The Student's Dynamics, Comprising Statics and Kinetics

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PREFACE

This elementary treatise will be found to possess two main characteristics. In the first place, it treats the Science of Force, or Dynamics, as founded directly on Newton’s Axioms, or Laws, of Motion—and more particularly on the Second Axiom. That is to say, the notion of force which is adopted at the outset is that which measures it by the acceleration which it can produce in a particle of given mass. Hence no distinction whatever is made between force as it is dealt with in Statics and force as it is dealt with in Kinetics—“statical force” and “dynamical force,” as the works and teachers of a past generation most unscientifically and misleadingly expressed it.

Statics and Kinetics here go together from the very outset, and constitute the two divisions of Dynamics. The student is taught that they deal with the very same entity (force), measured in the same way in both.

This procedure is, of course, no novelty; for other treatises (few in number, however) had previously adopted it; and I am convinced that for the future it should be the rule instead of the exception.

The second main characteristic of the work is the great prominence given from the beginning, and throughout, to arithmetical illustration and calculation.

Long experience in teaching has convinced me of the great mistake made by teachers—especially in the old universities—in expounding the principles of a physical subject first by algebraical symbols, followed (if at all) by a few numerical calculations. The very reverse of this method is alone efficacious.

Arithmetic is the reality of every science; and the principles of every science are far more readily and tenaciously grasped when they are applied to definite, concrete, arithmetical ex-
amples than when they are presented to the learner in the shape of algebraical symbols.

I hold that unless a mathematical physicist can bring his knowledge of Electricity, Magnetism, Hydrodynamics, or any other branch of Science, down to arithmetical calculation, his knowledge is unsound and useless.

It will, then, be found throughout this work that the principles of every new part of the subject are always introduced by numerical, and not by algebraical, illustration: I make Algebra follow, not precede, Arithmetic.

So far as the amount of mathematical knowledge assumed on the part of the learner is concerned, I may say that I require the ordinary school-boy knowledge of Geometry and Algebra, together with the very rudiments of Trigonometry. Indeed, the knowledge of the properties of the sine, cosine, tangent, etc., of one angle is all that I require in Trigonometry.

In inviting students to commence the study of Dynamics without this slender trigonometrical foundation, the University of London has, in my opinion, made a most unfortunate mistake.

What can a student really know about resolving or compounding forces, or taking moments, if he does not know what a cosine means?

Examiners laugh at this attempt to proceed without the elements of Trigonometry, and are sometimes at their wit's end to avoid setting questions which violate this inconvenient restriction.

If the system is radically unsound—as I have no doubt that it is—it will be readily seen that large examining bodies, in adopting it, are exercising an evil influence on the school teaching of the country.

Proceeding to matters of more detail, it will be observed that I have dwelt very much on the subjects of Impulse and Momentum and of Work and Energy. The student who masters thoroughly the Dynamics of Pile Driving, or of the firing of a shot from a gun into a block of wood, may be said to understand nearly all that is important in the Dynamics of a particle.

Finally, in this work I have made another effort to banish that extremely misleading term centrifugal force. It is an evil
as great in this part of Physics as the terms electromotive force and magnetomotive force (which are not forces at all) are in Electricity and Magnetism.

The proofs were read over, and in several instances corrected, by my colleague, Professor Alfred Lodge, to whom I beg to tender thanks.

GEORGE M. MINCHIN.
ERRATA

In Example 5, page 56, for (a) 39 pounds' weight; (b) 26 pounds' weight, read (a) 39 pounds' weight; (b) 26 pounds' weight.

In Example 7, page 72, for $a=g$ read $3a=g$.

In Example 11, page 81, for distance from $O=50$ feet read distance from $O=250$ feet.

In Example 5, page 117, for $81$ read $83$.