

Hare
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REPLY TO A CRITICISM OF PROF. OLMSTED,
UPON THE ARGUMENTS RESPECTING
THE MATERIALITY OF HEAT,
ADDUCED BY DR. HARE.

IN the number of the American Journal of Science, for October last, I observe some strictures by Prof. Olmsted, on an essay of mine, on the question *whether heat can be motion*, published in 1822, in Vol. 4 of the same work.

The following passage is partially quoted, from Sir Humphrey Davy's Elements, by the learned professor, as introductory to his strictures.—I beg leave to quote it in full. "It seems possible," says Sir Humphrey Davy, "to account for all the phenomena of heat, if it be supposed that in solids the particles are in a constant state of vibratory motion, the particles of the hottest bodies moving with the greatest velocity, and through the greatest space—that in fluids, and elastic fluids, besides the vibratory motion, which must be conceived greatest in the last, the particles have a motion round their own axes, with different velocities, the particles of elastic fluids moving with the greatest quickness—and that in ethereal substances, the particles move round their own axes and separate from each other, penetrating in right lines through space. Temperature may be conceived to depend upon the velocity of the vibrations; increase of capacity on the motion, being performed in greater space; and the diminution of temperature, during the conversion of solids or fluids into gases, may be explained on the idea of the loss of vibratory motion, in consequence of the revolution of particles round their axes at the moment when the body becomes liquid or aeriform—or from the loss of rapidity of vibration, in consequence of the motion of the particles through greater space."

After his partial quotation of this passage, Prof. Olmsted proceeds as follows:

"He (Dr. Hare) has attempted to show, that the supposition that temperature results from the velocity of the particles of heated bodies, subjected to a vibratory motion, is inconsistent with the laws of mechanics. 'It is fully established in mechanics, (says Dr. Hare,) that when a body in motion is blended with, and thus made to communicate motion to another body, previously at rest, or moving slower, the velocity of the compound mass, after the impact, will be found by multiplying the weight of each body by its respective velocity, and dividing the sum of the products by

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the aggregate weight of both bodies.' He then proceeds to show that the phenomena of temperature do not coincide with this law. Thus, when water or mercury of different temperatures is added together, the resulting temperature is not a mean, as it would be, were temperature merely the operation of a law of motion; but the water is affected too little, and the mercury too much, to admit of our referring the change to such a law. Little as I am disposed to adopt the views of Sir Humphrey Davy, I cannot but think that Dr. Hare has here suggested an answer which is not altogether unobjectionable. The application of his rule or test, makes it necessary to suppose, that the particles subjected to impact, are all moving in the same direction—that they all actually come into collision, each upon each, and that they are non elastic; none of which conditions are capable of being proved actually to exist, although it is only when they are all present, that the law of motion which he adduces holds true—however, if Dr. Hare be allowed to have fully and clearly refuted the hypothesis of Sir Humphrey, his argument is still imperfect, for it by no means establishes the doctrine of the materiality of heat, to prove that Davy has failed of showing that it is a product of motion. Both parties, in my view, evince how idle it is to reason respecting chemical phenomena upon mechanical principles."

However "*idle*" it may be to advance mechanical principles as the means of explaining the phenomena of Chemistry, I assert that, *when mechanical principles have been brought forward as the means of explanation*, it is not *idle* to show the explanation thus founded inconsistent with its own premises.

Though I might have hesitated in applying to the reasonings of so great a man as Sir H. Davy, the epithet employed by Prof. Olmsted, I challenge him to point out in my essay any word which tends to show, that I do not think it idle to employ mechanical principles in reasonings on Chemistry.

We concur in disapproving of the hypothesis of Sir Humphrey Davy, but because I have met it with arguments upon its own basis, instead of briefly denouncing it, Prof. Olmsted accuses me, no less than the illustrious author, of polluting chemical science, with mechanical reasonings.

If these reasonings be idle, let the great English Chemist, who introduced them, bear the weight of Prof. Olmsted's animadversion. Besides erroneously holding me up as the friend of a method of reasoning, of which I am really the antagonist, the criticisms of Prof. Olmsted would convey to any person, who had not read my essay, an impression that I had

been so dull as to consider a disapproval of the hypothesis of Sir H. Davy as establishing that which I have myself espoused ; and that I had advanced no direct arguments in favour of the materiality of heat, although to such arguments, the latter part of the essay is devoted. I beg leave here to quote the reasoning, as I am still of opinion that it is unanswerable, notwithstanding the unaccountable neglect with which it has been treated by the professor.

“ We see the same matter, at different times, rendered self-attractive or self-repellent ; now cohering in the solid form with great tenacity—and now flying apart with explosive violence, in the state of vapour. Hence the existence, in nature, of two opposite kinds of reaction, between particles, is self-evident. There can be no property without matter, in which it may be inherent. Nothing, can have no property. The question then is, whether these opposite properties can belong to the same particles. Is it not evident that the same particles cannot, at the same time, be self-repellent and self-attractive ? Suppose them to be so—one of the two properties must predominate ; and in that case, we should not perceive the existence of the other. It would be useless, and the particles would, in effect, possess the predominant property alone, whether attraction or repulsion. If the properties were equal in power, they would annihilate each other, and the matter would be, as if void of either property. There must, therefore, be a matter in which the self-repellent power resides, as well as matter in which attraction resides.”

In support of my opinion, I also cited the radiation of heat in vacuo, agreeably to an experiment of Sir H. Davy himself, in which a thermometer in the focus of one mirror, is influenced by a hot body in the focus of another mirror, the whole being within an exhausted receiver. I will thank Prof. Olmsted to explain how heat can be transmitted under such circumstances, even with more ease than in pleno, if the cause of it be not material.

I did not dwell on this fact, because I supposed its importance generally known and admitted, and conceived that it would produce the most forcible impression, when viewed in its greatest simplicity.

In opposition to Davy's hypothesis, I had advanced several arguments, of which Prof. Olmsted notices but one. With respect to that, it does not appear to me that he has adduced any fact, or any learning, which can invalidate the application, which I have made of a rule admitted by him to be true to a limited extent. It is enough for me, if the case in point

fall within the limits of that rule. What is the case in point? The particles of two masses, mercury and water, while undergoing a vibratory rotatory motion, with unequal velocities, have their movements equalized by contact. Will Prof. Olmsted deny that the resulting motion ought to be nearest to that, to which the heavier particles were previously subjected?

The reasoning in my essay which Prof. Olmsted has overlooked, is as follows:—As, in order for one body, or set of bodies, in motion, to resist another body, or set of bodies, in the same state, the velocity must be as much greater as the weight may be less, it is inconceivable that the particles of steam should, by any force arising from their motion, impart to the piston of a steam engine the wanted power: or that the particles of air should prevent a column of mercury, almost infinitely heavier, from entering any space in which they may be included by beating it out of the theatre of their vibratory and rotatory movements.

Again, admitting it to be conceivable that the momentum of particles so light may be competent to such effects, it is utterly impossible that these could be permanently sustained; since in all cases where motion is communicated, what is gained by one body is lost by another: so that the motion of the body communicating the motion, is lessened at every impact, and finally ceases.—Further, since it is self-evident that a body, acting directly upon another, cannot produce a motion greater than its own, it is incredible that heated solids should, by any possible movements of their particles, produce the prodigious velocities, which, according to the disputed doctrine, must be attributed to aeriform matter, when its levity and its power of resistance, as above exemplified, are taken into view.

I must leave it to the reader to judge how far these arguments merit the oblivion, to which Prof. Olmsted would consign them.