

## REMARKS ON THE SUBJECT OF FORCE IN GENERAL.

BY JOHN A. ROEBLING.

[For the Scientific American.]

[Continued from page 123.]

Reduced to last principles, all difference between mechanical, dynamical and living forces or motions disappears. In every case motion is communicated. No motion is created or conjured up by any process whatever. Wherever energy is manifested it is caused by a disturbance of equilibrium, and this disturbance is caused by other disturbance, and so on to infinity. In other terms, the process of nature is a constant play of energies and movements communicated from one to the other.

Matter as the simple ponderable substance serves only as a vehicle of motion or energy. Energy in itself is simply the power to move a result of the principle of life. The different phenomena, therefore, which attend the display of the various energies of nature's life must be owing to the *scientific spirit* which directs these various movements. All motions are subject to mathematical laws, and consequently the science of mathematics, comprehended in its largest sense, can only supply the key which will unlock these mysterious movements. Human reason cannot be mistaken in this, because *itself* and mathematics are identical.

Luminar motion is a straight-linear, impulsive vibrating motion. It is the primary motion, forming the basis of all other motions. Caloric motion is centropertic, involving circular and spiral action, expanding and contracting. The tendency of gravity is towards the center, but its motion results in the ellipse. Magnetic motions, it is believed, are parabolic, and electricity is governed by the hyperbola.

As said before, motion is only communicated. The action of a waterfall may produce a thousand different results by communicating its motion. Wind is raised, vapor ascends, heat and electricity are evolved. By the gravity of the water wheels are turned and all kinds of machinery set in motion. Mechanical action again is converted into friction, heat, electricity and magnetism, etc., etc. Nothing is lost, neither is any thing created. All phenomena are but changes and conversions of the forms of matter, interwoven and interlocked to such a degree that only an infinite mind can comprehend the wonderful action and harmony of the whole.

The finest emotions of the human soul may be called up by mechanical action. A performer sits at the piano and expresses his musical ideas by mechanical action through the instrument. The latter being constructed in accordance with the laws of sound, musical harmony results from this mechanical performance, and it reverberates in the organism of the inner man through the channel of the outer ear. Here is a profound mystery, incomprehensible to a finite understanding. Musical ideas are converted into sound by mechanical action, and vice versa. If no relation existed between mind and matter could such phenomena take place? The truth is plain that all physical energies involve a spiritual principle, and that all mental phenomena involve material action.

There is no such thing as dead matter, neither is there an immaterial spirit. All energies result from spiritual action, outwardly manifested. Spirit and matter are as *cause and effect*; they are indissolubly connected, the one cannot exist without the other. Existence is life in degree, comparative life, and involves both, spirit and matter, the positive and the negative; their *polar* relations as *cause and effect* produce all energies and all phenomena of nature.

Motion is a translation of space into time and of time into space. Motion is an interweaving of space and time, but is antithetical to both. The principle of motion precedes the reality of space and time. The latter become actual relations through the reality of motion. Motion is the result of a process, and this process again involves motion. Notwithstanding the apparent circular logic of this statement, it is a deep truth, but its further elucidation would be out of place here, as it would lead to a purely metaphysical discussion. The reader is referred to a well digested essay on the origin of motion to Stallo's "Philosophy of Nature."

I will only add here, that the formation of natural

matter, or of concrete points, out of the abstract center, is identical with the production of motion itself, and also with the appearance of space and time. Motion, space and time, and matter, form a trinity in unity; they hail from the same spiritual source, and are born out of the same womb, and by one and the same act.

Motion or energy is a primary function of life. The principle of life is uncreated, and so is energy or motion. We can make no distinction between energy and motion, they mutually state each other. Motion or energy being given as the cause, outer matter results as the effect, yet the two state themselves simultaneously. It is a useless task to account for motion or energy on purely material grounds; as much so, as a material explanation of life will always leave the question unanswered. The human mind must accept life as an uncreated principle, as the final cause of existence: natural reason, therefore, can only comprehend its natural relations, but no more. The self evident truth of a final cause, however, must form the basis of every sound philosophy.

The energies of forces are as the square of velocity, and the simple mass. The mass is constant, the velocity may vary, as it is the result of inner energy, or communicated. The so called force of *inertia* is no force at all. *Inertia* is pure passiveness, whether at rest or in motion. Whatever the motion of matter may be, this motion is not the result of *inertia*, but the result of energy. There is no inertia to overcome. When a body is at rest its weight exerts a pressure. Now it is this very weight or pressure which has to be overcome before the body can be set in motion. Gravity has grown out of inertness, but acts only in one direction, towards the center, while inertness acts in no direction because it is simple passiveness. In raising a body vertically its gravity alone results and this is exactly equal to its weight; there is no inertia to overcome. Also when a body is suspended like a pendulum to a string, infinitely long and without any stiffness, in moving that body no inertia results. But motion cannot without conversion be suddenly communicated in *mass* or *quantity*, but only by small increments.

No motion can be maintained by inertia; energy is required because resistance is met everywhere. There is no vacuum; a nothing does not exist; matter is universal, consequently resistance; and wherever is motion there energy is at work.

Matter at rest exerts a pressure towards the center of the earth in consequence of gravitation. This is the force of gravitation arrested. Now the initial velocity of a body at rest will be 1 in the first unit of time, as soon as its support is removed. Pressure, therefore, may be considered a momentum, resulting from an initial velocity of 1. Pressure resulting from simple weight or tension, is a force whose momentum is equal to the weight or tension. To start a railroad train requires more force than to keep it in motion. On a perfect level and with perfect machinery, however, no more power will be consumed to start the train with an initial velocity than is needed to maintain this speed, provided this speed is *infinitely* small. By any increase of speed a portion of the necessary force, in place of communicating motion to the train, will be converted and not rendered useful. The resistance being as the square of speed, a much greater expenditure of force is needed for rapid starting and this great expenditure is usually charged to *inertia*, but erroneously.

Inertness, massiveness and ponderability are all identical. The momentum of a moving body, once acquired, will continue, until it is diminished, either gradually or brought to rest suddenly, by resistance. This momentum being the result of two factors, that is, motion and massiveness, it is plain that without massiveness, there can be no momentum, no force, no motion. This is equally true in a mechanical as well as in a dynamical sense.

Chemical action results from the presence and contact of opposites. In the measure of forces two values have to be distinguished, *volume* and *intensity*. The direct agency in chemical action appears to be electricity. Now in electric tension there are *volume* and *intensity*, corresponding to volume and intensity in the phenomena of sound. Tension is energy, either asserted or moving. The higher the tension of a musical string the greater will be the number of

vibrations per second, and the more intense and higher will be the sound. But the volume of motion, its massiveness, depends upon the quantity of matter moved. The volume of force, whether in sound or chemical action, would appear to be in the simple ratio of the mass of matter moved. In chemical action, therefore, this ratio should correspond to the atomic or equivalent number, because this represents the relation of weight or massiveness. In sound it is the mass of the sounding body. On the other hand the intensity of action in either case depends upon tension or rate of motion.

[To be Continued.]

## The new English Steamship "City of Boston."

The Inman new screw steamship *City of Boston* will form a valuable addition to the numerous and handsome fleet of vessels belonging to the Liverpool, New York and Philadelphia Steamship Company. For strength, speed and beauty, probably the *City of Boston* cannot be excelled, although she may be equalled. The *City of Boston* is 305 feet in length, 39 feet in breadth, 27 feet 6 inches in depth, and 2,278 tons, old measurement. The hull is built in six water-tight compartments, each bulkhead running from the keel to the spar deck, and, in effect, guaranteeing the greatest possible security to life should any accident occur at sea such as, under ordinary circumstances, would be likely to cause a ship to sink. To give additional strength the deck is from one end to the other made of iron plates of the best quality manufactured by the Mersey Steel and Iron Company, and upon the plates is laid the ordinary timber deck. The propelling power is supplied by a pair of direct acting trunk engines, of 350 horse power, nominal, the cylinders being 36 inches in diameter, having a three-foot stroke. The boilers are fitted with surface condensers and fired by wings. The screw has a pitch of 24 feet.

## To Catch Birds of Prey.

A correspondent of the *Irish Agricultural Review* sends the following ingenious plan for catching predatory birds:—

"Take an egg-shell, stuff it with yellow clay, and stick it on the top of a sharp-pointed stick. Put the stick standing upright in a pool or shallow stream of water. Now place a stone in the water, with only a small portion of it appearing over the surface, and on that place a good rat-trap, in such a position that the bird, to get at the egg, shall have no other place to stand on but the trap. Shake a few dead leaves on the trap, and he will soon have a magpie, if there are many about. Of course, he will turn the unbroken part of the egg-shell up. The clay is only put in to afford a hold for the stick. The success of this method depends very much on changing the trap occasionally, watching it closely, and taking away the birds as they are caught. Magpies are very knowing, and will soon learn what it is, and avoid it. I have killed numbers in this way; both gray-backed crows and magpies."

## J. F. Winslow and the Bessemer Process.

Mr. Holley thus dedicates his work on "Ordnance and Armor":—

"JOHN F. WINSLOW, Esq.—*My Dear Sir*:—The inscription of your name in this work on Ordnance and Armor, is not only gratifying to me on personal grounds, and appropriate from a civilian student in the Art of War, to a civilian ever foremost in improving and developing the *materiel* of war; but it is an expression of that respect, shared by my countrymen at large, for the liberality and enterprise to which, together with the efforts of your associates, we are indebted for the *timely Monitor*, the first home-made steel ordnance, and the introduction of the Bessemer process. I am, dear sir, very respectfully your friend,

"A. L. HOLLEY.

"New York, Sept. 21, 1864."

A MAN came to the Duke of Wellington with a patented article. 'What have you to offer?' 'A bullet-proof jacket, your grace.' 'Put it on.' The inventor obeyed. The Duke rang a bell. An aid-de-camp presented himself. 'Tell the captain of the guard to order one of his men to load with ball cartridge.' The inventor disappeared, and was never seen again near the Horse Guards. No money wasted in trying that invention.