Books

The Restless Atom

by Alfred Romer

Doubleday Anchor Books .... *$.95*

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The Restless Atom belongs to the Science Study Series published by the Physical Science Study Committee of Educational Services, Inc., whose main purpose is to provide collateral reading for the secondary school physics program now being developed by the committee. However, the level of presentation is aimed not only at the high school student, but also at the college undergraduate and the general public, by offering to them "the most stirring and fundamental topics of physics, from the smallest known particles to the whole universe."

In keeping with this objective, Romer's book is devoted to the discovery of radioactivity and the disentanglement of the laws of spontaneous transmutations of atoms during the 20 years from 1895 to 1915. The author succeeds in fulfilling the aims of the series since his presentation is accurate, but at the same time skillful and sufficiently lively to hold the interest of the reader.

The work described in the book was intimately interwoven with obtaining the definite proofs for the existence of atoms and elucidating their structure. The author even writes in his preface: "This is a book about the experiments by which we have gained one section of our knowledge of atoms and the way in which they behave." But if this was his primary aim it is hard to understand the omission of certain material which would have rounded out the subject of the book without appreciably adding to its bulk.

(1) More might have been said about the discovery of the electron, which was entirely independent of Roentgen's x-ray discovery although almost contemporaneous with it. Romer regards the x-rays as the beginning of modern physics, but the conception of the electrons was at least of equal importance. It is mentioned in the book that J. J. Thomson was the discoverer of the electrons but nothing is said about the circumstances.

(2) Of considerable value would have been some reference to the cloud chamber experiments of C. T. R. Wilson, making visible the tracks of electrons and x-particles. This was the most palpable and dramatic demonstration of the existence of elementary processes.

(3) The author justifiably writes a good deal about the periodic system of elements, but the culmination of its understanding in this period is unaccountably not sufficiently emphasized — namely the realization that it is the nuclear charge of the atom and not its weight that determines the position in the system. The Soddy-Fajans rule that led to it is mentioned, but the text seems to imply that nuclear charges and atomic weights lead to the same result.

A factual inaccuracy occurs on pages 32-33 where a figure and its long caption (entitled "Pierre Curie's Electrometer") purport to describe and illustrate Marie Curie's way of measuring radioactive intensities. In reality the method used by her and previously developed by her husband was materially different. Pierre Curie's electrometer, though a good instrument, was of the standard Kelvin type and was used by the Curies only as a zero device. The essence of the method was to balance the potential difference to be measured against a piezo-electric quartz crystal, which could be done in a rapid and precise way, the electrometer serving as yes-or-no indicator. Pierre Curie, jointly with his brother Jean, had established the Curie laws of piezo-electricity in a famous investigation for which they received a prize from the Academie des Sciences. The piezo-electric quartz instrument for accurately measuring small voltages was a by-product of this work. Its availability was one of the main reasons why Marie Curie undertook the investigation of radioactivity.

Also, in another connection, Romer's writing is less felicitous when it deals with the scientific background of early times remote from his own. On

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page 16 he makes the statement: "In 1896 not many physicists believed in atoms." On page 21 he amplifies it: "In spite of all the chemist knew, the physicist found very little about the atom that he could fix his mind on . . . It seemed necessary to leave it out of physics altogether, and what gets left out can hardly seem real."

The facts are otherwise: The kinetic theory of gases was founded in the late 1850's by Krönig and Clausius. By 1890 it had received a high development at the hands of Maxwell, Kirchhoff and Boltzmann, and could boast of spectacular successes in predicting the temperature independence of viscosity and the value of the ratio of specific heats, and in elucidating the nature of the entropy concept.

The atoms were no longer so elusive to physicists because the order of magnitude of their dimensions and absolute weights had been calculated from the data of viscosity and heat conduction. In the 1890's the standard physics courses in practically all universities contained some account of the kinetic theory. An important educational event was the posthumous publication of Kirchhoff's lectures on theoretical physics which was completed in 1894. After that, most universities provided an advanced treatment of kinetic theory either in connection with thermodynamics or as a special course.

Of the leading figures in physics only Planck had for a time some vaguely stated reservations, not so much against the atoms as against the statistical method; but on the whole the situation was that in the classroom and in the laboratory the physicists of the 1890's spoke of the atoms as of a scientific fact, although in their writings they thought it prudent to refer to them as a theory, or even a hypothesis.

This hedging was necessary because of a small but vocal group of philosophic hairsplitters who loved to bait the physicists by reminding them that they had no conclusive proof for the existence of the atom. Strangely, the center of this group of doubters was the famous chemist, Wilhelm Ostwald. Romer makes it appear that the custodians of atomism were the chemists, and perhaps they were, but Ostwald was an annoying exception. For a few years he was a source of great irritation to the physicists through his championship of this and other lost causes, in company with a few philosophers of the Machian school, until his contentions were disproved by the accumulating knowledge.

It must not be forgotten, however, that the older men – familiar with the early period through having lived and worked in it, or soon after it – did not write about its history. We must be thankful to Alfred Romer, who undertook this labor of love, even if his account contains a few unavoidable minor errors. Therefore, the present reviewer has no hesitation in warmly recommending to Caltech students this useful and interesting book, whose author is incidentally himself an alumnus (PhD '35) of our institution.