

**ENERGY IN NATURE: BEING, WITH
SOME ADDITIONS, THE SUBSTANCE
OF A COURSE OF SIX LECTURES
UPON THE FORCES OF NATURE
AND THEIR MUTUAL RELATIONS**

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Energy in Nature: Being, with Some Additions, the Substance of a Course of Six Lectures upon the Forces of Nature and Their Mutual Relations by Wm. Lant Carpenter

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WM. LANT CARPENTER

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ENERGY IN NATURE,

BEING, WITH SOME ADDITIONS, THE SUBSTANCE OF A COURSE
OF SIX LECTURES UPON THE

FORCES OF NATURE AND THEIR MUTUAL RELATIONS,

*Delivered under the auspices of the Gilchrist Educational Trust,
in the Autumn of 1881,*

BY

WM. LANT CARPENTER, B.A., B.Sc.,

FELLOW OF THE CHEMICAL AND PHYSICAL SOCIETIES, AND OF THE
SOCIETY OF CHEMICAL INDUSTRY.



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1883.

To my Father,

WILLIAM B. CARPENTER, C.B., M.D., LL.D.,

F.R.S., F.G.S., F.L.S., &c. &c.,

WHO HAS DEVOTED MUCH OF THE ENERGY OF A LIFETIME

TO THE SCIENTIFIC EDUCATION OF THE PEOPLE,

I Dedicate this Little Book.

P R E F A C E .

THE object of the following pages is to give to those who have had little or no opportunity of studying the subject, some idea of the mutual relations existing between the various so-called "Forces of Nature," expressed in the simplest language, but at the same time, it is hoped, with sufficient scientific accuracy. Whenever it is impossible to avoid the use of technical terms, they will be carefully defined and explained, and the illustrations used will, as far as possible, be matters of common experience. An attempt is made in the earlier pages to lay down clearly the distinction between *Force* and *Energy*, and to explain how the language of the older books on the so-called Forces of Nature, the Correlation of Forces, &c., has been of late modified

by the development of the doctrine of Energy and its Conservation. The book may be shortly described as an endeavour to expound in popular, yet accurate language, the meaning and consequences of that important principle known as the Conservation of Energy. Considerable pains, however, have been taken, especially in dealing with Electricity, to illustrate and explain the very latest developments of the subjects treated in the text, since the transformation of Mechanical into Electrical Energy by the dynamo-machine is a remarkably good example of the general principle. The substance of what is here written was delivered extempore by the writer to large audiences of artisans and others, under the auspices of the Gilchrist Educational Trust, in five Lancashire towns during the autumn of 1881, the lectures were abundantly illustrated by experiments, and by the projection of photographs upon the screen. It is believed that this was the first occasion on which the attempt was made to bring home to those who were not, in the

ordinary sense of the term, either educated persons or students of science, the important practical consequences arising out of, as well as some of the glorious thoughts suggested by the consideration of, that grand doctrine of the Conservation of Energy, probably the most sublime generalisation of modern times, since its effects are not confined to our own planet, but pervade the Universe.

So much interest was excited on the subject among the audiences to whom the lectures were addressed, and so many enquiries have been made for a book in which the subject is treated in a popular manner, as to create a belief that the publication of the substance of the lectures in book-form will meet a real want; although no one, probably, is more conscious than the writer, of the different impressions produced by essays on a subject, and by the same matter treated orally, with experimental demonstrations and other illustrative aids to the comprehension of what may be to many readers comparatively unfamiliar scientific truths.

I wish to express my obligation to Professor Balfour Stewart, and to one or two other friends, for valuable suggestions made to me while the book was passing through the press; and to Messrs. Macmillan, Mr. Stanford, Messrs. Longman, and the publishers of *Engineering*, for permission to reproduce certain illustrations.

36, Craven Park,
Hartesden, London, N.W.
September 1st, 1883.