

# **NEWTON'S LAWS OF MOTION**

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Newton's Laws of Motion by P. G. Tait

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**P. G. TAIT**

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BY

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## PREFACE.

No really intelligent conception of any one of the numerous branches of Natural Philosophy, still less of their intimate interdependence, can possibly be formed by a student until he has an accurate acquaintance with its unique basis, *The Laws of Motion*.

Yet, if the Teacher have but six months given him to discuss such an enormous subject, and be expected to deal impartially with its various branches, the time which he can devote to this indispensable auxiliary must be altogether inadequate. And in the three months' course, which is now required of medical students, it cannot fail to be almost ludicrously insufficient. Hence the imperative necessity that the student should to some extent be his own teacher in this all-important special region:—that he should be assisted in the endeavour to prepare himself, by previous efforts of his own, to follow intelligently all that his Teacher has time to say about it:—and that he should have the means of refreshing his recollections of it throughout the whole of the course. This forms *one* of my reasons for producing the present little book.

But there is another reason, at least equally strong; and, as it is practically independent of the first, their effect is strictly cumulative. There is, perhaps, no more striking example of the development of misdirected zeal into pernicious habit than that which is lavishly furnished by the practice of "taking notes." Of course I do not refer

to mere jottings as to the proper division of a subject, the order in which its parts must be treated, &c. Nor do I refer to the booking of isolated numerical data ; such as the number of particles in a cubic inch of air, the Centigrade temperature of Absolute Zero, the number of foot-pounds equivalent to a unit of heat, &c. This may or may not be laudable, but it is harmless at least, and sometimes useful. I refer to the attempts made, often by the most eager and diligent students, to record *part* (for it cannot be more than a part, usually a small part) of a chain of reasoning, while *necessarily* depriving themselves of what may be their only chance of listening to a connected exposition of the whole. None but a fully trained stenographer could take notes of any real value under such circumstances ; and even *he* would lose the unquestioned benefit of the spoken lecture ; while his record would probably not be so useful for future reference as would the corresponding paragraphs of some well-written text-book. Such chains of reasoning occur, of course, in all parts of our subject, but they are specially important in connection with its fundamental principles.

I have, therefore, endeavoured to prepare a short and pointed summary of the more important features of what I have called the basis of the subject :—and I have indicated by asterisks the portions which are not indispensable. Brevity has been persistently aimed at :—but, even in the present compressed form, each part of the subject treated has been dealt with far more completely than would be possible in the very best of “note-taking” by one who tries really to *follow the Teacher*, and is not a trained shorthand-writer. To such a man the present digest may be useful in two ways, besides saving him from his note-book and its insidious but fatal allurements:



—it may not merely help him to recall to his memory what he has already heard:—it may enable him so to prepare himself beforehand as to profit fully by what he is about to hear.

In the pursuit of brevity much has inevitably been omitted:—a single example (always, if possible, of a really representative character) being often all that is given for some special branch of the subject. But, while insisting on the fundamental principles, I have selected, as examples of their development, those consequences especially which have the widest applications throughout the whole range of Physics.

This does not pretend to be a Text-book, though its composition has involved more labour than has sometimes been required for a much bulkier volume:—still less can it be called a cram-book, for its contents are not presented in a form adapted to parrot-like repetition:—it is an attempt, on the one hand, to supply an acknowledged want; on the other, to remedy what is felt by many competent authorities to be little short of a crying evil.

It is now issued, after long delay, almost as much for the sake of profiting by some unintended hint from the sarcastic criticism which experience warrants my expecting, as for the help in teaching which I confidently anticipate from it.

P. G. TAIT.

COLLEGE, EDINBURGH,  
*September 1899.*

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## MATTER AND ENERGY.

Reason and experience force on all who rightly employ them the conviction of the objective reality of the Physical Universe.

It exists altogether independently of the senses and subjective impressions by which alone a conception of it can reach our minds.

Denial of this statement lands us at once in hopeless inconsistency. It is scientifically certain that the physical universe existed before there were any senses to perceive it; and that, during these ages, it would have produced sensuous impressions if organs of sense had existed. Although therefore it can only be conceived of as related to the senses, it has an existence altogether independent of the senses.

Acceptance of the statement leads to such difficulties only as exercise the ingenuity of Metaphysicians. The more reckless of the class have denied that the physical world is real; the more cautious of them have been striving to determine precisely what its objective reality means. Wishing the latter more success than they seem hitherto to have had, we leave the problem in their hands.

The objective realities in the physical world are of two