The first law of motion laid down by Sir Isaac Newton (Princip. Math. Jes. Ed. tom. i. p. 15) is not a universal law, but is only capable of a restricted application. The incapacity of matter to alter its condition, whether of rest or motion, is a doctrine which becomes untenable when we examine matters which are always *proprio motu* altering their condition. Grave as such a statement may at first sight appear, we must begin with it if we wish to arrive at the truth.

Motion is the property which matter possesses of always changing its position relatively to other matter, and each little atom of the 64 elementary substances known to chemists contains a certain amount of tendency to move ; this is a part of its nature, it would not be what it is without this ; as that great mathematician, M. Poisson, says, the tendency to move resides in it. The five gaseous elements, for instance, have each their respective amounts of tendency to move residing in the atoms of which they are composed. Prof. Faraday says, in his "Researches in Chemistry," p. 454, "a particle of oxygen is ever a particle of oxygen—nothing can in the least wear it. If it enter into combination and disappear as oxygen—if it pass through a thousand combinations, animal, vegetable, and mineral—if it lie hid for a thousand years, and then be evolved, it is oxygen with its first qualities—neither more nor less. It has all its original force, and only that ; the amount of force, which it disengaged when hiding itself, has again to be employed in a reverse direction when it is set at liberty."

Now what is the meaning of the word *force* which Prof. Faraday uses here ? is it not the certain amount of tendency to move which I mentioned before ?

A particle of oxygen contains a certain amount of tendency to move, without which it would not be a particle of oxygen at all ; and this tendency it can never get rid of, "it has all its original force, and only that."

What, then, does the Conservation of Force doctrine amount to in plain English ?

It amounts to the simple admission that the tendency to move is a property of matter inseparable from it and coexistent with it, and it is this tendency to move which is the cause of all the changes which we observe around us.

There is, however, nothing new under the sun, for the old doctrine of Argan in *Le Malade Imaginaire* is revived again ; when Argan answers his examiner for a licence to practise in medicine, he says :—

Mihi a docto Doctore
Domandatur causam et rationem quare
Opium facit dormire
A quoi respondeo
Quia est in eo
Virtus dormitiva
Cujus est natura
Sensus assoupire.

Many a clever student has laughed at this answer who little thought that research and experience would confirm it so strongly as they now do.

The virtues of opium are chiefly dependent on the morphia which it contains, and morphia is one of the vegetable alkalis containing nitrogen in combination with carbon, oxygen, and hydrogen. The *virtus dormitiva* of morphia is the certain amount of tendency to move inherent in this combination ; and this tendency, if the morphia is exhibited in the human subject, comes in contact with and retards the tendencies to move which certain component parts of the body possess, and produces that state which we call sleep. The salts of morphia are largely used to allay pain and produce sleep. Dr. Bence Jones says in his Croonian Lectures on Matter and Force, p. 84, "Stimulants, tonics, and evacuants may perhaps not only take part directly in the motions of any part of the body, but they may also promote or retard the conversion of one motion into other motions. Specifics and alteratives may directly as well as indirectly change the motions in the system. And sedatives and narcotics may have the same double action in retarding or stopping the motions that take place. This view will almost lead us to consider all medicines as alteratives, and if so we may perhaps place stimulant and sedative medicines at the two extremes of the alterative actions ; the stimulants giving rise to the greatest increase of motion, and the sedatives allowing the least motion or the nearest approach to rest."

The practical student of our day, when he speaks of terrestrial matter being at rest, means that it is then moving at the same rate of motion as the earth itself. Prof. Ansted treats of motion thus :—"The first and greatest lesson that the students of Geography and Geology must learn is that motion is not limited to masses of bodies, but is actually taking place always and under all circumstances within all masses, whether solid, liquid, or gaseous, and often without approaching the surface."—"Physical Geography," p. 2.

The Universe is one mighty system of changes, and these changes arise from the inseparable connection between matter and motion ; and Dr. Bence Jones says truly, "The question between materialism and spiritualism is in fact only a question between ponderable and imponderable materialism."

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THE BIG GUN OF WOOLWICH

WHETHER considered as a weapon of terrible power or simply as a specimen of skilful and successful forging, the 35-ton Fraser cannon is without parallel. Of extraordinary strength and proportions, and withal so carefully, and one might almost say, elegantly finished, this magnificent gun is indeed a masterpiece well worthy of the greatest factory in England, from which it emanates. Cannon of larger dimensions have, it is true, been produced, capable actually of delivering a heavier projectile than that employed with the Woolwich weapon, but none of them are to be in any way compared with this, either in respect to battering power or length of range. That the gun is, moreover, not merely a show production, as was the case with the monster Krupp cannon, but a really serviceable and efficient fire-arm, is shown by its endurance of the severe test to which it was subjected at proof. On this occasion the 700lb. projectile was thrown from the gun by the enormous charge of 130lbs. of gunpowder—the largest, in fact, that has ever been safely consumed in any fire-arm—the explosion being without the slightest injurious effect upon the steel bore or surrounding wrought-iron castings. The solid cylinder of iron which constituted the shot issued forth at the terrible velocity of 1,370 feet per second, and, after travelling some fifty yards, buried itself in the butt of loose earth to a depth of thirty-three feet.

The pressure of the gas at the time of explosion was, as may be supposed, exceedingly great, and herein obviously lies the great difficulty to be overcome in the construction of large guns ; this pressure or strain, we find, increases in a much greater ratio than the amount of powder that is burnt would appear at first sight to justify, and for this reason large guns require to be proportionately much stronger than little ones. Thus, in the present instance, when a charge of but 75lb. of powder was fired, the pressure of the gas upon the copper piston at the rear of the projectile was shown to be seventeen tons per square inch, while 130lbs. of powder (not double the former charge therefore) gave a pressure amounting to sixty-four tons on the square inch. It has, by the way, been questioned whether this method of estimating the pressure, by means, namely, of a copper piston which is pushed in upon itself, affords a strictly reliable test, but in any case there can be no doubt that the strain upon the gun is increased in a greatly increasing ratio to the quantity of powder consumed. When we state, therefore, that the weapon withstood in every part this excessive strain, and that, under ordinary circumstances, the cartridge will contain but 90lbs. of powder, there is every reason to believe in the solidity and perfection of the structure.

The data obtained by the firing of the gun at proof lead us to hope for very successful results from its employment. It is calculated that at a distance of fifty yards the heavy projectile would be thundered forth with such force as to penetrate fourteen and a half inches of solid iron, an armour plate such as no vessels of our present construction are enabled to carry. At two thousand yards—at upwards of a mile, therefore—the shot would possess

enough penetrating force to pass clean through the side of the strongest ironclad afloat—those of the *Hercules* class —or, in other words, is endowed with impact sufficient to pierce twelve inches of iron ; and it must be remembered that this last-named distance is one at which gunners can make very good practice, so that, under ordinary circumstances, every other shot would take effect against a target such as is presented by the keel of a large frigate. As regards extreme length of range, a quality of some importance, when, as in the recent instance of the Paris siege, great projecting power is of more importance than precision of aim, this Fraser gun may vie with almost any other, with the exception, perhaps, of Whitworth's cannon. The utmost distance to which "the Woolwich infant," as it has been nicknamed, will in all probability be capable of projecting a shell is about ten thousand yards, supposing the arm to be laid at an elevation of some thirty-three degrees.

So satisfactory, indeed, has this experimental structure turned out, that a further batch of sister guns have forthwith been commenced, and will serve to arm some of our heavy iron-clads which are now building. Only a small number of such weapons will be carried by these vessels —two, or at the most four, apiece—and thus our modern men-of-war will present a perfect contrast to those of a dozen years ago, when a ship, being regarded merely as a box of guns, sometimes received on board as many as a hundred and thirty cannon. Nevertheless, a broadside delivered from four guns of these giant dimensions (for the whole armament being carried in turrets may be brought to bear at one time), representing almost a ton and a half of metal, very far exceeds that which an old first-class three-decker could throw into her antagonist, and would indeed be sufficient to sink most vessels at a first discharge.

As regards the method of building up these large guns, we need say nothing, seeing that the subject was fully discussed recently in these columns. It may be of interest to know, however, that in the present instance as much as fifty tons of metal were employed in constructing the arm, and that at one time thirty tons of this was brought to a glowing white heat for the purpose of welding. The reverberatory furnace in which this massive coil was heated is an apartment in which a dozen persons could dine comfortably, and the length of the bars before coiling amounted to upwards of 1,200 feet. The length of the arm is sixteen feet and a quarter, and its extreme diameter fifty-six inches.

A NEW INEXTINGUISHABLE STORM AND DANGER SIGNAL LIGHT

THIS new Signal, possessing most remarkable properties, has now been brought before the public. It was first exhibited at the President's meeting of the Royal Society on 22nd April, when it attracted great attention. The peculiarities of the Signal Light are, that it is self-igniting when placed in water or thrown on the sea. Contact with water being the only means of igniting the lamp, it is inextinguishable when once ignited ; neither wind nor storm has any effect upon the flame. The light is of intense brilliancy, and of great duration, and can be seen for a great distance in the open-air. Photographs may be taken by the light of this new signal. Experiments were tried on the evening of 25th April, at ten o'clock, in the presence of some scientific gentlemen, to determine its brilliancy as a signal. A lamp was placed in a bucket of water on the top of Primrose Hill, and the light was so intense that after the signal had been burning for twenty minutes small newspaper-print could be distinctly read at a distance of seventy feet, notwithstanding that the night was thick and foggy. This new signal light will burn for over forty minutes. In construction the lamp is exceedingly simple, and so contrived that when once burnt the whole may be thrown away. The chemical preparation contained in the lamp is a solid, hard substance, free from danger ; not affected by heat, and so non-explosive ; and the signal is comparatively inexpensive. Its applications for marine signals are numerous. In case of shipwreck a few lamps thrown on the sea would illuminate the entire scene, and enable assistance to be promptly and efficiently rendered. For rocket-line apparatus it is equally valuable, as, bursting into a flame on falling into the sea, it would indicate the position of the rocket-line. In connection with life buoys it would be a mark to the drowning sailor. In life-boat services it would be a signal to the vessel in distress, and the brilliant light would greatly assist in the rescue. In cases of salvage, ships' signals, tide and harbour warnings, the duration of the light renders this new invention of great value. As a railway signal, to be used by the guards and station porters in cases of accident, it is equally available, and will be of great utility. The difficulties of preparing the chemical compound have been entirely overcome by Messrs. Albright and Wilson, of Oldbury, the contractors for the manufacture of the lamp for Mr. Nathaniel Holmes the patentee.

FRESHWATER BATHYBIUS

AT a late meeting of the Natural History and Medical Society of the Lower Rhine, the well-known zoologist, Dr. R. Greeff, noticed an organism inhabiting freshwater and approaching very nearly, both in its structure and mode of occurrence, the celebrated deep-sea *Bathybius Haeckelii* of Professor Huxley.

Dr. Greeff, as much as three years ago, published a notice (in Max Schultze's "Archiv für mikrosk. Anat." Bd. iii., p. 396) of a new shell-less freshwater Rhizopod, which was remarkable for its gigantic stature in comparison with all previously-known organisms of that kind. He called attention at that time to its occasional occurrence in great quantity in the mud of standing waters, and indicated that, on account of its peculiar structure, it could be referred neither to the true *Amœbæ* nor to the *Actinophryes*. Since that time, the author has never lost sight of this extremely remarkable creature, and he thinks it desirable no longer to keep back his observations, especially considering the high degree of interest that has been excited by the *Bathybius*-mud which has been discovered in the depths and abysses of the ocean (to beyond 25,000 feet).

As regards the occurrence of this freshwater organism, to which the author provisionally gives the name of *Pelobius*,* and which he considers to be truly comparable with *Bathybius*, Dr. Greeff states that it is found in many standing waters with muddy bottom, which have apparently persisted for a long time, and seldom, if ever, have dried up. Thus, near Bonn the bottom of the Poppelsdorf fish-pond is found occasionally to be *almost entirely covered with masses of Pelobius ;* to such an extent, indeed, that sometimes a glass vessel brought up from the bottom contains almost more *Pelobius* than true mud-particles, &c. The *Pelobius* never disappears in these waters, but remains throughout the year in great masses, sometimes in one place, sometimes in another. The cake-like lumps of mud which rise to the surface and float about there by the agency of enclosed gas and air-bubbles, especially during the warm season, also sometimes contain *Pelobius* in masses.

In their external form, in both the living and the contracted state, these organisms present the appearance of more or less spherical lumps, varying from one or two millim. in diameter down to the most minute points, scarcely perceptible by the naked eye. Middle-sized

* From πηλός, mud. [The name *Pelobius* has been long preoccupied.—Ed.]