

**A COURSE OF SIX LECTURES
ON THE VARIOUS FORCES
OF MATTER, AND THEIR
RELATIONS TO EACH OTHER**

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A Course of six lectures on the various forces of matter, and their relations to each other by
Michael Faraday & Sir William Crookes

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MICHAEL FARADAY & SIR WILLIAM CROOKES

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BY

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*Delivered before a JUVENILE AUDIENCE at the ROYAL INSTITUTION
of GREAT BRITAIN during the Christmas Holidays of 1859-60*

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PREFACE.

WHICH was first, Matter or Force? If we think on this question we shall find that we are unable to conceive of matter without force, or force without matter. When God created the elements of which the earth is composed, He created certain wondrous forces, which are set free, and become evident when matter acts on matter. All these forces, with many differences, have much in common, and if one is set free it will immediately endeavour to free its companions. Thus heat will enable us to eliminate light, electricity, magnetism, and chemical action; chemical action will educe light, electricity, and heat; in this way we find that all the forces in nature tend to form mutually dependent systems, and as the motion of one star affects another, so force in action liberates and renders evident forces previously tranquil.

We say tranquil, and yet the word is almost without meaning in the Cosmos;—where do we find tranquillity? The sea, the seat of animal, vegetable, and mineral changes, is at war with the earth, and the air lends itself to the strife. The globe, the scene of perpetual intestine change, is as a mass, acting on, and acted on, by the other planets of our system, and the very system itself is changing its place in space, under the influence of a known force springing from an unknown centre.

For many years past the English public have had the privilege of listening to the discourses and speculations of Professor Faraday, at the Royal Institution, on Matter and Forces, and it is not too much to say that no lecturer on Physical Science since the time of Sir Humphry Davy has been listened to with more delight. The pleasure which all derive from the expositions of Faraday is of a somewhat different kind to that produced by any other philosopher whose lectures we have ever

attended. It is partially derived from his extreme dexterity as an operator,—with him we have no chance of apologies for an unsuccessful experiment, no hanging fire in the midst of a series of brilliant demonstrations, producing that depressing tendency akin to the pain felt by an audience at a false note from a vocalist. All is a sparkling stream of eloquence and experimental illustration. We defy a chemist who loves his science, no matter how often he may himself have repeated an experiment, to feel uninterested when seeing it done by Faraday.

The present publication presents one or two points of interest. In the first place, the Lectures were especially intended for young persons, and are therefore as free as possible from technicalities; and in the second place they are printed as they were spoken, *verbatim et literatim*. A careful and skilful reporter took them down, and the manuscript, as deciphered from his notes, was subsequently most carefully corrected by the Editor as regards

any scientific points which were not clear to the short-hand writer; hence all that is different arises solely from the impossibility, alas! of conveying the manner as well as the matter of the Lecturer.

The interest which was felt in those numbers of the *CHEMICAL NEWS* in which the lectures appeared was so great that the republication of them in a separate form was considered to be almost a duty to those young lovers of science to whom a purely chemical journal with its inevitable technicalities would be a sealed book. May the readers of these lectures derive one tenth of the pleasure and instruction from their perusal which they gave to those who had the happiness of hearing them!

W. C.

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LECTURES
ON
THE PHYSICAL FORCES.

LECTURE I.

THE FORCE OF GRAVITATION.

It grieves me much to think that I may have been a cause of disturbance in your Christmas arrangements⁽¹⁾, for nothing is more satisfactory to my mind than to perform what I undertake; but such things are not-always left in our own power, and we must submit to circumstances as they are appointed. I will to-day do my best, and will ask you to bear with me if I am unable to give more than a few words; and as a substitute I will endeavour to make the *illustrations* of the sense I try to express, as full as possible;