

[geometrical optics] — [Newtonian mechanics]
 to the more extensive domain :

[optics in the widest sense] — [an appropriately widened type of mechanics]

Until Born suggested, correctly as I believe, that the wave formulæ in quantum mechanics are simply expressions of probabilities, Planck, like everyone else, found insuperable difficulties in reconciling the corpuscular features, for example, of light, with its very marked undulatory characteristics. This appears in a paper on the synthesis between wave mechanics and corpuscular mechanics, published in 1940 (*vide* Vol. 2, p. 685). Naturally he could not then appreciate the significance of the fact that the corpuscular aspect only appears when sufficiently small numbers of particles are involved and the wave phenomena (as in Sir Geoffrey Taylor's experiments) when enormous numbers are dealt with. With enormous numbers probabilities approach certainties, as the success of insurance companies indicates.

At the end of Vol. 3 is the address delivered by Max von Laue at Planck's graveside, some personal memories of Planck by Dr. Otto Hahn, and a short essay on his life-work by von Laue.

As the originator of the quantum theory Planck's fame will endure and his name will always rank with those of Newton, Clerk Maxwell and Einstein. But there is something more to be said about him: he was a kindly, good man—a great gentleman who endured patiently and bravely the sorrows and suffering which overwhelmed him in his later life. He was a real friend to me and I shall always remember one of his favourite sayings:

"Man muss Optimist sein". W. WILSON

OPERATIONAL RESEARCH

Proceedings of the First International Conference on Operational Research, Oxford, 1957

(Organized by the Operational Research Society, United Kingdom; The Operations Research Society of America; and the Institute of Management Sciences.) Pp. viii+526. (London: English Universities Press, Ltd., 1957. Published for the Conference Committee.) 50s. net.

THIS volume is one that no professional operational research worker can be without, for it gives a very wide sample of the types of problems which he may be likely to be called upon to deal with. It has already become a recognized source book in the short period since publication. Not the least valuable parts of it are the references to earlier work and the discussions, which have been kept commendably brief.

The volume may possibly leave a stronger impression than is desirable that operational research is not much more than applications of advanced mathematical and statistical methods to decision problems. On the other hand, the methodology of operational research is much more mathematical and statistical than general scientific; this conference was methodological, and so it is not surprising that the published matter exhibits apparent bias.

A weakness in industry is to think of operational research as solving problems which require these advanced methods (these are the cases which, inci-

dentally, can usually be published without breach of confidence) and excluding the class of problems which can be resolved by much simpler techniques. An enormous amount of progress can be made with little more mathematical equipment than the elements of the theory of functions, for after all what is a business enterprise but a mathematical function when represented in a form suitable for analysis.

A curious feature of the Conference Proceedings is that almost everywhere in the world military operational research seems to be ahead of industrial work. This is understandable in countries which were involved in military operational research during 1939-45. It is, however, less understandable in other countries.

This is not a work for business executives, unless they happen to be well equipped with a knowledge of mathematics and statistics. Perhaps this is unfortunate, but after all the object of the Conference was to aid the operational research scientist, rather than the employer. It is to be hoped, however, that much more attention will in future be devoted to educating the potential customer. British industry is undoubtedly making quite insufficient use of the men available who can apply scientific methods to problems at all levels from the board room to the shop floor.

The standards of printing and layout of the book leave nothing to be desired. K. PENNYCUICK

THEORY OF ROCKET FLIGHT

Exterior Ballistics of Rockets

By Prof. Leverett Davis, Jr., James W. Follin, Jr., and Prof. Leon Blitzer. Pp. v+457. (Princeton, N.J.: D. Van Nostrand Company, Inc.; London: D. Van Nostrand Company, Ltd., 1958.) 64s.

THIS book expounds the mathematical theory of the motion of unguided rockets stabilized either by fins or by spin, and launched either from the ground or from an aircraft. After defining the force-system the authors formulate the equations of motion and solve them under the usual approximation of constant acceleration, to obtain the ideal trajectory and to show the errors arising through malalignment of thrust, the action of gravity and wind, tip-off effects as the rocket leaves the launcher, and the various other hazards which mar the accuracy of this type of missile. The book ends with a useful collection of formulæ and tables of Fresnel functions.

The theory presented in the book was developed in the United States during and just after the Second World War, but the final report on the work was not printed until 1953. Before open publication was allowed, various items had to be deleted, and the authors also made corrections and a few additions. The book has been reproduced from the 1953 report thus modified, by a photo-offset process. One beneficial result of this procedure is that there are very few misprints: so high is the standard that the mis-spelling of Jeffreys on p. 166 comes as quite a shock. The authors write well, and they develop the theory in a logical order, fully explaining the physical basis for each step in the argument. The result is a book which is unlikely to be superseded for many years. Its value is enhanced by the pleasing layout and by the clarity of the print, especially the mathematical symbols and the diagrams (though there are a few messy diagrams, one of which seems to be a