gentle and pleasant than the start and stoppage; no jerking or wrenching of any kind is observable, and although the car is not provided with springs it rides along very easily. The tube is 107 feet in length, 6 feet in diameter, and is composed of fifteen layers of veneers, laid and cemented in alternate spirals, forming a total thickness of an inch and a quarter. This peculiar construction gives great strength and rigidity. The car carries twelve passengers, and its body is rounded on the same curve as the tube. Indeed, the body was made of a section of the tube cut in halves and the ends united forming a long open cradle without roof, with seats on each side, presenting the appearance of an omnibus sleigh. The wheels project three inches through the shell of the body, turn in boxes arranged under the seats, and run on a small track laid through the tube. One end of the car is provided with a disk or head which fits the tube and forms a traveling piston. There is a door in the disk, also ventilating valves; the lights and water gages are also arranged upon the disk. The disk presents a superficial area of 28 feet against which the atmospheric pressure acts to propel the car.

The Æolor or blowing wheel is made in the form of a screw propeller. It is 10 feet in diameter, made of wood, has eight blades, and revolves at the mouth of the tube opposite to that at which the car enters. When the screw turns in one direction it sucks the air through the tube and the car is drawn in. The car, as it passes along, moves a lever which gives a signal and by the time the car arrives near the screw the latter is reversed which forces a blast of air into the tube and drives the car back. The Æolor is capable of producing a far greater pressure than can be safely used upon the car in so short a length of tube.

There are two of the Æolors at the Exhibition. One of them works the Pneumatic Railway, the other, of smaller size, the Postal Pneumatic Dispatch. Both are driven by one of Root's little trunk engines, diminutive in size but exceedingly compact, runs beautifully, and gives out abundant power.

The visitors at the Exhibition manifest a lively interest in the Pneumatic Railway, and all seek for the ride. To be carried along by the air pressure is an entirely new sensation. More than twenty-five thousand persons have already been safely carried, much to their enjoyment and satisfaction. Mr. John D. Gilbert is the conductor and accompanies every train. It is probable that a Pneumatic Railway of considerable length for regular traffic will soon be laid down near New York under the auspices of the Pneumatic Dispatch Company of New Jersey, of which Mr. Beach has lately been elected President. Great credit is due to the Holske Machine Company who were the builders of the Pneumatic Railway and the Pneumatic Postal Dispatch as presented at the Exhibition. The whole work, tubes, cars, blowing screws and all, were constructed by them in the short space of six weeks. Considering that every thing was of a novel and experimental character, this was making good time. The work was conducted under the immediate personal superintendence of Mr. W. F. Holske, who is one of our most reliable, experienced and energetic mechanical constructors. It has been his business for many years to build experimental machinery. He is quick to appreciate a new idea, and prompt in putting it into bodily form. Many of the best patent models that come to our office are from the establishment of the Holske Machine Company, 528 Water street, New York city. We shall give a description of the Postal Pneumatic Dispatch in our next.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

Artesian Wells.

MESSRS. EDITORS:—The ascension of water in Artesian wells is not very satisfactorily accounted for, and the cases reported by your Chicago correspondent, on page 163, current volume, is an unique instance.

From a depth of more than 700 feet, and rising more than 80 feet above any surrounding source of production and higher than any land of that elevation within a hundred miles or more, as is the case, is an anomaly in hydro-dynamics

The prevailing *rationale* of the subject has generally been this: High sources in elevated land, with dipping stratified rocks, which being tapped by boring, forming the inverted syphon, the water must inevitably rise to the level of its source; but this contingency does not prevail at Chicago, nor in hundreds of other localities where water is always found, if the borings are continued deep enough in quite or entire horizontal rocks, the syndinal or antidinal pitch of the strata are never consulted or required. This theory is hardly a rational explanation of the results.

Another explanation is, that as all the sedimentary and even the primitive rocks are the result of crystalization or deposit from water, the hardening and shrinking of the strata leaves interstices and cavities filled with water which, when tapped, the superincumbent pressure forces it up and it follows the law governing fluids in like cases. But in this case it would be fair to presume that the source in time would become exhausted, like the oil wells of Pennsylvania.

Another, and to my mind the most rational one is, that as it is universally admitted that the center of the globe is in an incandescent or even fluid state, its great heat must produce from the lower portions of the 40,000 feet of the sedimentary rocks, steam, which penetrating the pores, fissures, and laminated portions, arrives at the condensing point under great pressure, which, on being relieved by boring, would in all cases produce a constant and unchangable flow.

Mr. Schufeldt's question in hydraulics is an abstruse and difficult subject for elucidation. Let us suppose that the source of supply is not a great basin or reservoir which the boring has penetrated, but a region of rock containing lamina and porosity, where the water by force has remained in a quiescent state for all time; on being relieved from its imprisonment by boring, it is produced from all quarters by flowing and segregation. On rising to nearly a balance of power, the antagonistic principles of weight and upward pressure are slowly adjusted and take time to assert their rights.

On turning the stop cock at the surface, there is no accumulation of water or head, there is no absolute space to contain it, and it is simply locked in a quiet state as it was before its release, and consequently when nearly on an equilibrium of forces, must necessarily rise very slowly.

I regret that Mr. S. did not report the temperature of the water, as well as that of the springs or wells, that we might compare the results with other locations, as to its increase according to depth. I should expect it to be about 70° Fah., well water being 55°. L.

Rochester, N. Y.

[Several other communications on the same subject account for the phenomenon on the principle of the inverted syphon, well understood by students of natural philosophy. One from the Pensylvania oil region gives an account of similar performances. The presence of carbonic acid gas in subterranean caverns communicating with the well hole, is suggested by one correspondent as a possible explanation of the Chicago well performance; but we do not understand that theory as sufficient to satisfy all who make physics a study. The reason for the intermittent, almost capricious action of the Chicago well is probably yet to be ascertained. Its exhibition is by no means new. For years travelers have known of similar wells—natural—in the Tyrol, and in Sweden such phenomena in wells dug for domestic purposes are not rare.—EDS.

The Comets Again.

MESSRS. EDITORS.—In No. 13, current volume of the SCIENTIFIC AMERICAN, Mr. P. G. Yendell has endeavored to refute the theory advanced by me in No. 10, current volume of your paper, namely, "that the tails of comets are refracted light." Mr. Yendell has evidently not seen Dr. Ramsay's article in No. 6, current volume of the SCIENTIFIC AMERICAN, in which that gentleman advances the theory that the tails of comets consist of reflected light. My communication is merely a modification of Dr. Ramsay's theory. If Mr. Yendell will read Dr. Ramsay's very interesting paper, he will get a very good explanation how it is that although light moves in straight lines the tails of comets appear curved. Mr. Yendell says "that he cannot resist the conviction that the tails of comets are composed of nebulous matter as evidently left behind by the motion of its head as the smoke of a locomotive by the progress of a train."

According to this theory the tail of a comet would follow precisely in the path or orbit of the same and would spread to the rear even when receding from the sun which your correspondent perhaps by experience knows it does not. If the appendage of a comet was nebulous matter left behind from the nucleus, like smoke, the nucleus would soon be dissolved and would disappear entirely unless it could be explained where it got the material from to feed and keep up the nebulous tail.

Before advancing a new theory it should have been proved that the old existing theory was not correct. The question to settle now is "is it possible and in harmony with the known laws that govern the universe that the tails of comets consist of nebulous, ponderable matter?" To me it appears impossible and entirely against the law of gravitation that a nebulous appendage could be formed many millions of miles in length, apparently much rarer than the body of the comet; it seems to me as impossible, as it is, that the atmosphere surrounding the earth could form an appendage and follow in the orbit of the same.

My supposition is that comets are worlds of a more recent formation than the other planets of the solar system; they are going through the process of development and are perhaps in a liquid and vaporous condition holding in solution all the elements to form a crust as on the planets. As long as this crust is not formed the body of the comet is not opaque, the rays of the sun can pass through it and are refracted, and in this way the tail is formed. AUGUST WILHELM.

Philadelphia, Pa.

The Rotary Force Centrifugal.

MESSRS. EDITORS:—You have been coquetting for some time in your journal with the essence of matter, the centrifugal force, and with Helwolt'z's theory of vortex motion by calorical force.

This theory is opposed by an old discovery—neither heat nor electricity, when set free, are motive forces. They pass through bodies, disturbing the molecules, and leave them as before.

Your other questions, the essence of matter and the centrifugal force, are subjects of deep interest, and will be better understood if we state first what are the real discoveries that are made, and what is yet conjectural in the science of motion. At present there is no genius, no scholarship, no proofs that will satisfy the public mind, until it is guided out of the dark problem of Sir Isaac Newton's theory of attraction of gravitation. His great discoveries that have awed public opinion into submission to his views, were made from his observation of the phenomena of motion, and not on his problem of attraction. His problem itself is centripetal, and if it proves any thing clearly, it brings all bodies in motion to a state of rest.

It so completely ignored the centrifugal force, that for generations it has been unrecognized by science. Witness recent calculations of how long before the earth will fall down upon the sun. Now, if I at all understand the hidden power in the rotary force, which the attraction of gravitation fails to account for, it discloses more than is yet known of motion, by the aid of Sir Isaac Newton's discoveries. By comparing the phenomena of motion, which the attraction of gravitation fails to explain, with the phenomena of motion which it does account for, we shall gain the share which the rotary force controls in the movement of bodies in space.

And first, gravitation explains why the planets, comets, and sattelites, revolve in elliptical orbits, or curves, consisting of circles, ellipses, parabolas, etc. Secondly, it explains the unequal velocities of these bodies, in their orbital movements, together with the perturbations common in the movement of the planets.

Sir Isaac Newton says all these phenomena are susceptible of explanation and computation by his theory of universal gravitation; and here the domain of the law stops.

It fails absolutely to account for the force which revolves the planets on their axes; it does not explain why the planets and sattelites revolve in orbits so nearly circular; it does not answer the significant question, why the planets revolve around the sun in the same direction. Gravitation would have accounted for this motion if the planets had circled around the sun in opposite directions.

All these questions therefore remain for the rotary force to explain. Moreover, gravitation gives no reply to the question why the planes of the planetary orbits are so nearly coincident, or why the planets all rotate on their axes, in the same direction in which they revolve in their orbits, or why the sattelites obey the same rule, and the sun itself in like manner rotates on its axis in the general direction of the motion of its attendant sattelites.

From what is conceded to Sir Isaac Newton's theory of the attraction of gravitation, and what it fails to account for, we may see how much is concealed from us in the hidden power of the centrifugal, and its resultant rotary force.

Rhinebeck, July 23, 1867. F. V. M. D.

Pumping Hot Water for Boilers.

MESSRS. EDITORS.—My attention has been attracted to a paragraph in the SCIENTIFIC AMERICAN from your correspondent, on the subject of pumping hot water and your observations thereon, because it is one of much importance in regard to the safe working of steam engines, etc. It might be considered a matter of course, by many, that if a force-pump of given dimensions will inject a certain volume of cold water into a boiler within a stated period and continue to do so uniformly, that the same pump will inject a like quantity of hot water in the same length of time.

I am of opinion that somewhere about here lies the key to the solution of so many mishaps in the bursting of steam boilers, and that the explosions generally arise from the want of a sufficient supply of water by the force pump. My theory is that a force-pump for water of a high temperature ought to have twice the capacity of that used to pump cold water