

opposes its centripetal force, from perihelion to aphelion, and because at aphelion, the tangent of its orbit, is at right angles with its radius vector, and from aphelion to perihelion the angle between the tangent and radius vector is acute, therefore, the inertia of the planet co-operates with the centrifugal force from aphelion to perihelion.

Hence, *inertia*, in conjunction with the centripetal force, is sufficient in all cases of elliptic motion, to bring back the planet from aphelion to perihelion.

Again, the writer says, (p. 407) "the degree of ellipticity of each planetary orbit is due to the inclination of its axis." That the reader may judge how much weight should be allowed the author's statement, let this statement be compared with known facts.

The eccentricity of the earth's orbit is .0167922; that of Venus is .0068618. The inclination of the earth's axis is about  $23\frac{1}{2}^{\circ}$ ; that of Venus  $75^{\circ}$ . That is, the inclination of the earth's axis to its orbit is less than one-third that of Venus; whereas, the eccentricity of the earth's orbit is more than twice that of Venus.

The author's statement, therefore, is not only not supported by the facts, but is in conflict with the facts.

J. E. HENDRICKS.

DES MOINES, Sept. 3, 1881.

#### To the Editor of "SCIENCE":—

The prevailing scientific ideas of any period are regarded by the common people, and even by the scientists of that period as indubitable facts, without due examination of their origin or their foundation. But further thought and observation often compel a reluctant retreat therefrom. Thus present conceptions have all the weight of perfect truth. We call them "*facts*."

The rapid discoveries of the present age, and the unprecedented freedom of thought are disturbing all theories that are not well founded. The new law of Conservation of Force will cause the final destruction of every theory that is not in harmony with it. The paper upon the "Great Primordial Force" was but an effort to bring the explanation of the physical forces into consistency with that all-governing law.

That the paper should give rise to such questions as those proposed by our critic was most natural, and we shall endeavor to answer them in the same candid spirit in which they were asked.

1. Bodies fall by force of gravitation. Resistance to such fall of course produces light and heat, precisely as resistance to the motion of the electrical current produces the same. If we admit that the electrical current is convertible into these forms, by parity of reasoning, so is gravity.

2. The relations of matter and force seem adequately set forth in the paragraph referred to. (See "SCIENCE," p. 405.) Electricity, which in its tenuity pervades all matter, is abundantly demonstrated to be itself matter in varied form, as in the thunderbolt, the fire ball, and in the St. Elnios fire.

3 and 4. The only rational explanation, whether to us satisfactory or unsatisfactory, of the origin of force, is found in the hypothesis and admission of already existing force, the *primum mobile*. HELMHOLTZ says, that a body set in motion around the sun in vacuous space, and with a certain velocity will continue to move with the same velocity to all eternity. It is sufficient for us to know that the motion *is*, and the magnetism *is*, and thus we have the "celestial armatures" already in revolution,—the effects of which it is for us to observe. To us the effects are, and are called, the "physical forces."

Our critic is disturbed by our questioning of the dogma that "gravity acts inversely as the square of the distance,"—on the ground that if that force is weakened by the earth's being removed to aphelion, it could not again bring back the body to perihelion. We re-affirm FARADAY'S position; "The received idea of gravity appears

to me to ignore entirely the principle of the conservation of force, and by the terms of its definition, if taken in an absolute sense, 'varying inversely as the square of the distance' to be in direct opposition to it." But we would not rest the assertion upon any great name. It is evident that inertia can "bring back" nothing, that inertia, or momentum, or centrifugal force, or whatever other expression is used, may effect only motion in a straight line. Momentum, (which evidently is what the critic means by "inertia,") has no tendency towards circular motion. It is attraction, gravity, centripetal force alone that draws, or "brings back," and if that force is *weakened*, how can it make itself stronger? If once diminished (as the principle, "gravity acts inversely as the square of the distance" necessitates,) then the opposite force has the balance of power, has destroyed the equilibrium, and except some favoring force steps in to restore the lost ground, momentum, ("inertia") must forever send it farther and farther into space.

Finally, our critic in order to show that the electrical theory, which makes the inclination of a planet's axis to govern the ellipticity of its orbit, is not true to fact, adduces the instance of Venus. This asserted "*fact*" (?) that Venus' axis has an inclination of  $75^{\circ}$ , is wholly unfounded, Astronomers to-day are not so ready to assert it. The dazzling brilliancy of this planet prevents any positive disclosures as to the period of its daily revolution, to say nothing of the more delicate and difficult determination of the inclination of its axis.

Our distinguished astronomer NEWCOMB says:—The latest physical observations on Venus, with which I am acquainted are those of Dr. VOGEL, "Bothkamp Observations, 1873." The result to which these observations point is that the atmosphere of Venus is filled with clouds so dense that the solid portion of the planet cannot be seen, and no time of rotation can be determined." HERSCHEL said that he was never able to see any permanent markings on Venus,—but it is only by such markings that these determinations are made.

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#### MEDICAL CONGRESS NOTES.

(London, 1881.)

At the close of Professor Huxley's address, Mr. MacCormac followed with a statement, the most important items of which were that the number of members amounted to 3,210; that the sections had held 11 meetings, extending over 293 hours; that there had been delivered 464 written papers and 360 oral addresses. The attendance at the sections had been large, and had not shown signs of falling off even quite to the close. The museum was referred to as a great success, and the demonstrations of living patients had been attended by crowds each morning.

#### ENDORING VIVISECTION.

Sir James Paget then presented the following resolution forwarded by Professor M. Foster, from the Physiological Section: "That this Congress records its conviction that experiments on living animals have proved of the utmost service to medicine in the past, and are indispensable for its future progress; that, accordingly, while strongly deprecating the infliction of unnecessary pain, it is of opinion that, in the interest of men and animals, it is not desirable to restrict competent persons in the performance of such experiments." Pointing out that it was impossible to discuss such a resolution then, the President asked those who were opposed to it to record their names and votes at the close of the meeting. The resolution was then adopted with loud cheers, and no hand was held up in opposition to it.