Book Reviews

Ballistics in the Seventeenth Century. A study in the relations of science and war with reference principally to England. A. R. Hall. New York: Cambridge Univ. Press, 1952. 186 pp. Illus. $4.00.

It is easy to see why the seventeenth century, the age of the revolution in thought that first shaped our modern tendencies in science, has a special interest for historians and scientists. To what extent the new science—more especially the new dynamics of Galileo, Huygens, and Newton—can be explained in terms of the social and economic forces of the time, and how far it resulted from the internal laws of scientific progress, are questions on which students of the period are sharply divided. There have been staunch adherents of both extreme positions. A. R. Hall, assistant lecturer in the history of science at Cambridge University, makes an important contribution to our understanding of this broader question by examining closely the special case of ballistical investigations during the sixteenth and seventeenth centuries.

At first glance the influence of military technology on early science seems undeniable. It is well known that it was for the ostensible purpose of determining the ideal trajectory of a projectile that Galileo made his studies of falling bodies, developed his theory of inertia, and overthrew the structure of Aristotelian dynamics. This example has been repeatedly cited to illustrate the influence of military problems upon science. But Dr. Hall makes it clear that we have no right to infer from this an intimate collaboration between scientist and technologist; still less an immediate application of these discoveries to the useful arts. Although he would probably be the last to deny the interest of the seventeenth-century scientist in the world of practical affairs, yet he strongly insists that "men were led to discoveries in mechanics less by their practical usefulness than by the logic of historical development." The seventeenth-century contributions to ballistical science grew gradually out of the earlier tradition of scholastic speculations on motion, as modified by the impetus theory of the later Middle Ages and by the work of sixteenth-century theorists like Tartaglia. As we follow the progress of ballistical studies from Galileo through the time of Huygens and Newton, Hall demonstrates with great persuasiveness that the immediate purpose of these studies was scientific and mathematical; and that the results, since they assumed ideal conditions not encountered in nature, were not applicable to the needs of the practical artillerist. His examination of the manuals intended for the guidance of the soldier shows that, when they were not merely practical handbooks, they clung to the obsolete doctrines of the later scholastic physics long after the new dynamics had been universally accepted by men of science. No serious attempt to popularize the new parabolic ballistics was made until the last third of the century.

Dr. Hall has provided a useful corrective to some of our current notions by stressing the *de facto* independence of dynamical science from the fields of military technology and invention. But our author does less than justice to the ideology of utility that prevailed in the seventeenth century. The failure of the "new experimental learning" to find useful applications in this and that field of technology does not in itself justify treating its spokesmen as mere propagandists indulging in wishful thinking when they stress its social utility. Apart from the question whether men like Tartaglia and Galileo believed—as Hall's own evidence showed that they did—that they were making important contributions to the art of war, the fact remains that *immediate* utility and application were not what the apologists of the new learning habitually stressed. The new learning was defended as useful knowledge, first and foremost because it was the *kind* of knowledge that could be applied to the real world. Unlike scholastic natural philosophy, with which they were constantly comparing it, its concepts and theories were rooted in experience, and capable of verification by quantitative experiment. From Bacon onwards, with a vision and perception we can but admire, the apologists of this early modern science stressed not its immediate application to useful ends, but its eventual and long-term applicability. Bacon repeatedly warned against the "overhasty and unseasonable eagerness to practice" in the pursuit of this new approach to nature. This ideological position, carefully stated by the defenders of the Royal Society—we may perhaps describe it as the doctrine of the presumptive utility of abstract science—served to clothe even the most technical and abstract investigations with a mantle of social respectability.

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Origins of American Scientists. A study made under the direction of a faculty committee of Wesleyan University. R. H. Knapp and H. B. Goodrich. Chicago: Univ. Chicago Press, 1952. (For Wesleyan University.) 450 pp. $7.50.

A brief article in Science (113, 543 [1951]) has already acquainted its readers with one of the principal findings of this study: the tremendous differences in the percentage of male graduates of different colleges who later become scientists. From 1924 through 1934, the period which Knapp and Goodrich studied most intensively, the leading college in the United States was Reed College in Portland, Ore., which sent 13% of its male graduates on to scientific careers and later listing in *American Men of Science* with Ph.D. degrees, stars, or both. California Institute of Technology was next, with 7%. Then the list went down, through the University of Chicago, which was 16th with 4%, Rochester in 38th place with 3,