PHYSICS

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649166022

Physics by Ernest Fox Nichols

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

www.triestepublishing.com

ERNEST FOX NICHOLS

PHYSICS

Trieste

PHYSICS

BY

ERNEST FOX NICHOLS

PROFESSOR OF EXPERIMENTAL PHYSICS
COLUMBIA UNIVERSITY

New York
THE COLUMBIA UNIVERSITY PRESS
1907

Set up, and published December, 1907.

PHYSICS

A LECTURE DELIVERED AT COLUMBIA UNIVERSITY
IN THE SERIES ON SCIENCE, PHILOSOPHY AND ART
AS THE OPENING LECTURE IN THE NATURAL SCIENCE GROUP
OCTOBER 23, 1907

PHYSICS

In the upbuilding of all the great and diverse departments of thought, characteristic methods have arisen which the human reason has found best suited to the pursuit of the many phases of truth which it seeks. In the perfection of methods and resourcefulness in applying them, no age has been more fertile than our own. Yet one ever present danger to the orderly and symmetrical development of modern thought, is that those working in different fields for its advancement may lose touch with one another, and the interchange of methods and results so essential to balanced growth, be neglected.

If in such a course of lectures as this, each lecturer coming from a neighboring or distant field succeeds in showing the nature of the evidence he has been taught to consider, his methods of weighing it and some of his results, the university will be the gainer in increased knowledge, in broadened sympathies and in a deeper realization of the wholeness of truth.

It is doubtful if our understanding of the unity of external nature can ever be illuminated by the lamp of any one of the natural sciences. The division of nature into separate departments of study has been an intellectual necessity caused by the greatness of the task.

The easiest cleavage would separate the animate from the inanimate, the biological from the physical sciences. This cleft, the first to form, will be the last to close; for to

define the precise relations of life to matter is now one of the most intricate and difficult problems in the whole range of human endeavor. Who will fundamentally answer the question, how does a seed become a tree?

The phenomena of inanimate matter are involved and complicated in the extreme, but those of living matter are even harder to understand. The outward or objective manifestations of life, are of a material or physical character, and the purpose of the biologist is to apply to them the principles of physics and chemistry as far as these will carry him, and in many directions they have already carried him far. When however we consider the subjective phenomena of life, or consciousness, the question seems to me a metaphysical one and we are without assurance that physics and chemistry can lead us beyond the boundaries of it. Indeed just where physics and chemistry leave off, I feel a real and deeper problem begins. If so, the question lies at present beyond the reach of natural science which biologist and physicist alike interpret as the science of matter and energy.

In what follows I shall try to review very briefly the principal ideas upon which modern physics rests and shall say something about where we think we have arrived in our search for knowledge. I need scarcely remind you that in the natural sciences as in more practical affairs, *how* we have arrived is as important as *where* we have arrived. I shall therefore spend some time in presenting detached fragments of the experimental evidence and inferences upon which certain conclusions are based, hoping in this way to illustrate some of the constructive methods of reasoning employed in research.

The ideas which underlie all our thinking are space, time and inertia or mass. With space and time as a background, the physicist must pursue inertia and everything related to it, along every conceivable path. In this pursuit

he comes upon four ultimate though related conceptions: Matter, Ether, Electricity and Energy.

The historical development of these conceptions cannot even be sketched in such a lecture as this, but it should be remembered an important part of our present knowledge of matter, and nearly all that we know of the ether and electricity, has been gained not immediately but by inference. In so many cases we see or know directly only the first and last link of a chain of events and must search by indirect means for the mechanism lying between.

At bottom, I suppose, the ether, electricity, force, energy, molecule, atom, electron, are but the symbols of our groping thoughts, created by an inborn necessity of the human mind which strives to make all things reasonable. In thus reasoning from things seen and tangible, to things unseen and intangible, the resources of mathematical analysis are applied to the mental images of the investigator, images often suggested to him by his knowledge of the behavior of material bodies. This process leads first to a working hypothesis, which is then tested in all its conceivable consequences, and any phenomena not already known which it requires for its fulfilment, are sought in the laboratory. By this slow advance a working hypothesis which has satisfied all the demands put upon it gradually becomes a theory which steadily gains in authority as more and more new lines of evidence converge upon it and confirm it.

If we now consider more closely the nature of the conceptions, matter, ether, electricity and energy, we shall later find that matter, ether and electricity possess some attributes in common, and if we take careful heed to what we shall understand by the word, we may call them substances. Energy appears as the measure of their possible interactions.

Taking energy first: All the numberless changes we