work of others, particularly from the four-volume study by Machlup and associates, that getting good data about publishing and libraries is extraordinarily difficult (*3*). The presentation by King and associates is disconcerting in its certitude; it would inspire greater confidence if the limitations of what is presented as well as the rationale for numerous grand estimations presented were explained.

Interpreting the data, which presents no problem in some instances, is difficult in others. What can be measured is generally a proxy for what we want to know, and not infrequently fairly contradictory inferences can be drawn. If total expenditures for information are rising faster than the gross national product, are we to consider the trend a sign of extravagance and inefficiency or a healthy sign for a society in which information is becoming increasingly important, or neither? If the number of articles published rises more rapidly than the number of scientists at work, are we to conclude that the productivity of researchers is increasing or that a perverse reward system gives scientists an incentive to maximize the number of articles emerging from a research project? Such ambiguities only touch on problems of interpretation that will take a great deal of further research and the clustering of groups of indicators to clarify. Uncertainty about such matters, however, reflects the state of the art more than shortcomings in the work by King and associates, which is intended as a pioneering effort, not as the last word. Still, I think it fair to say that the book lacks the quality of analysis that is reflected in *Toward a Metric of Science* (*4*), the volume emerging from a conference called to evaluate the first issue of *Science Indicators*. Similarly, in the area of economic estimates, it does not match the rigor of Machlup's work (which fell short of its own goals for quite different reasons).

Nonetheless, King and associates have a good deal to say that is interesting and suggestive. The authors are clearly on the right track in taking a broad view of the scientific and technical information system. Their survey results add another dimension to the study, and their outline of future developments will be useful to readers who are not familiar with the possibilities offered by technological developments.

The results of the user survey should interest scientists who wonder about the habits and predilections of their peers. Some examples:

Scientists decide what to read primarily by browsing, which leads them to 40 percent of the articles read. Citations in printed indexes are next in importance, accounting for the selection of 24 percent, and computer searches rank last, accounting for only two-tenths of one percent (but that was in 1977).

Readers depend on their own subscription copies for 69 percent of the articles they read, on library copies for 14 percent, and on photocopies for 12 percent.

Although the primary reason given for reading articles is self-education, 45 percent of the respondents said they read for methodology and 44 percent for research findings related to their current research.

A striking aspect of the responses to a number of questions is the range of differences among disciplines. Mathematicians, for example, say they spend 19 hours a month reading articles, computer scientists 3.4 hours.

A final question is implicit in this work: Where do we go from here? A book is suitable for reporting the results of a research project, but it is not a good tool for presenting up-to-date information, as this book makes painfully clear. The latest data are for 1977 (with extrapolations to 1980), and the concluding chapter discusses a National Periodical Center at length, as if its establishment were a foregone conclusion, when in fact the proposal was killed by Congress two years ago. If the state of scientific communication is worth monitoring, it ought to be monitored on a continuing basis and the results ought to be reported in a timely fashion.

Science Indicators 1978, the latest edition published, includes several measures of scientific communication that were apparently developed independently of the work by King. The estimates include the number of articles published annually by field and by the level of research (basic vs. applied), an estimate of cooperation among scientists (articles jointly written by authors in different institutions and countries), and frequency of citation. These indicators have been based on a sample of 2100 journals tracked by the Institute for Scientific Information. Such a fixed sample, though useful for some purposes, is not suitable for others. Conceivably, the work by King and associates may provide leads for the inclusion of additional items in *Science Indicators* or it may stimulate selective monitoring efforts by private agencies as a spinoff of the services they provide.

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Thermophysiology

Thermoreception and Temperature Regulation. H. HENSEL. Academic Press, New York, 1981. x, 324 pp., illus. $48.50. Monographs of the Physiological Society No. 38.

At present many aspects of the classical orderly model of temperature regulation are being questioned and new concepts are being advocated. But a new, widely accepted model has not yet been established. Therefore it is difficult to introduce briefly and clearly current ideas about temperature regulatory mechanisms. Hensel deals skillfully with this problem. He begins each chapter with a description of general aspects of the subject and then evaluates current theories and research. The descriptions are terse but well considered, so that the points at issue are clear.

The book emphasizes work on humans but refers to data on animals when they have "possible predictive value for human thermophysiology." The book covers temperature sensation, the neurophysiology of thermal reception, thermal comfort and behavior, and autonomic temperature regulation, especially as it is understood from neurophysiological and neuroanatomical findings. In addition, displacements of set point, including fever, circadian variation, and sleep, long-term thermal adaptation, and ontogenesis of temperature regulation are discussed. These are subjects in which there is particular interest nowadays.

Special emphasis is given to the introduction and evaluation of current theories of thermal perception. "Thermal perception" is a relatively recent term used to describe a process in which different levels of heat energy (temperature) are detected by living things. Hensel states that biological thermal sensors not only are involved in conscious temperature sensations but also play an important role in the autonomic and behavioral responses of organisms to thermal environments.

The book does not deal with other interesting aspects of the subject, such as comparisons of ectotherms and endotherms and hormonal thermoregulation. However, it is nearly impossible to cover all facets of temperature regulation in a book of this size. The author's intention was to concentrate on thermal reception and related thermoregulatory mechanisms, and the book gives excellent and thorough coverage of them.

The references are selected carefully and provide an overview of the contemporary issues of temperature regulation.

The book is a useful introduction to temperature regulation as well as an evaluation of current work on the subject.

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Females as Strategists

The Woman That Never Evolved. SARAH BLAFFER HRDY. Harvard University Press, Cambridge, Mass., 1981. xiv, 256 pp., illus. $17.50.

Popular books dealing with the evolution of human sexual behavior have tended to fall into one of two distinct categories. First there have been those by authors who have reified the "man the hunter" stereotype, arguing that the development of hunting has had profound influence on human evolution. Under this scenario, males are both the cooperative and the competitive sex, on the one hand cooperating with each other in the demanding pursuit of game, on the other hand competing with one another for mates. Male bonding (as exemplified today in Löwenbräu commercials) is viewed as having ancient evolutionary antecedents, and females are portrayed as mere baby-producing machines, whose reproductive functions demand neither cooperation nor competition with others of their sex. To the extent that intelligence and speech have evolved as the result of selective pressures placed on early man to hunt, these uniquely human attributes are, by implication at least, virtually sex-linked.

This view of human evolution, long championed by anthropologists and other social scientists, has recently been challenged by authors arguing that food gathering, a traditionally female task, was easily as important as hunting to the evolution of human behavior. Though food gathering is thought to have exerted strong selective pressures on intelligence and technological skills, proponents of this view are not agreed about the importance of competition and cooperation in the evolution of female behavior. The reproductive success of females is assumed to be less dependent than that of males on competition for mates, and as a result it is often argued that there has been little selection for competition or aggression in women. Some accounts argue that female subordination to males is a relatively recent event and stress women's alleged equality with or even domination over men in ancient times. As for cooperation, female bonding is often advocated by feminists, but there seems to be no firm consensus about the evolutionary role of female cooperative behavior. Indeed, in some accounts the ability of human and nonhuman primate females to form strong social bonds is denied entirely.

Despite their differing opinions, most books promoting these two views have shared one overriding characteristic: a level of ignorance of research on the behavioral ecology of birds and mammals that almost takes a conscious effort to achieve. To the limited extent that such works refer to research on nonhuman primates, they tend to draw selectively and inaccurately from the literature, and their references are often as much as 20 years out of date. Unfortunately, however, such insouciant hypotheses dominate popular accounts of the origins of human sexual differences.

Given this sorry state of affairs, *The Woman That Never Evolved* is a competent alternative. According to Hrdy, the woman that never evolved—the woman who cooperates with others and possesses none of the nefarious competitive traits of the opposite sex—is a myth invented by social scientists, and her intention is to set the record straight. In marked contrast to authors of previous popularizations, she has extensive knowledge of nonhuman primate behavior to bring to bear on the subject. Hrdy regards the behavior of present-day monkeys and apes as providing a model for the evolution of human female behavior. She further argues that the reproductive strategies of female nonhuman primates demand an almost Machiavellian ability to balance cooperation and competition in the manipulation of others for access to scarce resources and mates.

When male and female birds or mammals mate, the initial contribution of each sex to the fertilized egg is unequal, since, relative to the sperm, the larger egg is energetically more costly to produce. In mammals this initial inequality extends beyond gestation into lactation. The fundamental imbalance in parental investment is thought to have profound influences on the mating strategies of each sex. Evolutionary biologists have argued that the reproductive success of females is limited largely by the energy they can invest in the fertilized egg, whereas the reproductive success of males is limited primarily by the number of females they can fertilize. Because the upper limit on a female's reproductive output is set by nutritional requirements, the distribution of food should have an important effect on female behavior. Whether or not females forage singly or in kin groups should be determined by whether food is evenly or patchily distributed, rich or poor in quality. The distribution of males, on the other hand, is more a function of the distribution of females. The ability of males to monopolize more than one mate will be determined by whether or not it is in the females' interest to form groups.

Because it is advantageous for males to mate with as many females as possible, behavioral ecologists argue that monogamy should evolve only when females space themselves in such a way that each male simply cannot control access to more than one mate, or when male parental care is essential for the offspring's survival. Most species of birds are monogamous, probably because both parents are needed to feed the clutch. In mammals, however, males have largely been freed from direct parental care, since lactation places the burden of feeding the young squarely on the female. Perhaps as a result, most mammalian species are polygynous.

Sexual dimorphism is usually greater in polygynous than in monogamous species. Because a male can potentially monopolize many mates, competition among males for females is often intense, favoring the evolution of large body size, big teeth, and so on. A by-product of such intense sexual selection is that males become larger and stronger than females and are able to dominate females in social interactions. It is with this aspect of our primate heritage that Hrdy's book is concerned.

The Woman That Never Evolved is a schizophrenic book, calling for a schizophrenic review. At times I was annoyed by Hrdy's almost excessive efforts to show that females can be as competitive, manipulative, and sexually active as males. Then I remembered the rubbish that has preceded her book and wondered whether some hyperbole might not be justified. Hrdy's review of the repro-