
CURRENT SCIENCE—50 YEARS AGO

Reviews

The Restless Universe, by Max Born. Authorised Translation by Wirifred M. Deans. (Blackie & Sons, London, 1935.) Pp. 278, Price 8sh. 6d.

There is a good stock of popular literature on modern physics in the English language. Jeans and Eddington are almost household words. Entirely new ideas as well as difficult and abstruse subjects have been presented in lucid manner with the discipline of English style by these master minds. Nevertheless Max Born's *The Restless Universe* (authorised translation) may be called a new venture in this line considering the high ambition with which the author sets out and the wonderful manner in which he seeks to realise it. The reading of the book is a first-rate intellectual treat.

The book is divided into five chapters, each of about fifty pages, on the air and its relatives, electrons and ions, waves and particles, electronic structure of the atom and nuclear physics. The author starts with the simplest type of matter, *viz.*, the gas and explains its essential properties by introducing the Kinetic theory of the molecules which are really the main objects of study in the first chapter. The statistical idea is introduced almost at the very start preparing the reader for the shocking surprise awaiting him in the later portion of the work that "all laws of nature are really laws of chance in disguise". After describing how actual beams of molecules can be produced to hit a target and how their number can be measured, the sub-division of molecules, chemically into atoms, their classification, the periodic table of elements are all brought in one sweep and the first step in the journey for the quest of the ultimate source of matter ends. The reader then crosses a boundary into a new realm populated with electrical beings: electrons and ions. The physicists now develop some refined sense organs to feel the existence of, to see and even measure these new creatures. The reader is now acquainted with Wilson Chamber, Geigar-Müller counter, and knows the charge of the electron, its mass and even the highly ethical unitary doctrine of identity of Mass and Energy. Then he comes almost to the heart of the problem. The electronic world often sends messengers

to the outside world of ours in the form of radiation and in turn receives such messengers from outside. The mystery then deepens. What is the relation of this messenger to the electronic population? The messenger, light, plays a dual rôle. While journeying in the outside world it is a wave but in the dealings with the atomic population it behaves as a particle of energy. On entering the realm of electrical charges it can knock out an electron with great speed to the outside world. The dual rôle is then found to be not only a characteristic of the messenger but also of the electron. Electron waves can be actually made visible on the photographic plate. The reader is then reconciled to the idea that matter is wave and wave is matter. The difficult subject of wave mechanics, probability wave and its bearing on the principle of causality are introduced gradually, and the reader learns that to understand the behaviour of the creatures of the new realm of electricity, one has to sacrifice the outside world law of causality which, as the author hints, is probably only a habit of thought.

Then comes Bohr's description of the new world of atoms. The electronic population within an atom is in a mad whirl round a citadel of positive charge called nucleus. This whirl may be described in terms of moving particles which curiously are restricted only to certain discrete paths which can be constructed only by adapting certain processes patented by the German physicist Planck more than thirty years ago. This was really the beginning of the modern quantum theory. Alternatively, a description in which the electrons are divested of their individualities and are regarded as waves in a certain conceptual space is also possible. The waves can only tell us about the odds that an electron will be found in a certain place but it will be quite in vain to think of the motion of the electron with time. Both processes are useful in understanding the observed behaviour of the electronic world but the latter ultimately proves to be more powerful. A host of phenomena previously considered to be unconnected or very imperfectly understood, now find unification within the electronic world of the atom.

The journey across the electronic realm takes the reader first through an outer region which is the region of activity of chemical changes and whence the

messengers are responsible for what are called optical spectra. The uplands are populated by electrons having more vigorous motion, and which send out more energetic messengers outside in the form of X-rays. Right up on the top is the citadel called nucleus. This is too strong to be penetrated by the ordinary means of the physicist. The history of the present-day advance in physics is really an account of the attempt by the physicists to storm the citadel.

The last chapter of the book describes the fundamental particles discovered by the bombardment of the nucleus, and the nuclear transformation which is a realisation of the dream of the alchemists of the Middle Ages by modern physicists (but not from a sordid spirit of lucre the author assures us). But here the reader is compelled to stop. The journey remains unfinished. Born's printer was once pleased to compose 'nuclear physics' as 'unclear physics,' and the author admits that the printer was not far wrong. For, after a successful journey over many an unknown and difficult region, the reader is now left on the citadel, the deepest centre of the material universe with the mystery wall still rearing its head proudly before him while off and on missiles sent from outside, or some of the inner population mysteriously leaking through the

wall bring very valuable information to the physicists. But the reader finds there is no solid ground underneath him anywhere. Starting from the outside world, looking into the sub-world of molecules shows them to be in continual motion colliding with one another. The electronic world inside the atom is in a mad whirl which becomes wilder and wilder the deeper one penetrates into the atomic layers. Besides, to be able to understand the workings of these lower sub-worlds one has to sacrifice his cherished outer-world ideas of wave and matter and even of casual principle. But the quest goes on and it is earnestly hoped that the scientists' love of truth will one day put him in possession of the secrets of matter, so far as it may be within the grasp of the human mind.

A novel feature of the book is the film and there are seven of them. I confess I have not been very successful with some of them but realise they will prove interesting to many, specially to the young readers. There are a few inaccuracies in the book, for instance on page 45 the proportion of hydrogen to oxygen has been inverted and the same defect occurs again on page 47, line 7.

N.R.S.

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