

of the subject. It is, however, a valuable reminder of what can be done with simple equipment, and those with sufficient patience to stick with this book will not be unrewarded.

P. F. DALE

## MAGNIFICENT DESOLATION

The Times Atlas of the Moon

Edited by H. A. G. Lewis. Pp. xxxvii+110. (Times Newspapers Limited: London, December 1969.) 95s.

FOR your money you get thirty pages of articles on the Moon, on mapping the Moon and the techniques of getting there, and of course the maps—110 pages of them, based on the charts produced by the US Air Force Aeronautical Chart and Information Centre. (Strangely, not the most complete set. Several tantalizingly blank areas of *luna incognita* appear on the far side maps.) The charts are, of course, a tribute to painstaking work in the United States beginning with mapping from photographs taken at the Pic du Midi, Yerkes, Lick and Mt Wilson observatories, and continuing with the Lunar Orbiter missions and the Soviet investigation of the far side, chiefly with Zond 3. Most people would rather the Orbiters had spent less time scanning the equatorial maria for allotment-sized crater-free areas and more time looking at more fascinating parts of the Moon, but that was the demand of the Apollo project. Without it there would have been none of the later Orbiters in polar orbits which made the photographic coverage of the Moon better than that of the Earth, providing the new breed of lunar geologists with enough material for a lifetime.

The 110 maps, then, which cover the best part of the front of the Moon, are at a scale of about 20 miles to the inch. The excepted parts are the polar regions beyond about 65° of latitude, and the limbs beyond 70° from the zero meridian (less at higher latitudes). The only coverage of these awkward areas is on the front and back endpapers, which are small scale maps of the northern and southern hemispheres. Then the far side, rather oddly, is elsewhere in the atlas, buried between a general article on the Moon and one on mapping. The area between 48° N and 48° S is given about 17 inches by 9.5 inches, with two separate projections for the polar regions. They are without the contribution from Orbiter 5, however, and hence the white patches. The accompanying text is a fair enough résumé of what is known about the Moon, although in places one feels that the stress might have been misplaced, and it is not without its errors. It seems to have been written at the time when the first news about the Apollo 11 specimens was leaking out of Houston, and enshrines the view that titanium is common in the maria.

It seems to me that the reproduction of the otherwise excellent illustrations in the text is not as good as it might have been. Green has been used lavishly. Many of the Apollo 8 pictures came out green of course, but in the atlas they look positively verdant, including one which I remember as blue when it first appeared. Somebody seems to have been inspired even to give the Orbiter photograph of the Alpine Valley a green cast—surely stunning enough in its original black and white. The Apollo 8 view of Goclenius gets the same treatment, and Copernicus from Orbiter 2 is battleship blue. One would like to have seen more use of the incredibly detailed Orbiter photographs, but not this way.

People will enjoy using the atlas, more I suspect for seeing how the published photographs from lunar flights fit in than for following the journeyings of the astronauts on the surface, which for the time being at least are going to be on too small a scale to register on these maps. It ought to be bought by libraries, but one wonders whether the non-astronomer, the extremely devoted excepted, would get enough out of it to make the outlay worthwhile.

EDWARD PHILLIPS

## GROUNDING IN STATISTICS

Statistics and Experimental Design

By Geoffrey M. Clarke. (Contemporary Biology.) Pp. xi+161. (Arnold: London, November 1969.) 42s boards; 21s paper.

THIS book is largely intended for undergraduate students of biology as basic guidance in the applications of elementary statistics to practical problems in their subject. Mathematical manipulation is therefore almost entirely absent, although there are clear explanations of the practical meaning of any statistical procedure discussed and worked examples are used to illustrate not merely the use of the procedure but also its appropriateness and limitations in different situations. The examples, and in one or two respects the subject matter, are conditioned by biological applications—reference to sample surveys and non-parametric tests is rather limited; however, as the author says, the book should also prove useful to non-biologists. Non-mathematicians will be helped by the author's consistent use of notation as listed at the beginning of the book.

Statistics as the common sense summarization of numerical data is developed from simple ideas of random variation, discrete and continuous variates and frequency-probability. The basic distributions (binomial, poisson and normal) are discussed with reference to practical examples, and the importance of the central limiting function of the normal distribution is emphasized. Significance tests and confidence theory involving the normal,  $t$ ,  $\chi^2$  and  $F$  distributions are dealt with, but there is no graph of an  $F$  distribution and the expected value (not elsewhere defined) of  $F$  is wrongly stated to be 1 (page 67). There is also no mention of paired comparisons, and for Fisher's  $z$ -test of correlation the reader is referred elsewhere. There are good introductions to regression analysis (based on  $y = a + bx$ ), and experimental design: there are careful discussions of the planning and analysis of completely randomized, randomized block and Latin square designs, together with simple factorial experiments. Unusually, interactions are introduced in factorial experiments rather than as a refinement of additive analysis of variance models. The author considers the problems of missing observations and non-normality and he describes the non-parametric sign and U-tests—but he gives no rank test of independence. Finally, the inclusion of comments and answers to exercises should help many students.

The book is usually clear and well written and may be strongly recommended to non-mathematical students requiring a common sense grounding in statistical methods.

K. L. Q. READ

## VARIABLE RELATIONSHIPS

Models in Regression and Related Topics

By Peter Sprent. (Methuen's Monographs on Applied Probability and Statistics.) Pp. x+173. (Methuen: London, October 1969.) 35s.

THE subject of regression has changed a lot since Galton used the term to describe the phenomenon whereby the heights of adult males in successive generations regress toward the population average; tall fathers having, on the average, sons who are shorter than themselves. Nowadays, it is the method of describing asymmetrically the relation between one variable and one or more other variables, through the mean value of the first, conditional on specified values of the others. The most common form for this relationship is a linear one where, if  $y$  is the single variable and  $x_1, x_2, \dots, x_n$  values of the others, it is supposed that the mean  $E(y|x_1, x_2, \dots, x_n)$  is linear, say  $\beta_0 + \sum \beta_i x_i$ . There is hardly a computer whose software does not include a program for performing linear regression,