WITHIN THE ATOM: A POPULAR VIEW OF ELECTRONS AND QUANTA

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BY

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PREFACE

THIS volume is intended for readers who wish to obtain a familiarity with the basis of modern physical science. Without mathematical formulation it deals with modern theories as to matter and energy, emphasizing the granular structure and electrical nature of matter, and the apparently corpuscular character of energy.

The reader need have no previous knowledge of electricity, mechanics, or chemistry. For the appreciation of the evidence of certain critical experiments upon which modern scientists base their belief in electrons and in quanta of energy some knowledge of electricity, however, is required. To supply this in a quick and easy manner, the usual historical order of presentation is abandoned and the correctness of modern theories is assumed at the start. There are postulated the electron and its counterpart, the proton. In terms of these there are then described those few phenomena of electricity which are essential to the later consideration of the evidence. In this way, it is hoped most rapidly to introduce the reader to modern theories as to the invisible workings of the physical universe.

J. M.

WYOMING, N. J.
June, 1921.

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INTRODUCTION

In the constellation of Orion is the bright reddish star Betelgeuse. For centuries it served with other stars as a guide to mariners and as an object for consideration by philosophers and myth makers. Although we still retain the name given to it by the Arabs and still see it as the right shoulder of the mighty hunter, science has removed all but the nomenclature of the earlier animistic interpretation and substituted cold quantitative facts. Since our school days we have known that Betelgeuse is a sun, essentially like that which illuminates our earth. Very recently we have been told by Professor Michelson of Chicago as to its astounding magnitude—three hundred times the diameter of our own sun. The methods by which he arrived at this relationship involve interesting theories and required precise experimentation. Like the newspapers, however, of the day following his announcement let us be content for the moment with the fact itself.

In the midst of the universe in which Betelgeuse is but a speck exists a smaller sun on a planet of which there crawl what Bertrand Russell aptly called tiny lumps of impure carbons and water. What a shock to the ego-centricity of these carbon compounds to realize their quantitative insignificance in comparison with Betelgeuse.

About this larger sun there are probably encircling planets. Are there organic compounds on any of these and how do they arise from inorganic compounds as the ageing planet slowly cools? Are there conditions of temperature and atmospheric content which are accompanied by such chemical changes? If organic substances can be formed will life appear on the planet? What intimations of the evolution of life can be found in modern science?

Our questions grow by association, overlapping one another, repeating and varying their content; and our apparently unbound speculation leads only to further questions. Some answers and much material for thought are vouched by modern science although the specific question as to the mechanism and process in the evolution of life remains unanswered.

What in fact do we mean by life? The caterpillar in its cocoon awaits the proper temperature for its metamorphosis: the radioactive atom spontaneously emits an electron and becomes a new substance. Both caterpillar and radioactive atom are but stages in a sequence of events, the one to be followed by more caterpillars all of which will differ slightly from the original and the other by more atoms which will differ radically from the original. The comparison is not too seriously intended although it is safe to say that the offspring of the radium atom will be moving in fast circles ages after the descendants of the moth have perished from the face of the earth.

When we have reached a satisfactory definition

of life shall death be its negative? Are life and death merely convenient terms which we loosely apply to phases in a wide process of continuous change? and what are the entities which are conserved during the change? To the last question science today may apparently give answer for in energy and in electricity it has two entities which are conserved in amount. The former manifests itself by changes in the location of the latter, for electricity is the only known constituent of the ponderable matter of which our universe is composed.

Whether we are interested in speculative questions like those just mentioned, in less speculative but yet unsolved questions like the mechanism for the transmission of stimuli by nerves, or in the purely practical matter of the efficient organization and operation of the multiplicity of machines which condition our daily lives, we must seek explanations in terms of energy and electricity.

The reduction of the number of unknowns with which science deals is a recent advance which has followed discoveries like those of radium and X-rays. Widely different branches of science are now known to be dealing with the same fundamentals of electricity and energy. For the first time in centuries there exists the material which a genius could synthesize into a universal science, in which physics and chemistry, biology and geology, will lose their identities in a common set of principles.

So rapid, however, has been the advance of science toward this simplification of terms and prin-