

equalled until the time of Tycho Brahe, but not necessarily that they were so used.

Troubled by these doubts I do not yet feel able to follow Thom in his interpretation of the grid-like stone rows of Caithness. He argues that they were used not as sight-lines but as computers for extrapolation of the observations of the monthly standstills of the Moon, to give a more accurate value for the extreme position at the 18.6 yearly major standstill than could be observed directly. Again we are speaking here in terms of minutes of arc, not degrees, and the interpretation depends on the demonstration that such accuracy of observation was in fact achieved in prehistoric times.

The exposition in the book is both lucid and compelling, although fairly tough going for anyone, such as myself, who has to learn his astronomy as well as his megalithic metrology from Thom. It is an exciting book, enlarging, like its predecessor, our view both of what prehistoric man may have achieved and how we may know of it. Prehistoric archaeology is fortunate to have in Thom so skilled and forceful an advocate for "megalithic" man. The evaluation and the interpretation of these results is now a challenging task for the prehistorian.

COLIN RENFREW

Medieval Optics

John Pecham and the Science of Optics—Perspectiva communis. Edited with an introduction, English translation and critical notes by David C. Lindberg. (The University of Wisconsin Publications in Medieval Science.) Pp. xvii+300. (The University of Wisconsin: Madison, Milwaukee and London, November 1970.) \$15.

IN recent years our understanding of medieval science has been greatly enhanced by the "University of Wisconsin Publications in Medieval Science" under the general editorship of Professor M. Clagett. Professor Lindberg's volume, the fourteenth in the series, is a particularly welcome addition, dealing as it does with medieval optics, a subject which has suffered from comparative neglect. John Pecham's *Perspectiva communis* was a particularly influential short textbook on optics, and Lindberg lists sixty-two extant manuscripts and eleven early editions. The author was a Franciscan friar and, from 1279 until his death in 1292, Archbishop of Canterbury. Lindberg thinks that most probably he composed the *Perspectiva communis* in the period 1277-79 when he was teaching at the Papal University in Viterbo and Rome. After the first composition, which Pecham says that he did not intend for publication, he wrote a new recension, which paradoxically

is only fully extant in one manuscript.

In his carefully established edition, Lindberg makes both versions accessible to us, although this only occasionally requires him to give parallel texts. His English translation makes the work much more approachable by the modern reader, but he admits that he has translated less literally than he would have if he were not providing the Latin text. This occasionally leads him into interpreting Pecham's thought in ways that may not be universally acceptable.

Lindberg finds that Pecham's treatise is based principally on the *Optics* of Ibn al-Haitham (known in the West as Alhazen) who flourished in Egypt in the late tenth and early eleventh centuries. Lindberg also sees the influence of various other writers including Robert Grosseteste, Roger Bacon and probably Witelo. In the case of Pecham's relation to such authors I rather missed the more extended critical discussion of the type given in recent editions in this series by E. Grant and M. Clagett. I would also like to have seen rather more of the obscurer passages of the treatise subjected to such discussion, and a feeling of curiosity remains about the *Tractatus de perspectiva*, which Lindberg regards as being an earlier work of Pecham's, but which is barely mentioned in his introduction. I hope that financial stringencies have not limited this volume undesirably. Nevertheless we are provided with copious references by means of which such problems may be more easily investigated.

The *Perspectiva communis* is divided into three parts in accord with the ancient division into optics, catoptrics and dioptrics. In the first part Pecham accepts a basically intromission theory of vision but still holds that the "natural light of the eye" is necessary to make the incident rays proportionate to the visual power. He adheres chiefly to the rectilinear propagation of light, but somewhat complicates the situation by at times speaking of a natural tendency of light to roundness and of a secondary diffusion outside the main beam. The modern reader will also realize that more mathematical precision could have been obtained if Pecham had not so often spoken in terms of pyramids of light rather than rays. When considering reflexion in the second part of the work Pecham of course recognized the equality of the angles of incidence and reflexion, but his treatment of refraction both in the first and in the third part is so bound up with his idea of its cause that only a qualitative account is given.

Our own education often disguises from us the difficulties that early writers had to face. It is not the least of the values of editions such as this that they bring these difficulties forcefully to our notice.

A. G. MOLLAND

Spells, Bound and Broken

Religion and the Decline of Magic: Studies in Popular Beliefs in Sixteenth and Seventeenth Century England. By Keith Thomas. Pp. xviii+716. (Weidenfeld and Nicolson: London, January 1971.) £8.00.

HISTORIANS have been so impressed by the innovatory nature of modern science that there has been a tendency to ignore or undervalue the systems of natural philosophy which were discarded during the triumphant march of progress. Neoplatonism, Aristotelianism and the magical systems have been regarded as stumbling blocks, inhibiting the scientific enlightenment. This has inevitably generated a view of the great scientific pioneers as men standing apart from their cultural environment, in which authoritarian and traditional beliefs persisted tenaciously among the educated classes and persisted most among the uneducated.

Recent researches have produced a strong impression that our simple established estimates of scientific progress are seriously deficient. The scientists of the seventeenth century from Gilbert to Newton, hitherto celebrated for their workmanlike independence and lack of susceptibility to metaphysical speculation, have proved to have strong intellectual affinities with formally discredited intellectual movements. We are now forced to consider whether the animism of Gilbert, Boyle's interest in witchcraft, or Newton's alchemy represent intellectual aberrations or integral parts of their natural philosophy.

Resolution of this issue has been handicapped by lack of serious historical studies of the non-mechanistic world views. The present book by K. V. Thomas repairs this neglect in a brilliant, superbly documented and comprehensive study of magic, witchcraft and astrology in England during the sixteenth and seventeenth centuries. This period is sufficiently broad to exhibit the genesis and unfolding of experimental science and the spectacular decline of magic during the final decades. An important contributive factor to the success of this book is the author's controlled and sensitive use of the methods and materials of social anthropology. Like the best writings on the latter subject, this book gives a sound balance between the analysis of data and general assessments. With scientific thoroughness the author depicts the problems and goals of Tudor and Stuart communities, magic being relevant to this situation at many points. Throughout the book, I was impressed by the relevance of this background to the understanding of the outlook of the pioneers of experimental science.

The interaction between established