

book reviews

infect half of an exposed population is between 8,000 and 10,000 spores per individual). Second, that the total quantity of anthrax spores responsible for all 88 cases and 68 deaths, occurring over a geographical distance of approximately four kilometres (plus animal cases spread out over a much greater distance), ranges from a low estimate of "an almost unbelievable two to four milligrams, hardly enough to see", to a high estimate of slightly less than a gram (the US State Department's estimate was 10 kilograms). An alternative hypothesis, not considered by Guillemain, is that massive amounts of spores were released, infecting victims with conventional dosages, but that not everyone in the path of the cloud was exposed to the agent, or was exposed to equal quantities.

Nevertheless, this is an exhaustive, authoritative and scientifically responsible account of the largest epidemic of inhalational anthrax yet on record. ■

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An education for climatologists

Statistical Analysis in Climate Research

by Hans von Storch & Francis W. Zwiers
Cambridge University Press: 1999. 494 pp.
£65, \$110

Robert E. Livezey

An article published last year called "Statistics education in the atmospheric sciences" by Timothy Brown and four other leading meteorological and climatological statisticians lists 16 statistical books that emphasize applications to atmospheric science. Of these, only four have the breadth and internal cohesion to qualify as textbooks for classroom use. Three of these have appeared since 1994, more than 35 years after the publication of the first, the venerable *Some Applications of Statistics to Meteorology* by Hans A. Panofsky and Glenn W. Brier. The most recent on the list, *Statistical Analysis in Climate Research* by Hans von Storch and Francis W. Zwiers, is easily the most ambitious and, from the standpoint of a practising dynamic climatologist (from graduate student to senior level), the most valuable. The book is substantial in scope, rigour and its oversized format, and extraordinarily thorough in content. Very little of importance to the subject area is left untreated, which is hardly surprising considering the stature of the authors, two of the leading academicians in the science of climate variability.

The text is advanced, serving equally well as a reference, but adopts a tone and philo-

sophical stance absolutely crucial in this era of almost unlimited access to computer power, data and sophisticated analytical software. The book sets out "... to provide ... the background needed to apply statistical methodology correctly and usefully". The authors do not serve up cook-book recipes, "because they are dangerous for anyone who does not understand the basic concepts of statistics". Rather, they set out to establish the base of understanding necessary to prevent "... falling into the many pitfalls specific to our field, such as multiplicity in statistical tests, the serial dependence within samples, or the enormous size of the climate phase space". Developing respect for these difficulties for the climate scientist is the most important goal of the book.

The text is organized logically into an Introduction and six parts, entitled respectively "Fundamentals", "Confirmation and analysis", "Fitting statistical models", "Time series", "Eigen techniques" and "Other topics". Each part (except the first) is preceded by a useful overview. All but part VI (intentionally) are tightly organized, and practically constitute mini-courses, all progressing to advanced levels. The appendices are followed by a comprehensive, large reference list. The book's figures, equations and layout are attractively presented, and examples, references and cross-references are plentiful. Traditional textbook problems are not included, but examples are sufficiently frequent and well developed to compensate for this.

The book can definitely be the basis for a series of courses covering almost all of the topics suggested by Brown *et al.* for an atmospheric scientist's statistical education, lacking only material on the major topics of Bayesian inference, hierarchical Bayesian analysis, and decision theory. Among the minor omissions are cluster and discriminant analysis, whose application to climate problems has been limited recently, and, sur-

prisingly, the skewness of precipitation distributions and how they are described. Otherwise, except for topics specific to meteorological rather than climatological applications, the book is quite complete. In the context of the curriculum proposed by Brown *et al.*, this book, complemented by both Daniel Wilk's more diverse and basic *Statistical Methods in the Atmospheric Sciences* (Academic, 1995) and Edward Epstein's monograph *Statistical Inference and Prediction in Climatology: A Bayesian Approach* (American Meteorological Society, 1985), should form the centrepiece of a climate analyst's reference shelf. ■

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Reviving the Doctor Universalis

Albertus Magnus "On Animals": A Medieval "Summa Zoologica", Vols 1 & 2

translated & annotated by Kenneth F. Kitchell Jr & Irven Michael Resnick
Johns Hopkins University Press: 1999.
1,920 pp. \$150, £124

Cynthia M. Pyle

Albertus Magnus, who lived in 1200–80, was a prominent teacher and official of the Dominican order, and has been called the 'Doctor Universalis' in recognition of his vast learning. His writings on natural science covered physics, meteorology, geology, motion, physiology (the movement of heat and the body's 'humours'), generation, plant life and animal life. Albert the Great's treatise on animals, *De animalibus*, has now

Recent references

Companion Encyclopedia of Archaeology, Vols I & II

edited by Graeme Barker
Routledge, £160

Oxford Dictionary of Biology

edited by Elizabeth Martin & Robert S. Hine
Oxford University Press, £7.99, \$14.95 (pbk)

Encyclopedia of Geochemistry

edited by Clare P. Marshall & Rhodes W. Fairbridge
Kluwer, £280, \$480

Oxford Dictionary of Medicines

edited by Elizabeth Martin
Oxford University Press, £8.99 (pbk)

Oxford Dictionary of Physics

edited by Alan Isaacs
Oxford University Press, £7.99, \$14.95 (pbk)

Encyclopedia of the Solar System

edited by Paul R. Weissman, Lucy-Ann McFadden & Torrence V. Johnson
Academic, \$99.95, £62.95

Encyclopedia of Spectroscopy and Spectrometry, Vols I–III

edited by John C. Lindon, George E. Tranter & John L. Holmes
Academic, £570, \$874

Father of the illustrated materia medica

As a surgeon to the Roman legions of Emperor Claudius in the first century, the author Dioscorides had plenty of opportunity to travel and catalogue substances used in treating illnesses and wounds. His text *De materia medica* looks at the medical uses of more than 1,000 plant and animal products, wines and minerals. He rejected alphabetical ordering and chose to classify the material as animal, vegetable and mineral. This picture of Dioscorides comes from the facsimile edition of the superbly illustrated medieval text *Medicina Antiqua* (Harvey Miller, £48, \$75). As Peter Murray Jones points out in his introduction to this edition, Dioscorides was credited in medieval times as the innovator of illustrated materia medica.



been translated from the original Latin in its entirety, so that English-speaking scientists, and historians and philosophers of science, can judge for themselves the quality and substance of his scientific thought. The treatise is part commentary on Aristotle's works on the life sciences (Books I–XIX), part compendium from Thomas of Cantimpré's slightly earlier work *On the Nature of Things* (*De naturalis rerum*; XXII–XXVI), and part Albert himself (XX–XXI).

This fairly literal English translation will clearly become the standard, precisely because it is complete (Books XXII–XXVI were translated in 1987 by James Scanlan). It will allow easier access to the Latin text in Hermann Stadler's 1916–20 edition, as William Wallace notes in his rich foreword. While proofreading is sometimes lax, the translation will allow easier access to the Latin text.

The translators' Introduction reviews Albert's place in medieval science and makes a starting point for the study of his works on natural philosophy — the medieval category that included what we now call 'natural science'. The interested reader may also wish to

consult the excellent collection of articles edited by James Weisheipl (Pontifical Institute, 1980). There, and in Edward Grant's 1974 *Source Book in Medieval Science* (Harvard University Press), we can assess the extent to which Albert's work measures up to present-day standards, in fields ranging from cosmology to the life sciences.

Albert exercised his significant critical judgement of sources even when commenting on 'the philosopher', the term used in the Middle Ages to refer to Aristotle. It is important to realize, however, that although the modern reader may be struck by the breadth of what appears to be Albert's first-hand experience, this is more often a profound first- or second-hand experience of learned texts. Albert may not have done as much direct descriptive or experimental work as is sometimes claimed, even by the translators of these volumes. His reading and evaluation of the evidence, however, were careful and exceptionally critical for his time.

Albert's knowledge of hunting techniques was obtained partly from the hunters and gamekeepers he spoke to or read about (such as parts of the contemporary work on

accipiters by Frederick II Hohenstaufen), and partly from his own experience as a boy. It is highly unlikely, however, that he observed the crocodiles or ostriches he describes, since his travels (undertaken on foot, according to his vows), while extensive, were mainly in northern Europe and took him only as far south as Italy. Similarly, his detailed discussion of the anatomy of the human brain comes from Galen (whose work he knew from Avicenna's Latin translation), among other sources.

Albert's approach to the natural world shows some characteristics of a 'scientific' approach, but statements by the translators and others attributing his inability to advance beyond what he did to "historical accidents" seem like wishful thinking. A thinker must be judged in context, and Albert's powerful mind, like all minds, was subject to the intellectual norms of his time and calling. Although certainly a great and critical observer of natural diversity, he was more concerned with the central interests of natural philosophy — the overview of 'causes' and the scheme of nature as understood in the context of the medieval Latin tradition.

We can be grateful for the enormous labour expended on this full version of a difficult, historically important text by a medieval thinker of vast knowledge and unquestionable intellectual power and dedication. ■

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Something for everyone

An Illustrated Guide to Theoretical Ecology

by Ted J. Case

Oxford University Press: 1999. 464 pp.

£22.50, \$49.95

Joan Roughgarden

Thirty years ago, the phrase theoretical ecology seemed a contradiction in terms. Today, though, theoretical ecology has matured, and is now represented by a curriculum shared by most courses in the subject at universities throughout the world.

Ted Case, a distinguished theoretical ecologist and professor of biology at the University of California at San Diego, has written the most recent textbook to serve this market. It is by far the most attractive book yet, and readily earns its title of being an 'Illustrated Guide'.

But the book is not only replete with pictures. It offers rigorous derivations of the models and theorems in theoretical ecol-