SCIENCE:

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It has been well said, that the poorest day that passes over us is the conflux of two eternities: it is made up of currents that issue from the remotest past, and flow onward into the remotest future.

On the 27th of June, 1829, an event took place which was to have a marked influence on the intellectual development of the United States, for on that day James Smithson died at Genoa, Italy, bequeathing his whole fortune to the citizens of the United States, in trust, *"for the increase and diffusion of knowledge among men."*

On the 6th of December, 1838, President Van Buren had the satisfaction of announcing to Congress that the claim of the United States to this legacy had been fully established, and that the money had been received by the Government.

The question then arose, what plan could be devised to carry out the intentions of the testator. In other words, how could "the increase and diffusion of knowledge among men" be best accomplished.

One of the first proposals for utilizing the Smithsonian fund was a scheme of founding a university of high grade, to "teach Latin, Greek, Hebrew, Oriental languages, and other branches of learning, including rhetoric, poetry, laws of nations, &c." Fortunately, such counsel did not prevail, and after nearly eight years of debate, and even a proposal to return the money to England being voted on, a bill was passed by Congress organizing the Smithsonian Institution on its present basis.

Such, briefly stated, was the origin of the Smithsonian Institution, and in memory of its founder the present Secretary, Professor Spencer F. Baird, directed Mr. William J. Rhees to compile a biography* of James Smithson, this work being one of the most recent publications of the Institution.

The general scope of this work is good, and it must be admitted that some account of the establishment of this Institution was called for. We must, however, express our regret that such an elaborate description of Smithson's aristocratic connections was presented, especially as the history would have been equally complete without this superfluous addition. The connection of the "proud" Dukes of Northumberland and Somerset with Smithson was hardly of a nature to be recorded in a form which should constantly bring the facts before the present generation and posterity.

The circumstances of Smithson's birth cannot be ignored, but there is no reason why they should be paraded before the public; we therefore would have dispensed with the portrait of the first Duke of Northumberland in this volume, and relegated the history of his life and death to the highest shelf in the Smithsonian Library.

Stript of such surroundings, the memory of Smithson must ever be dear to the people of this country. He was a man thoroughly imbued with the spirit of true science, and an active and industrious laborer in one of the most interesting and important branches of research—"mineral chemistry." His happiest hours were spent in the laboratory, where he carried on a series of experiments, which were recorded in the transactions of the Royal Society of London and other scientific journals of the day. Such being the direction of Smithson's scientific pursuits, we trust that the advancement of the physical sciences may claim the attention of the officers of this institution, and that they may be more duly represented in future reports.

Since the death of Smithson, Chemistry has attained a higher rank among the exact sciences. New methods and instruments of analysis have been introduced, while other branches of science have advanced at an equal ratio. New means "for the increase and diffusion of knowledge among men," have come to light, and among these the production of improved scientific manuals, and the increased number and excellence of scientific periodicals and journals, may be mentioned as having largely contributed to such results. Science at the present day is no longer monopolized by a select few, but is claimed as the common heritage of the thousands who have the intelligence to appreciate its value in developing the highest faculties of man.

Thomas Carlyle considered that "to know the divine laws and harmonies of this Universe must always be the highest glory of a man, and not to know them the highest disgrace for a man." This Journal represents one of the latest attempts to place at the disposal of all interested in scientific pursuits and human progress, a weekly journal worthy of the subject discussed. We are glad to find that our efforts have been appreciated, and the constant receipt of letters of welcome, co-operation and aid, increases our hopes for the future. Among our latest subscribers, we find three residing in Japan, one in Lucknow, India, another in New Zealand, and the directors of the Royal observatories of Brussels, Lisbon, and Rome have added their names. If "Science" is thus in demand in foreign countries, we trust to find our home subscription list rapidly increase, which will enable us to enlarge and improve the journal in various ways, thus adding to its usefulness.

Lord Brougham observed, that to instruct the people in the rudiments of philosophy, and to obtain

* James Smithson and his bequest, by William J. Rhees, published by the Smithsonian Institution, Washington, 1880.

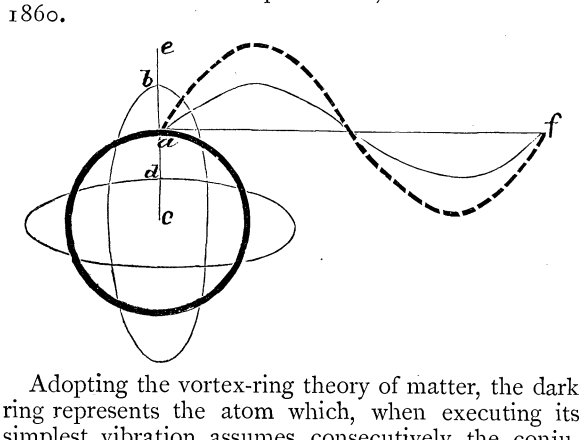
for the great body of our fellow creatures that high improvement, which both their understanding and their morals fit them to receive, is an object sufficiently brilliant to allure the noblest ambition. Without claiming such lofty aspirations, the promoters of "SCIENCE" yet look forward to the time when their efforts to establish this journal may be recognized as at least a step in that direction.

ON THE AMPLITUDE OF VIBRATION OF ATOMS.

PROF. A. E. DOLBEAR, TUFTS COLLEGE, MASS.

There is now sufficient evidence for the belief that the kinetic energy of atoms and molecules consists of two parts, one of which is the energy of translation or free path, the other of a change of form due to vibrations of the parts of the atom or molecule toward or away from its centre of mass. The pressure of a gas is immediately due to the former while the temperature of the gas depends solely upon the latter. These two forms of energy must indeed be equal to each other in a gas under uniform conditions; for if one exceeded the other in energy when there is as free a chance for exchange as among the atoms of a gas, there would result an increase of pressure on the one hand, or an increase of temperature on the other. Now the kinetic energy of a mass m and velocity v is expressed by $\frac{m\,v^2}{2}$ and applies as well to an atom as to a musket bullet, and if we take the mass of the hydrogen atom as unity and employ the calculated velocity of hydrogen atoms at 0° Cent. and 760 mm. pressure, namely 1860 metres per second, the energy will be $\frac{(1860)^2}{2}$.

We know also how many times the hydrogen atom vibrates per second, by dividing the velocity of light per second by some chosen wave length λ; so that $n = \frac{v}{\lambda}$. If attention be now directed to the vibrating atom possessing the same energy as in the free path movement, it will be seen that its *velocity of vibration* must also be equal to 1860 metres per second. But vibratory velocity is the product of a number n into an amplitude a, so that $v = na = 1860$.



Adopting the vortex-ring theory of matter, the dark ring represents the atom which, when executing its simplest vibration assumes consecutively the conjugate ellipses and any point a in the circumference will move over the line $b\ d$, the latter distance constituting the amplitude of the vibration. The limits to this movement must clearly be between $b\ d = 0$ when there is no vibration, the absolute zero of the atom and $c\ e$ which can never exceed $\frac{1}{2}\ \pi r$ and indeed must always be less than that value; for when half the major axis of the ellipse is equal to that it has become a straight line. As atomic vibrations result in undulations in ether it is evident that amplitude $b\ d$ will give an undulation $a\ f$ shown in continuous line, while maximum amplitude $c\ e$ would give same wave length shown in broken line. The greater the actual thickness of the ring the less must be the possible maximum amplitude.

The amplitude then becomes comparable with the diameter of the atom, and in this discussion the assumed diameter is the one given by Maxwell, namely .0000005 mm.

The numerical value of $\frac{1}{2}\ \pi r$ for such a diameter is .0000004 mm. which represents the theoretical maximum amplitude for a hydrogen atom.

If any hydrogen wave length be taken, say $C =$ .0006562 mm. the ratio of wave length to maximum amplitude is $\frac{.0006562}{.0000004} = 1640$, that is wave length is 1640 times such amplitude. But hydrogen C is not the fundamental vibration, but according to Stoney is the 20th harmonic of a fundamental having a wave length of .013127714 mm. and $\frac{.013127714}{.0000004} = 32819$. That is, it is 32819 times greater than the amplitude.

Now, Sir William Thomson, in his calculations on the amount of energy in the ether, assumed that the amplitude should not exceed one-hundredth of the wave length, but that value is evidently very many times too large. An undulation with the wave length of this fundamental for hydrogen is nearly twenty times longer than the longest one that can be seen; and as the sensation of light depends upon wave length and not upon amplitude, or what the energy of the ray, it follows that Dr. Drapers' deductions concerning the temperature of bodies beginning to be luminous will not necessarily apply to gases, for when extra energy is imparted to the atoms of a gas it is the amplitude of their vibrations that is affected, and if the impacts are sufficiently frequent some of the harmonic vibrations may appear continously, but they will not thereby necessarily indicate a higher temperature, but show that the energy is distributed in two or more periods, some of which have resulting undulations which may be seen; but this will depend upon the density of the gas. Suppose a body capable of vibrating a times per second for its fundamental, be struck b times per second; then will the rate of vibration be interfered with $\frac{a}{b}$ times. If b be less than a, then will the fundamental vibration have more than its required interval between impacts, and a certain number of these fundamental vibrations will be made per second. If b be equal to a, then, after the first impact, a will vibrate in its own period with increasing amplitude, without interference. If b be greater than a then will the impacts interfere in all phases of the vibrations, the fundamental will be destroyed, and only some harmonics and irregular vibrations will be possible; but the number of impacts