

whole problem is very complicated, and it is the writer's purpose merely to call attention to the importance of surface conditions in the production of the rare gases.

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THE FUNDAMENTAL EQUATION OF MECHANICS

MR. KENT, in his recent communication, invites expressions of opinion from Professor Huntington and myself regarding his method of explaining the principles of dynamics. My own view is that Mr. Kent's explanation of the effect of a constant force in giving motion to a free body initially at rest is entirely sound. It is, in fact, substantially the explanation I have long used in the classroom as a first step in establishing the fundamental equation of motion. Perhaps it is permissible to quote from my text-book on "Theoretical Mechanics," first published fifteen years ago:

If a force of constant magnitude and direction acts, for a certain interval of time, upon a body initially at rest, the body will have at the end of the interval a velocity whose direction is that of the force, and whose magnitude is proportional directly to the force and to the duration of the interval, and inversely to the mass of the body.

Since mass has already been defined as quantity of matter, this statement is seen to be identical in meaning with Mr. Kent's statement that "the velocity varies directly as the time and as the force, and inversely as the quantity of matter."

Mr. Kent's equation $V = KFT/W$ is entirely satisfactory and sufficient so long as our study is confined to the case in which a force whose direction and magnitude remain constant acts upon a body otherwise free and initially at rest. This is, however, a very exceptional case. The fundamental principle in its generality can be expressed only by introducing the notion of *instantaneous rate of change of velocity*, i. e., acceleration. When this is done Mr. Kent's statement quoted above must be replaced by the statement that "the acceleration varies directly as the force and inversely as the quantity of matter," while his equation $V = KFT/W$ is superseded by the more general one $a = KF/W$. This is

identical with equation (5) of my former communication,¹ except that quantity of matter is there represented by m instead of W .

To pass from the equation

$$\text{acceleration} = K \times \frac{\text{quantity of matter}}{\text{force}} \quad (1)$$

to the equation

$$\text{acceleration} = \frac{\text{quantity of matter}}{\text{force}} \quad (2)$$

of course requires that units should be defined so that unit force acting on unit quantity of matter causes unit acceleration. Mr. Kent regards this as an objection to equation (2). If the objection is valid a similar one seems to apply to his own procedure. His equation

$$V = 32.1740 \frac{FT}{W}$$

is true only because his unit force is defined as the force which would give a pound of matter an acceleration of 32.1740 ft./sec.² The statement that the accurate value $K = 32.1740$ is found as the result of "the most refined experiments, involving precise measurements of both F and W , and of S , the distance traversed during the time T , from which V is determined" is quite misleading. The stated value of K is not based upon any refined measurements of the character described, but upon a purely ideal definition of the unit force; just as the value $K = 1$ results from a different ideal definition.

If there is any reason for preferring the set of units which makes $K = 32.1740$ to that which makes $K = 1$ in equation (1), it is not because the former is any more easily understood than the latter. "The force which, acting upon a pound of matter, would cause an acceleration of 32.1740 ft./sec.²" is the same kind of a definition as "the force which, acting upon a pound of matter, would cause an acceleration of 1 ft./sec.²" It is true that the former of the two units of force thus defined

¹ SCIENCE, April 23, 1915, p. 609. It is well known that Mr. Kent objects to the use of the word mass for quantity of matter; my present object is to make my meaning clear rather than to invite an unprofitable discussion over a purely verbal question.

has nearly the value of that used in the "ordinary English system," and this may be regarded as an advantage.² The unit in "ordinary" use, however, is not and never will be the exact "standard" pound, because for almost all practical purposes the refinement of distinguishing between "local" and "standard" gravity-pull is of no importance. For precise work there appears to be absolutely no choice between the system which makes $K=32.1740$ and that which makes $K=1$ except that the latter simplifies the fundamental equation and all equations depending upon it.

Mr. Kent thinks the C.G.S. system "should not be inflicted on young students" because it is "only used in higher physical theory." The great majority of those who study mechanics are preparing for the profession of engineering. In view of the fact that in a large and increasingly important part of the present-day field of engineering—applied electricity—the units employed are based upon the C.G.S. system, it is difficult to assent to the view expressed by Mr. Kent on this point.

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March 29, 1915

CONDITIONS AT THE UNIVERSITY OF UTAH

TO THE EDITOR OF SCIENCE: In view of the fact that seventeen members of the faculty of the University of Utah have resigned their positions on the ground that it seemed to them "impossible to retain their self-respect and remain in the university," the council of the American Association of University Professors has authorized the appointment of a committee of inquiry to report upon the case. At the request of the president, the secretary of the

² The same advantage may be retained with the simpler equation (2) if we permit quantity of matter to be expressed in terms of a unit other than the pound. Why the reduction of quantity of matter from pounds to units 32.1740 times as great as the pound should be regarded as more puzzling than the reduction from pounds to tons or the reduction of a length from inches to feet, is something I have never been able to comprehend.

association recently spent four days in Salt Lake City investigating the situation in the university and collecting evidence to be laid before the committee. The special purposes and scope of the investigation are indicated in the extract from the letter addressed by the secretary of the association to the president of the university, which was printed in the issue of SCIENCE for last week.

The report of the committee of inquiry will be prepared and published at as early a date as is practicable. It is the purpose of the committee to present all the pertinent facts so fully in its report that university teachers may judge for themselves as to the administrative methods, and the conditions of professorial service, in the university. We make this statement in order that any one who is considering either the acceptance of a position in the university or the recommending of others for such a position, may look forward to a full knowledge of the situation in the near future, and may postpone immediate action in case he deems such knowledge advisable before reaching a final decision.

JOHN DEWEY,

President of the American Association of University Professors,

A. O. LOVEJOY,

Secretary of the American Association of University Professors,

EDWIN R. A. SELIGMAN,

Chairman of the Committee of Inquiry

April 30, 1915

UNNATURAL HISTORY

TO THE EDITOR OF SCIENCE: I am sure your readers will be interested and instructed, and the monotony of their daily grind relieved, by the following information regarding hitherto unsuspected details in the life history of the kangaroo. These facts were given out by a university student in response to the question: "Explain how the young kangaroo obtains its nourishment."

"Immediately after birth they are swallowed by the mother and finally lodged directly over the breasts, the teats being directed inwards.