

Comparing the distribution of the heights of children to those of their parents, Galton smoothed the data and obtained a dramatic example of what would now be called a multivariate normal distribution. This led him to the idea of regression lines and gave rise to the analysis of variance.

These ideas were taken up by Francis Ysidro Edgeworth, Karl Pearson and George Udny Yule, who between them took statistics into the twentieth century. According to Stigler, "Even in the varied world of nineteenth-century statisticians . . . Edgeworth was an anomaly". He was a classicist with no higher mathematical training who, while studying law, also undertook a massive programme of self-instruction in mathematics. From the beginning he sought links between mathematical ideas and areas such as psychology, economics and ethics. Soon he began to enquire into the statistical significance of irregularities in observations. At the jubilee meeting of the (Royal) Statistical Society he presented a paper on significance testing for the mean, and went on to develop an even more important idea: the correlation coefficient. Edgeworth changed the focus of statistics. Originally it had been about errors in observations. Now it was about the analysis of structure in data.

The nineteenth-century statisticians placed so much emphasis on the normal distribution that one might be forgiven for assuming that they recognized no other distribution curve. This is not entirely true, but they did expect observations of a single, homogeneous phenomenon to conform to the normal curve. Pearson challenged that viewpoint, and in his first publication on statistics he outlined an extensive theory of skew, or asymmetric, distributions. The full version ran to over a hundred printed pages and led to his election to the Royal Society. Pearson, whom Porter describes as a buccaneering type, was forever trying to grab new territory for statistics; in one memoir he applied his theories of skew variation to 14 examples, including the sizes of crabs, the American divorce rate and the number of petals on buttercups.

Yule was a student of Pearson, and when he arrived at Pearson's laboratory in 1893 he was probably expecting to study applied mathematics. But by 1895, says Stigler, "he was a statistician", and one showing signs of growing independence. Yule applied Pearson's skew curves to data on the frequency of paupers per poor-law union (combination of parishes for administrative purposes). Soon after he applied correlation methods to show that, contrary to assertions of Charles Booth in *The Aged Poor*, there was a relation between (in modern terms) the ratio of direct welfare to work-relief, and the incidence of poverty. In Yule's hands,

Galton's eugenic idea of regression became a universal (though still controversial) tool for the analysis of cause and effect.

Thus, by 1900, the main foundation stones of classical probability theory and statistics had been laid. Both authors sensibly stop there, rather than plunging into the technical intricacies of the twentieth century. These are two important and substantial books which, between them, give a great deal of insight into the creation of a fundamental branch of science. In particular it is instructive to witness the way in which general mathematical concepts evolved from a morass of special problems about an enormous variety of topics, at a time when the most difficult question was to find the right questions to ask. □

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Northern waters

W.J. Gould & D.G. Masson

The Nordic Seas. Edited by Burton G. Hurdle. Springer-Verlag: 1986. Pp.777. DM 198.

"HAFVILLA" is a term used in the Norse sagas to denote getting totally lost at sea. In the scientific sense, *The Nordic Seas* might well provide us with a safeguard against such a fate.

The editor has collected together lengthy contributions from leading authorities in their respective fields, and has produced an impressive reference book on the oceanography (including studies of ice and climate), geology and geophysics of the seas lying between Norway and Greenland.

As is inevitable in such a compilation, there is a degree of duplication of material — for example between the chapters "Brief Overview of the Physical Oceanography" and "The Arctic Waters" — but this is a minor criticism. Over 200 pages are devoted to climatology, ice cover, oceanography (including sound speed) and tides, while the remaining 400 or so deal with geology and geophysics. A surprising omission is any mention of biology, because the subject is of interest to some physical oceanographers and the Nordic Seas are an area in which a great deal of work has been carried out on the relationships between physical and biological indicators and on the effect of physical parameters on fisheries.

The latter part of the volume deals with topography and geology. Much has been written on the geology of the area in recent years but this is the first truly comprehensive review, discussing everything from superficial sediments to sound veloc-



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Outstanding feature — the 500-m high Ship Rock in New Mexico, a volcanic pipe which was exposed by erosion of its enclosing rock. The picture is taken from M.J. Selby's Earth's Changing Surface: An Introduction to Geomorphology, published by Clarendon earlier this year. The book will be reviewed in Nature's annual textbook issue on 12 March 1987.

ity in the mantle. With its detailed subject index and comprehensive bibliography, it is an excellent "geological dictionary" and will be indispensable for those interested in the Nordic Seas and surrounding areas.

The geological section has its disappointments, however. There appears to be little purpose in the straightforward description of bathymetry (Chapter 9), particularly because it is largely repeated and explained in terms of the underlying geology in the first part of the following chapter. Chapters 10 and 11 are simply too long; much of the considerable volume of data from areas peripheral to or analogous to the Nordic Seas could probably have been omitted without detriment to the overall content. Too much emphasis has also been placed on explanation of even the simplest geological terms — surely inappropriate in a work intended primarily for experts in the field. Finally, although it is otherwise well produced the book suffers from poor reproduction of many line drawings, to the extent that the chapter on bathymetry loses almost all of its impact because contour lines on the charts are invisible and only the annotation remains.

But the merits of the volume greatly outweigh the flaws. *The Nordic Seas* will find its way into the libraries of a wide range of scientific establishments and will be much referred to. It is as up to date as could possibly be expected and will remain as a key document for many years. □

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