has forced the biologists working on them to focus on the spatial arrangement of populations and habitats and to realize that the long-term persistence of many of these species cannot be achieved outside of a metapopulation context.

Though these books do an admirable job of providing an overview of the metapopulation concept in theory and practice, they also hint at some of its deficiencies. Clearly, some species have patchy distributions that seem to fit one or more metapopulation types, and metapopulation models have been useful in developing conservation plans for these species. However, for other species it is difficult to distinguish between habitat and non-habitat, and not all habitat is of equivalently suitable quality. Dealing with such species will require a new generation of metapopulation models, but sufficient data to parameterize these models will be difficult to come by. Though the increasing use of geographic information systems, global positioning devices, and spatial statistics clearly enhances opportunities for obtaining data on the spatial structure of habitats, getting the critical information on local dynamics and dispersal rates at the required level of precision will be a real challenge, particularly in the short time periods that characterize most conservation-planning horizons. Although it is currently fashionable to deal with these issues experimentally, experiments at the appropriate scale are usually impossible, and experimental model systems are unlikely to provide the species-specific information required.

Accurate data on dispersal, the most important unifying process in metapopulation dynamics, are particularly important, but dispersal is very difficult to study. Often hundreds of individuals must be marked and dozens of habitat patches must be searched for dispersing individuals. Moreover, many species exhibit long periods of local isolation with infrequent episodes of long-distance dispersal, requiring a long time horizon for such studies. Additional field time must be spent obtaining long-term data on habitat quality and how it is related to succession and other ecosystem-level processes and on the demography, dispersal, and genetics of the species of interest in several local populations. Each of these presents real logistic and monetary challenges. However, we will be unable to design landscapes that both accommodate human needs and enhance the survival of patchily distributed species until these challenges have been met.

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# Assessing Assessments

**How Science Takes Stock.** A History of Meta-Analysis. MORTON HUNT. Russell Sage Foundation, New York, 1997. xii, 210 pp., illus. $29.95 or £24. ISBN 0-87154-389-3.

In *How Science Takes Stock* Morton Hunt, a journalist, expounds meta-analysis for the general reader. Meta-analysis has been promoted as the best way to summarize a scattered scientific literature on some point. The method, described here as "a means of combining the numerical results of studies with disparate, even conflicting, research methods and findings," is said to enable researchers to "discover the consistencies in a set of seemingly inconsistent findings and to arrive at conclusions more accurate and credible than those presented in any of the primary studies." Meta-analysis most often focuses on assessing or comparing the effects of some characteristic or treatment on some outcome, such as the effect of family background on psychological status or differences between the outcomes of two medical treatments for the same disease. Hunt describes five basic steps in meta-analysis: formulating the problem, collecting the data, evaluating the data, synthesizing the data, and presenting the findings. Meta-analysts have elaborated these steps into substeps that are meant to reduce bias, improve the objectivity of interpretation, and reduce random variation in the results. Though many meta-analyses stop with the description of individual study findings, others—often those with the biggest impact—take a further step to derive a single overarching estimate of the size of the effect under study, with statistical confidence bounds. It is this last step that has raised the most questions and concerns.

Meta-analysis—though Hunt characterizes it as "not itself a science" but "a tool used by scientists"—is said to be not only as precise as available data allow but strictly objective. Thus, shouldn't two meta-analysts with access to the same database make much the same procedural choices and come to similar conclusions? Often they do not. In the wanderings of my own work such cases have not been rare, and I have examined more closely two pairs of meta-analyses that came to sharply conflicting summaries: one pair dealing with the benefits of mammographic screening before age 50 and one with antibiotic treatment of chronic middle-ear effusion. If meta-analysis can come so far from being reproducible, something needs explaining.

The reader of Hunt's book will get little hint of such difficulties, because the extensive literature questioning meta-analysis is scarcely mentioned. Hunt presents one meta-analysis after another as a scientific advance and a triumph of the method, including meta-analyses on such widely different questions as whether violence on TV stimulates antisocial behavior or the accuracy of judgments about the character of a stranger that are formed after only a few seconds of observation. In the few places where Hunt mentions problems they are quickly dismissed. But problems are at the core of the method. They include not only the false appearance of objectivity but consistent bias in the studies selected for analysis, heterogeneity in the effects compared (so that no combined estimate is appropriate), and lack of sufficient knowledge on the part of the meta-analyst to interpret results correctly, especially those coming from a "shop" that does one meta-analysis after another on unrelated topics. For example, some decades of research have shown a sequence of successes in developing new treatments for cancer, but national mortality rates have barely begun to edge downward. Meta-analyses have summarized the study-by-study successes but missed the population-wide failure. (Reasons for this discrepancy are unclear, but may include the selection of the most responsive patients for research study or the choice for study of treatments that require an arsenal of expertise and equipment available only in a tertiary referral center.)

Other difficulties center on the use of the "quality score" that some meta-analysts attach to the studies they review; these are often used to weight studies (for example, a study scored at 50 gets half the weight of the perfect study, scored 100). However, different meta-analysts often score the same studies quite differently. Nor is there reason to believe that the evidentiary value of a study is appropriately scored on a linear scale. Cantekin (personal communication) has shown that in one series of papers nearly every investigator found some benefit from a treatment, but the study scores were strongly and negatively correlated with size of effect, with a downward trend suggesting that the perfect study would find no effect at all. Weighting such studies by quality score diminished the estimated size of the benefit, but only to a small degree.

Other specific problems that I have often seen have come from carelessness (one meta-analysis of a drug effect included a paper on the wrong drug) and from lack of expertise in the subject matter (for example, a meta-analysis of the health risks of chlorination of drinking water (cited by Hunt) came to a result at serious variance with animal studies, which were

not even mentioned). Published meta-analyses have summarized papers with serious internal contradictions (such as a claim that patients were assigned alternately to drug treatments when the data showed major, unexplained discrepancies in the numbers of subjects) as well as papers with such grave defects as to be useless (for example, studies of spontaneous abortion rates in which "inevitable abortion" was determined post hoc and used to exclude many patients from the analysis—especially those assigned to a favored treatment). In fact, serious problems have affected every one of the meta-analyses I have examined carefully.

Can meta-analysis be done right? It is likely that the answer is yes, but problems have been so frequent and so deep, and overstatements of the strength of conclusions so extreme, that one might well conclude there is something seriously and fundamentally wrong with the method. For the present, the arguments Hunt presents to the contrary notwithstanding, I still prefer the thoughtful, old-fashioned review of the literature by a knowledgeable expert who explains and defends the judgments that are presented. We have not yet reached a stage where these judgments can be passed on, even in part, to a formalized process such as meta-analysis. Hunt has ably presented one side of this matter; the other side now needs deeper consideration.

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## Vignettes: The Call of the Media

We drank our coffee in the tent, while listening to the BBC World Service on the shortwave. There was a program . . . called *Letter Box, with Margaret Howarth*, in which letters from listeners would be dramatically read out by actors to said Margaret, who would then reply to their various concerns and complaints. A typical letter would be from somebody living on some plantation deep in the wilds of Borneo writing in complaining about why the radio program *What-ho, Jeeves* had been shifted to three in the morning his local time, and how upsetting it was to have to get up every night at that hour to listen to it.

—*Christopher Scholz*, in *Fieldwork: A Geologist's Memoir of the Kalahari* (Princeton University Press)

The "pull" of television . . . may be less its entertainment value than its pervasive trance-inducing qualities, which provide for a kind of electronic stress reduction. This might explain why travelers often put on the television immediately after entering a new hotel room. The combination of the familiar programming content and the regularity of its electronic rhythms may act to reduce the stress of being in an unfamiliar environment. If this is the case, then television programmers may have unwittingly recognized the true function of television in their strategy of providing highly predictable and stereotypic content to their already modularized programming format.

—*Bradd Shore*, in *Culture in Mind: Meaning Construction and Cultural Cognition* (Oxford University Press)

## Browsings

**The Dawning of Gauge Theory.** Lochlainn O'Raifeartaigh. Princeton University Press, Princeton, NJ, 1997. xii, 250 pp. $69.50 or £55, ISBN 0-691-02978-4; paper, $29.95 or £25, ISBN 0-691-02977-6. Princeton Series in Physics.

The "long and tortuous process" by which gauge theory came to occupy its present place in physics traced by way of reprintings of 14 papers, 1918–1955, by Hermann Weyl, Otto Klein, Erwin Schrödinger, C. N. Yang and R. L. Mills, and others, with historical background and commentary by O'Raifeartaigh.

**El Niño Southern Oscillation and Climatic Variability.** Rob Allan, Janette Lindesay, and David Parker. CSIRO, Melbourne, Australia, 1997. x, 405 pp., illus., + CD-ROM. $110 or A$110. ISBN 0-643-05803-6.

A collection of color maps giving global monthly data on mean sea level pressure and sea surface temperature, 1871–1994, along with a historical introduction and other relevant material, intended "to provide the basis for a synthesis of past ENSO phases, and the extension of our understanding of the phenomenon and its relationship to natural climatic variability."

**Fire and Mud.** Eruptions and Lahars of Mount Pinatubo, Philippines. Christopher G. Newhall and Raymundo S. Punongbayan, Eds. Philippine Institute of Volcanology and Seismology, Quezon City, and University of Washington Press, Seattle, 1997. xviii, 1126 pp., illus., + diskette. $80. ISBN 0-295-97585-7.

Results of the 1991 eruptions and associated mud flows as documented by detailed geological and meteorological monitoring, with some consideration of the "human drama."

**Journeys of Women in Science and Engineering.** No Universal Constants. Susan A. Ambrose, Kristin L. Dunkle, Barbara B. Lazarus, Indira Nair, and Deborah A. Harkus. Temple University Press, Philadelphia, PA, 1997. xxiv, 461 pp., illus. $59.95. ISBN 1-56639-527-5. Labor and Social Change.

First-person profiles (alphabetically organized) of 88 women, derived from interviews conducted by an interdisciplinary team; the subtitle is not a feminist deconstruction but refers to the variety of the subjects' experience.

**Judgement Day for the Shroud of Turin.** Walter C. McCrone. Microscope Publications (McCrone Research Institute), Chicago, IL, 1996. xxiv, 341 pp., illus. $36. ISBN 0-904962-15-6.

An analyst who has studied the relic defends his conclusion that it is "a medieval painting" and takes an admittedly "less than charitable view" of the U.S. Shroud of Turin Project and others with whom he is in disagreement.

**Life in the Balance.** Emergency Medicine and the Quest To Reverse Sudden Death. Mickey S. Eisenberg. Oxford University Press, New York, 1997. xvi, 304 pp., illus. $30 or £19.99. ISBN 0-19-510179-0.

An emergency-room physician describes procedures for resuscitation from the time of the prophet Elijah to the present, including the development of techniques for artificial respiration, restoration of circulation, and defibrillation.

**Notable Women in the Physical Sciences.** A Biographical Dictionary. Benjamin F. Shearer and Barbara S. Shearer, Eds. Greenwood, Westport, CT, 1997. xiv, 477 pp., illus. $49.95. ISBN 0-313-29303-1.

Brief essays on 97 women, living and dead, representing biochemistry and other fields bordering on biology as well as astronomy, chemistry, and physics.