lightest eight elements these considerations give a unique structure, but more work is required on the heavier atoms.

The production of spectra is most simply illustrated by the lightest sub-atom, which is identical with the atom of hydrogen. If the electron is disturbed by an external stimulus it bounces, like an india-rubber ball on the earth, with a frequency which varies continuously as the amplitude decreases. This is accompanied by the radiation of a continuous spectrum, the limiting frequency (for zero amplitude) of which is the Rydberg constant, R. Similar bouncing of an electron in a molecule formed of two such atoms in line gives a continuous spectrum with limiting frequency, $R/2^2$, and the 'difference-frequency' between these two limiting frequencies gives the first line of the Lyman series. Co-operation of more complicated molecules yields the other lines of the hydrogen spectrum. By assuming equilibrium positions of the electron at different distances from the centre of the non-spherical positive mass, the characteristics of the secondary spectrum are similarly described in terms of difference-frequencies. The theory is extended to explain the spectra of the other light elements as well as X-ray spectra, and a few remarks on certain cosmic problems are added.

The author shows great ingenuity in interpreting the details of spectra, which he has taken the trouble to understand beforehand, and his idea is not to be ranked with certain fantastic alternatives to the quantum theory which have been suggested without knowledge of experimental facts. It cannot, however, be considered—at least in its present form—as a serious rival to the current interpretation of spectra. It follows facts throughout, often at a considerable distance, and it appears to be devoid of suggestions for increasing our knowledge. Moreover, there are many facts (for example, the existence and spectrum characteristics of isotopes), well accounted for by the quantum theory, with which it is not obviously able to deal at all.

These defects would be considerably discounted if the theory were, as it claims to be, based entirely on Newtonian mechanics, but the behaviour of the atoms and molecules in producing spectra by no means follows inevitably when Newtonian laws are applied to the assumed structures. In the last resort the theory requires postulates as arbitrary as those of the quantum theory, so that a satisfactory comparison can be made only on heuristic grounds, where it is not likely to survive. The author is, nevertheless, to be commended for having produced a very interesting and suggestive hypothesis and for his diligence in developing it so far as he has done.

Science and Poetry

The Poetical Works of Kenneth Knight Hallowes. Vol. 1: *1896–1934.* Pp. xvi+212+2 plates. (London: Methuen and Co., Ltd., 1934.) 7*s.* 6*d.* net.

MR. HALLOWES in his recent book has raised again an oft-discussed question and given some interesting illustrations of its possible solution. The question is how far can poetry express and keep pace with the discoveries of science. The illustrations are drawn from poems of Mr. Hallowes himself, when on the Geological Survey of India in the years 1905–23. In speaking of these, it will be sufficient here to point out that Mr. Hallowes has at least three of the essentials for carrying out the work to which he rightly attaches high importance. He has an observant eye, a passionate love of Nature and a profound sense of one of the greatest truths which modern science has revealed, namely, that the earth and all that it contains are subject to incessant change, and that what we see, though the result of these changes, is often to the superficial glance quite different. It is due to this apparently paradoxical transformation that Mr. Hallowes owes some of his most telling word-pictures; for example, "From rock once molten fire blue speedwells bloom". Such pictures of transformation are, as we might expect, frequent in the work of a man who from the starting point of geology sets out on the work of a poet of science.

How does science fare generally in the works of poets? Our contemporary bards tend to deal, in short and rather emotional fragments, with the psychology of persons or striking events. Such psychology is by no means scientific. If we look at the older poets of rather larger scope, we find that the ideas of the Greek philosophers, who were also the men of science, were quite naturally expressed in verse. There was no such barrier in modes of expression as have since arisen. Then, with the Romans, we have the immortal poem of Lucretius, which actually puts into verse a great scientific hypothesis. In the Middle Ages, Dante gives us in more poignantly human form the science and philosophy of his day. Among the moderns, it is noticeable that Goethe, the greatest poetic force of the nineteenth century, was also an important figure in the science of those times. Wordsworth, Browning, Tennyson, Sellby Prudhomme, Alfred Noyes have all written poetry inspired by science. One would be inclined to say that the general lack, of which Mr. Hallowes speaks, is rather due to the dispersive, uncontrolled and rather aimless character of much of the writing and thinking of the present day than to any long-standing divorce between poetry and science.

F. S. MARVIN.