

IMPROVED COMPOUND STEAM PUMP.

The special advantages claimed for the improved steam pump illustrated herewith are as follows: 1st. It has only two moving parts, except the pump valves, thereby reducing friction to a minimum. 2d. The steam, having performed its work in the high pressure space, is afterward expanded, thereby extracting all the power possible from it, and effecting a large saving in fuel. 3d. The high pressure and expansion are both carried on simultaneously throughout the entire stroke, thereby maintaining a more uniform aggregate piston pressure to the end of the stroke. 4th. It is simple, compact, durable, and portable, and can be used without expensive foundations.

The indicator diagram shown in Fig. 1 was taken from one of these compound cylinders, and a study of it will demonstrate the economy of such a pumping engine in comparison with pumps that must use a cylinder full of steam at each stroke. Attention may also be directed to the very short passage ways for live steam between the valve and the high pressure piston, thus insuring less waste of steam from steam passages than is usually the case.

In Figs. 2, 3, and 4 three sectional views of the machine are given. The elongated piston has two ends provided with packing, and has a cylindrical portion of a less diameter extending between the said ends, the said portion being fitted to work steamtight in a central partition in the cylinder. Two annular chambers are thus formed, into which steam is admitted to act upon the smaller areas of the piston ends; and it is afterward expanded into the spaces between the piston ends and the cylinder covers, to act upon the larger areas of the said piston. A double cylindrical valve regulates the movements of the steam, each half of it being formed with a passage to connect two ports, through which steam passes from the annular space to the space between the piston and the cylinder head, and also with a passage which connects the larger steam space with the exhaust passage. Steam is admitted into a space between the two parts of this

Fig. 3.

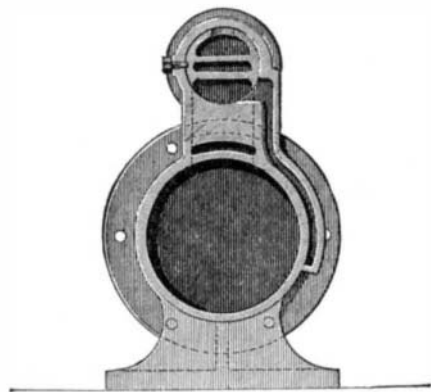
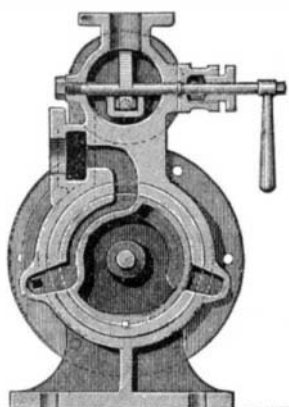


Fig. 4.



valve, and finds its way by suitable openings into the end spaces between the said valve ends and valve box covers; the said end spaces are connected by passages with ports formed in the aforementioned partition; and as the piston moves

to and fro, passages formed in the said piston establish a communication between the said ports and a port leading into the exhaust passage, thus relieving the valve from pressure on one end and causing it to be quickly pushed in that direction by the steam at the opposite end; the parts are all so arranged as to provide effectually for sufficient steam

Fig. 1.

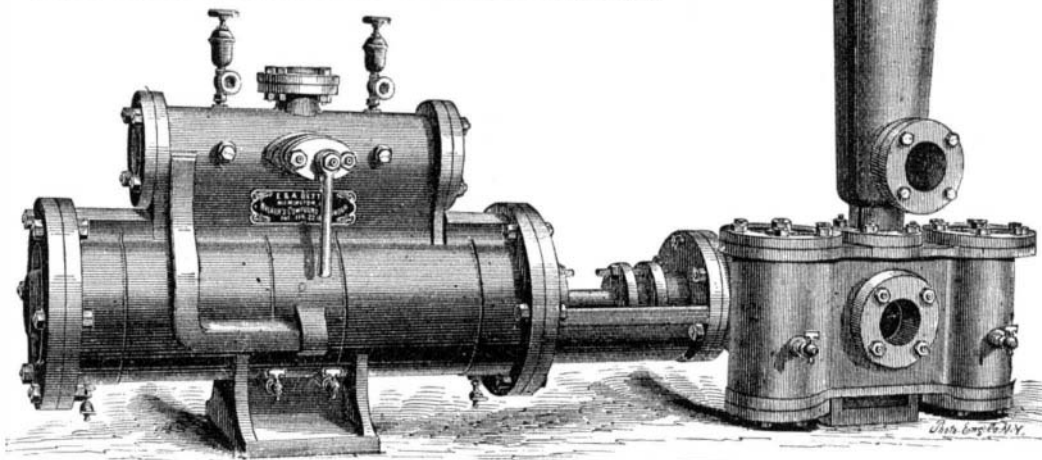
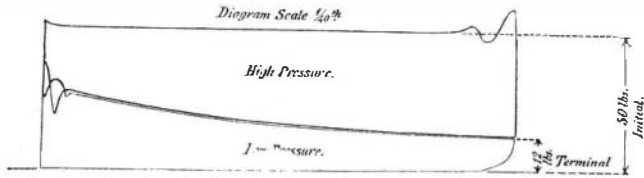
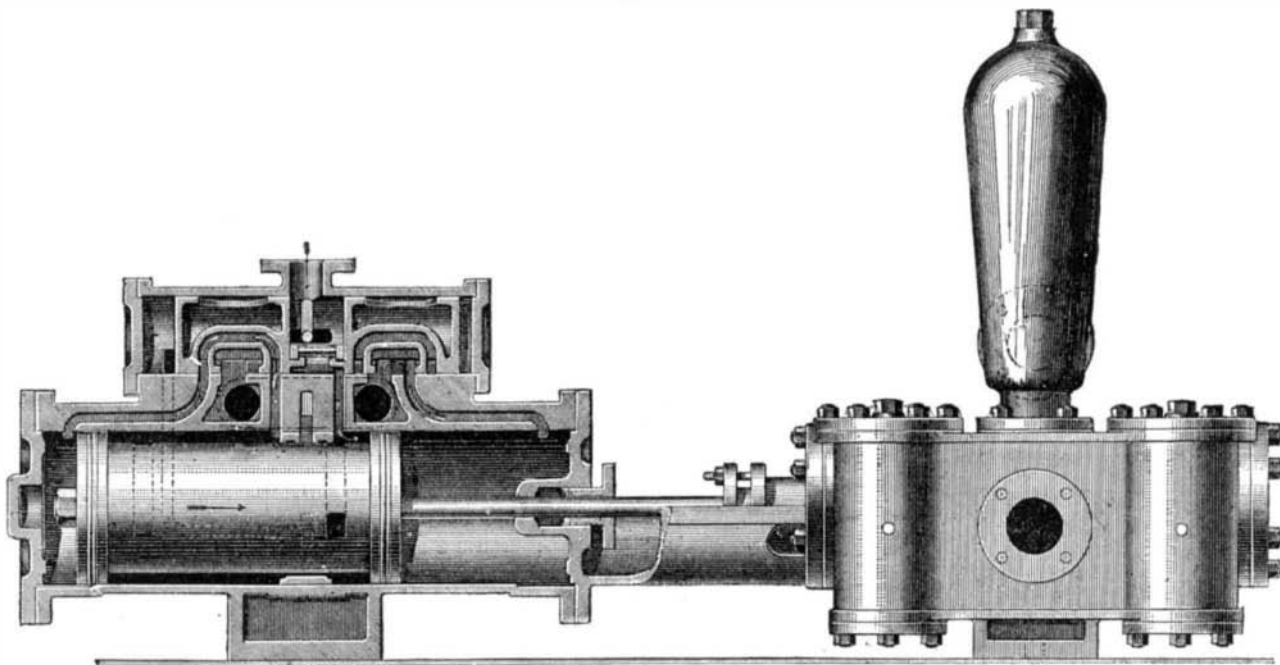


Fig. 2.



WALKER'S COMPOUND STEAM PUMP.

to cushion both the piston and valve so as to prevent striking under any circumstances.

For further particulars address the manufacturers, Messrs. E. & A. Betts, Wilmington, Del.

American Nickel Mines.

The nickel deposit near the Gap, Lancaster county, Pa., is considered the largest yet discovered in the world, and the only deposit of the ore worked in America. The mine is on the high dividing line between Chester and Pequea Valleys. Besides nickel, copper, iron, and limestone are found in the same locality. Nickel was discovered here about the year 1856, though copper, which is taken from the same mine, was known in the same locality seventy years ago. The ore has a gray color, is very heavy, and so hard that it is mined entirely by blasting. After the ore has been broken into small fragments, it is put into kilns holding eighty or ninety tons each, and subjected to heat produced at first by the burning of a small quantity of wood, and continued by the conversion of the expelled gas. It is then put into a smelting furnace, and undergoes a treatment similar to that of iron ore.

New Steam Canal Boat.

A new invention for the propulsion of canal boats was tested at Rochester, N. Y., recently. The peculiarity of this boat is in the position of the propelling wheel or screw. It is placed in the middle of the boat, and works against the water at an angle of thirty-eight degrees, in this way throwing the water against the bottom of the canal instead of horizontally. It works in a casement from which the air is exhausted and which is consequently full of water. On the trial, without a load, three miles an hour was run by a boat to which the screw had been affixed.

Extension of the Greenwich Railway, London.

The London and Greenwich Railway was constructed and opened upwards of forty years ago, not long after the opening of the Liverpool and Manchester railway—the first steam passenger railway in England. The Southeastern Company, who are now the owners, have extended it to the North Kent line, *via* Maize Hill, Charlton, and Woolwich, which

places Greenwich in direct railway communication with Gravesend, Chatham, Maidstone, and other districts in North and Mid-Kent.

The old London and Greenwich line is carried entirely on masonry arches, and on a high level, that is to say, it is a city elevated railway. The extension line about to be opened is, however, an underground line, diverges from the elevated line near Deptford Creek, and is thence carried, in a northeasterly direction, along a descending gradient, until it arrives at London street, which it passes under, immediately on the south side of the parish church. In constructing this portion of the line, about 150 houses had to be purchased; and as the whole of one side of a thoroughfare was also absorbed and diverted, the company have had to construct a new street, with a roadway under the new line leading into Greenwich road. At this point a heavy outlay has likewise been incurred by the company in the diversion of about 1,700 feet in length of the main sewer belonging to the Metropolitan Board of Works, near London street. The new sewer, which is carried at a considerable depth under the railway level, is 11½ feet in width. It is circular in form, and lined at the bottom with blue Staffordshire brick, and all round with white gault brick. There are staircases at intervals for the purpose of descending into the sewer from the street. The cost of this sewer was \$260 per yard. From London street, Greenwich, the line is carried forward in a tunnel, 26 feet in width and half a mile in length, which passes under the Royal Naval Schools. At the end of the tunnel the line is carried on to the Maize Hill Station, through a cutting which is walled in throughout its entire length. The portion of the line from Maize Hill to Charlton and Woolwich, where a junction is formed with the North Kent line, was opened nearly two years ago; the entire length of the line from Greenwich to Woolwich is between two and three miles.

The whole of the works have been designed by Mr. Brady, the company's engineer, and executed by Messrs. Lucas & Aird, the contractors.

MAY'S IMPROVED BILLIARD TABLE LEVELER.

The invention herewith illustrated is a combination of leg

Fig. 1

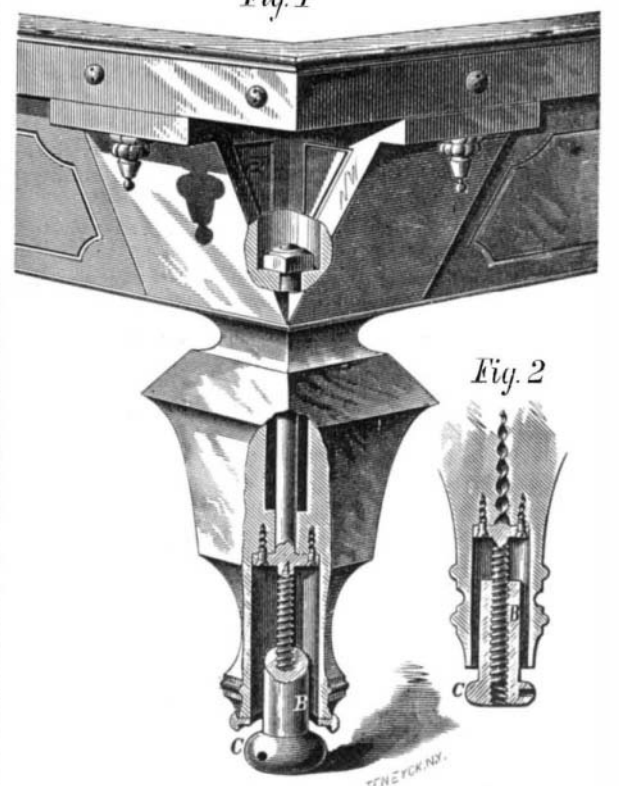


Fig. 2

bolt and leveler, so that a single bolt holds the leveling attachment firmly to the leg, and at the same time secures the latter to the table. In some billiard tables the legs are merely doweled on, but this is liable to give trouble in case

of accident, packing, etc. The screw in the present device is not exposed, and the arrangement generally is neat and substantial, and, we are informed, cheap.

In the lower end of the leg is a deep socket, Fig. 1, through which passes the screw rod, A, on the extremity of which is a long nut, B, having an oval head, C. The leg has preferably a metal cap with a flange, projecting downward to conceal the nut and the upper side of the head thus making a neater finish; or the cap may be omitted, as in Fig. 2, as the nut will ordinarily appear like an ornamental foot.

In Fig. 1 the rod is represented as extending up through the leg into the head block and bolting the leg fast thereto. In Fig. 2 there is simply a short bolt having a wood screw formed on its upper end to enter the wood. A collar is attached on the rod at the point where it rests against the bottom of the socket, when the bolt is screwed home. This is fastened by suitable wood screws entering the leg through the notches on the collar, by means of which the latter is screwed up. The nut, B, is adjusted by a pin put in its hole. The device is well adapted for piano legs or those of bagatelle and other tables requiring to be adjusted level.

Patented to Samuel May through the Scientific American Patent Agency, July 25, 1876. For further particulars address Messrs. Riley & May, 81 Adelaide street west, Toronto, Canada.

Correspondence.

On a Mechanical Theory of Gravitation.

To the Editor of the Scientific American:

The main cause of the failure hitherto to construct a mechanical mode of gravitation action, which would be found consistent with acknowledged scientific principles, in agreement with the facts of observation and mathematical developments of the theory itself, appears to be the supposition that no mode by which tension would be produced is admissible: etherial pressure or impulsion being alone scientifically allowable. But this contradicts experience, and even general analogy. The tension of a cord is used as an elementary illustration; and optical phenomena not only show etherial vibrations to be transversal to the course of propagation, but that in impalpable matter the ether is densest, and therefore probably condensed instead of rarified around it. We have only to suppose the ether to equilibrate by condensation any enforced tension within it (say, by being stressed toward dense matter) to make the propagated vibrations transversal, and their velocity unvarying.

If we assume the energy of the Universe to be concentrated in the continuous mutual transmutations of ether and dense matter, masked by various and transformable modes of manifestation: such transmutation occupying more time than the periods of molecular vibration where radiant energy is displayed, but less time than any molar motion: we can perceive unconstrained translatory motion of masses to be possible even in an absolute plenum, there being merely a transmutation movement. A constant aberration would follow as a natural result. If the thorough transmutation of molecules be less rapid than their general motions, their extra motive forces will be transferred to the ether until the periodic time of motion reaches that of transmutation, when the radiant energy is all dissipated by there being no more etherial resistance.

Such rapidity of transmutation is the only novelty of the present hypothesis. But this assumed rapid action of the constituted forces of matter finds its parallel in the transmutation of force itself: while the principle finds its analogy in physiological action, in which matter assimilated takes on the constituted quality of the matter emitted. This continuity of molecular transmutation implies neither growth nor decay, but simply continuous "manufacture": like molecules having identical properties everywhere, constituting them alike.

I assume the ether to be of equal density throughout, except where differences of pressure or tension are produced, when the density will vary equally by the tendency to maintain equilibrium of condition. But with this difference of density I also (as Professors Challis and Clerk-Maxwell have done) assume that the ether resists any break in its continuity, because:

1. No portion of the Universe can be isolated in its action, nor unaffected by the rest.
2. We avoid making the mathematical quantities of nothingness vastly greater than those of substance.
3. We are more consistent with thermodynamical principles; and
4. We do not contradict common sense in making the dynamic bond of the Universe consist in the isolation and repulsion of its every atom.

If we suppose the process of assimilation carried on with a greater rapidity than is possible for the ether to withdraw the emitted matter into its naturally equable distribution of density throughout free space, a state of stress in the medium towards every particle of dense matter will be necessitated. We need not inquire into the primeval condensation of ether into gross matter; but if it be conceded as a truth, it follows from our hypothesis that the absorption of ether will cause it to be strained towards the gross matter, and be drawn thereto with greater density to equilibrate the tension. The condition of stress will be precisely like that of our atmosphere, the tendency of the condensed ether to expand being balanced by the pull upon it for assimilation. This conception of the ether agrees with that of Newton. In his letter to Boyle, he says: "I suppose that there is diffused through all places an æthereal substance, capable of contraction and dilatation, strongly elastic: in a word, much like air in all respects, but far more su-

tile." The result then would be that the ether contains within itself as many spheres of stress as there are particles of matter: every atom being the center of such a sphere, which may be assumed to reach to any assignable distance, and coeval with the being of the atom.

The force of stress around gross matter is thus the balance between the activity of transmutation and the tendency to etherial dilatation; and an increase of the one would correspond to a decrease in the other. If the ether, by offering increased resistance to transmutation, thereby lowered its activity, an equal and opposite resistance would be developed by the constant tendency of the body to give its transmutative energy free play. Should also, through any cause, the lines of dilatation be deflected perpendicularly to the lines of tension, the energy of transmutation will be lowered in the directions of the latter, the amount of which it is decreased becoming transformed into an equal and opposite reacting tensional force. Therefore, however great the amount of resistance to a body's natural assimilation of ether in order to maintain existence, or the number of directions whence such resistance comes, if the effect merely be to lengthen the period of time in which transmutation takes place, the amount of dense matter remaining constant, equal and opposite counterpulls to all will be developed. Now a body alone in space could be subject to no difference of stress, the self-caused etherial tension around it, being equable, making the lines of force straight outward from it in every direction; and the molecular energy of transmutation in the present condition of the ether would be at a maximum. But the presence of other bodies similarly conditioned would destroy the equilibrium of the ether on the sides toward each other, and its tendency to dilatation would act perpendicularly to the opposing stresses, being the directions of least resistance; and coalescence of the stresses would result, bringing the bodies at their centers together. The sides towards each other, being the sides whence resistance to transmutation comes diminishes therefrom its potential energy, which becomes changed into the actual energy of bodily motion. It will be seen that this theory of the action of gravity is similar in form to Faraday's conception of the action of dissimilar poles when face to face in magnetism, namely, by the coalescence of their lines of force, and which had previously existed in the space between them. For it is plain that, whatever faces of all bodies be turned toward each other, they will bear the character of opposite poles, the lines of steps being directed inward to each from every direction.

Transmutation energy and gravitation action would, according to this, be mutually convertible the former: being diminished by decreasing activity wherever there is a resultant attraction. The resistance to transmutation developed during the coming together of bodies is the equivalent of the motive force given out in yielding to the increasing tension; while the diminished resistance during any enforced withdrawal of them is the equivalent of the work done in overcoming their tendency to come together by the coalescence of their spheres of stress: or in other words, by diminishing such resistance, and increasing transmutation activity.

We can thus see how every particle of matter may be potentially infinite, without being substantially penetrable, and the molecular force of every mass impotent, as regards its own change of rest or motion in the aggregate, while potential in altering the conditions of rest or motion of all others. The fundamental correlation of matter and manifested force is also evident from the result that their dissipation would be mutual, as there could be no equilibrium of stress arrived at in the Universe until all the dense matter became again dissolved into the ether, without possible return into gross substance.

Although the force of tension exercised by different bodies is equal, the distance through which each sphere will be drawn during coalescence will be in the inverse ratio of the masses at their centers. For the potential energy of transmutation in bodies taken as wholes being directly as the masses, a portion of which becomes transformed into kinetic energy while yielding to their mutual tensions, the motive force will be according to the proportional diminution in each of such potential energy required to produce equality of pull. And a transmutation action stresses the ether from every direction; the potency of resistance to it, through the combining of mutual stresses, will be as the number or breadth of surface of the lines of force coalescing. The tensional power of coalescence will thus increase with the concentration of the spheres of stress, being potentially an element of the radial distance from every body. It is evident that particles free to move in any direction will tend to group themselves spherically during aggregation around the point which would be the center for all the spheres of stress were they to become blended into one, being the converging point for the equilibrating tendencies: while it will become the balancing point or center of motion's around which would revolve all those bodies whose deviating forces of motion are sufficient to overcome the tendency towards it.

If the efforts of the spheres of stress to coalesce be resisted by the motions of bodies under an opposing impulse, the lines of tension, by being inoperative, will be necessarily accompanied by equal pressures perpendicular to them along their whole length in the tendency to etherial equilibrium, and the tensional force will become constantly neutralized. In the case of any cosmical couple (the only kind of balanced motion in free space) the mutual tensions will be constantly equalled by the motive forces of the bodies acting perpendicularly to them: their joint masses or amounts of transmutation energy determining the measure of both. The

volume of the sphere of stressed ether around which any determinate masses revolve is also, by its internal equilibrating action, a measure of the motive force exercised, or the time occupied in revolution squared. In other words: taking the major axes of any orbits as the diameters of naturally elastic spheres of stressed ether, the times of revolution squared by the bodies producing the stress, divided by the number of units of volume in the sphere around which they revolve, will give the amount of kinetic energy, which is a constant for the same masses throughout all space; or the square root of the number will give the time, which is Kepler's harmonic law, viewed as a physical reality.

To give the appearance of a physical reality to the fundamental law of the heavenly motions might thus be consistently formulated:

An infinite sphere of stress and proportional condensation of ether is produced around every body by rapid mutual transmutation of substance, and resistance to breach of continuity, which, while permeating, is constantly striving to coalesce with all others in the effort towards etherial equilibrium: thereby resisting all impressed tendencies of the central masses to recession by altering the direction of their paths, combining with them in coupled motions, or bringing them together with a force inversely as the squares of their distances: the coalescing energies and moments of cosmical couples being directly as the masses.

Philadelphia, Pa.

WM. DENOVAN.

Zinc as a Preventive of Boiler Incrustation.

To the Editor of the Scientific American.

The articles on zinc as a remedy for boiler incrustation recall to my recollection an experiment of some magnitude in that direction, made half a dozen years ago by a party of which I was a member. Experiments on a smaller scale than that in question had proved that iron in contact with zinc was not only protected from corrosion during immersion in most fluids, but that any covering upon the iron would be removed by the action of one of these metals upon the other, or by their mutual action. This action was not confined in its operation to salts, oxides, resins, grease, and dirt of all sorts; but in some instances it loosened electro-plating. When the iron became perfectly clean, and the condition of the fluid used admitted of it, the latter when charged with oxide of zinc deposited the metal upon the iron by the well known galvanic process. The oxide of iron was removed with the same facility as any other substance; and this latter fact probably originated the prejudice against whatever thoroughly cleanses the boiler, such cleansing being supposed by some to cause leakage. Doubtless this mode of cleansing a boiler would take out iron rust even from the joints of the plates; but this should be taken as a needed premonition of danger, and the iron itself is absolutely protected from further oxidation in the presence of the zinc.

The experiment alluded to was within the boiler of an ocean steamer, plying between this port and Savannah. Zinc was introduced and suspended upon the tubes near the points of incrustation, and sundry necessary conditions were provided. At the termination of the trip, it was found that the zinc which was, wrongly, in sheets, had fallen down, having separated at the fold or bend over the tubes; it was eaten up at these points. The crust was about one third the usual thickness, showing, perhaps, that the trip was two thirds performed before incrustation began. The crust consisted of the usual salts accumulating in the use of sea water, and was deposited upon the zinc as well as on the boiler; but under the crust on the zinc, and between the two, was a uniform coating of black oxide of zinc in contact with and lying upon the latter. Clearly this oxide was placed there before incrustation took place; and my impression is that none would have been deposited if the metal sheets had been substantial enough to resist the wear and tear and the increasing weakness from oxidation. The remaining zinc and the crust, with the oxide between them, separated almost with a touch.

Although this experiment was in itself a failure, it was deemed conclusive of the fact as to the operation of zinc in preventing incrustation in boilers.

R. H. ATWELL.

Baltimore, Md.

Weight in a Hollow Sphere.

To the Editor of the Scientific American:

I have been interested in reading the communications that have recently appeared in the SCIENTIFIC AMERICAN in support of the hollow sphere theorem, notably those from Messrs. Pratt and Palin, page 181, current volume, each of which is an unanswerable demonstration of the truthfulness of the said theorem. The single point upon which I stumbled, as it clearly appears, was in assuming the force of gravity, as measured at the surfaces of spheres differing in size, to be directly as their respective masses. Upon this point the whole matter turns; and the proportions supposed to be hostile are at once harmonized. I was conscientious in my attack upon the theorem, doubting its truth; and it was my purpose to do so vigorously, and to use terms as to the significance of which there could be no mistake, hoping to provoke a controversy that would result either in its complete vindication or overthrow. I now cheerfully acknowledge my error, and am as thoroughly convinced of the truth of this oddly appearing theorem as I am of the truth of the properties of the triangle.

Rochester, N. Y.

E. B. WHITMORE.

THE French meter is inaccurate to the extent of $\frac{1}{37}$ of its length. Is short that much. So said Professor Hilgard to the scientists the other day.