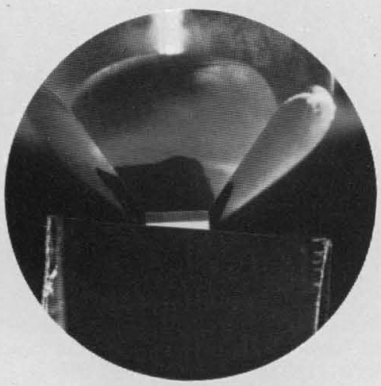
SCIENCE

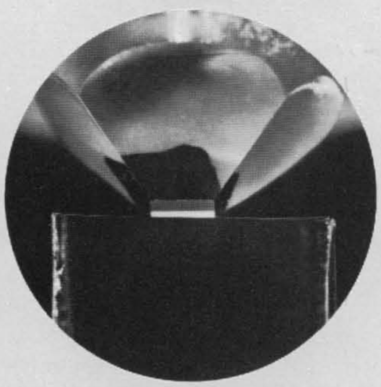
30 June 1972

Vol. 176, No. 4042

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Index Issue





Through the microscope, the illuminated gap between specimen and knife is seen as a brilliant slit.

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

COVER

First known tornado cloud to be photographed (Miner County, South Dakota, 28 August 1884). More Southerners than Northerners are killed by tornadoes, a fact that may be related to differences in psychology. See page 1386. [Library of Congress; obtained from U.S. Weather Bureau; the photograph was probably taken by F. N. Robinson]

LETTERS

An Emperor's Work

I would like to call attention to the recent biological papers by Emperor Hirohito of Japan, and also to the new books compiled by the Imperial Household in Tokyo. One of the papers, "Additional notes on *Clathrozoon wilsoni* Spencer" [5 pages in English, 3 pages in Japanese, 4 plates (Biological Laboratory, Imperial Household, Tokyo, 1971)] is a supplement to the Emperor's 1967 publication, "A review of the hydroids of the family Clathrozonidae with description of a new genus and species from Japan" (Letters, 4 Aug. 1967, p. 488). In 1969 the Emperor obtained a small portion of the paratype of *C. wilsoni*, which was presented to him by the National Museum of Victoria in Melbourne, Australia. In addition, through Mrs. J. F. Watson, he obtained a living colony of the same species, which had been collected at a depth of 40 meters near Cape Woolamai, Victoria. Comparing these specimens with those from Japanese waters, he confirmed their identity. He succeeded in keeping the living specimens in an aquarium and carefully observed their parts: highly extensile and contractile dactylozooids, reduced but detachable medusae, and so forth. The Emperor describes his observations and confirms his original view that the genus should be assigned to the suborder Thecata, in spite of its apparent resemblance to the Athecata.

In a second paper, "Some hydroids of the Amakusa Islands" [32 pages in English, 19 pages in Japanese, 1 plate, 18 figures (Biological Laboratory, Imperial Household, Tokyo, 1969)] the Emperor describes 52 species, including one previously unknown in Japanese waters, and one new variety. All the accounts in the paper reflect the Emperor's painstaking observations of the materials and his careful judgment of the data.

Two fine quarto volumes entitled, respectively, *The Sea Shells of Sagami Bay* [489 pages in English, 741 pages in Japanese, 105 color plates, 16 black and white plates (Imperial Household, Tokyo, 1971)] and *Nova Flora Nasuensis* [15 pages in English, 334 pages in Japanese, 184 color figures (Imperial Household, Tokyo, 1972)] are both products of the Emperor's biological labors at his vacation villas at Hayama and Nasu. Sagami Bay is famous for the richness of its fauna. Tokyo University's Misaki Marine Biological Station is located near the tip of a peninsula on the eastern side of the bay. The Hayama villa is about 25 kilometers from Misaki. The Emperor has a collecting boat, from which he obtains materials for his own study, as well as some which he assigns to specialists for identification. The 5000 shell specimens in his collection were studied by T. Kuroda, T. Habe, and K. Oyama. The book deals with 160 families, 683 genera, and 1121 species and subspecies, including 30 new genera and subgenera and 104 new species and subspecies. Among these are *Mikadotrochus (Pleurotomaria) beyrichi* Hilgendorf, the famous "living fossil"; *Thatcheria mirabilis* Angas, the curious spiriform shell; and *Choristes vitreus* Kuroda and Habe, which are parasitic on shark egg capsules. The figures, mostly in color, are reproductions of photographs of the specimens collected by the Emperor. Undoubtedly, this book will serve as a reference for conchologists and amateurs interested in marine shells, especially those from the northeast Pacific area.

Nova Flora Nasuensis is a sequel to a smaller book, *Flora Nasuensis* published in 1962, and its supplement. Nasu is a highland located about 170 kilometers north of Tokyo where the Emperor has a summer villa. In the book's Foreword, the Emperor remarks, "It was at about the end of Taisho era (1912–1926) that I first started investigating the plants there, although not in a manner enthusiastic enough, and later my work had been interrupted by World War II. After all, it was since about 1948 or 1949 that I have been putting myself with active interest into the study of the wild life at Nasu and its vicinity." Most of the material of the accounts of the book are derived from the Emperor's own observations, supplemented by the knowledge of botanical experts M. Honda, A. Kimura, S. Kitamura, H. Hara, and T. Sato.

Nasu highland comprises several volcanic peaks that are 1700 to 1900 meters above sea level. The main peak, Chausu, emits much smoke containing sulfur dioxide. The area's vegetation was severely damaged by a violent eruption in the summer of 1881, but it has gradually recovered. The flora is composed principally of temperate forms, yet it includes many plants of the alpine and subalpine zones. It also includes both the Northern and Southern elements, both the Pacific and Japan Sea elements, as well as some endemic ones. In the book are listed more than

1600 species of Pteridophyta and Spermatophyta that are found in the Nasu area, with notes on locality, flowering, and fruit-bearing times, most of which are derived from the careful field notes of the Emperor. As far as I know, the vegetation of few localities in Japan, or anywhere else in the world, has been so closely observed and minutely recorded. The many color plates of plants in their natural surroundings and of sceneries in various seasons are excellent, both scientifically and artistically.

TAKU KOMAI
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Space Shuttle Costs

The letter from Ralph E. Lapp on space shuttle costs (3 Mar., p. 392) contains some factual errors and incorrect reasoning which make a difference of an order of magnitude in his estimate of the program cost. Lapp refers to cost data on past manned and unmanned space experiments, but not to the paper which proposes and explains the $100 per pound payload cost estimate for the shuttle (*1*). The latter estimate is based on 7 years' experience at the National Aeronautics and Space Administration (NASA) with airborne systems (*2*) and is modified to take into account the differences between aircraft and the shuttle (the causes of the previous high costs have also been examined to be sure they can be eliminated).

Lapp's argument is based on ". . . the extreme assumption that NASA's payload costs can be slashed to $2000 a pound. . . ." He adds $11 to $16 billion in development and operations costs to the resulting $40 billion for 20 million pounds in orbit. He gives no basis or justification for his "extreme assumption," which is an order of magnitude too high. Further, he reasons that payload construction costs must be brought down to about $100 per pound (a few times "the cost of gold") to justify more economical transportation systems, but he includes the transportation system and *not* the payload construction cost in his estimates of payload cost (he divides $11 billion by 20 million pounds). At $100 per pound, 20 million pounds would cost $2 billion, not $40 billion, over a period of 10 years.

Finally, NASA's claim is not that a payload can be "lifted from earth to orbit" for under $100 per pound, but that construction of a payload for a shuttle sortie mission would cost between $100 and $200 per pound (*1*). This cost makes it "meaningful to seek cheaper space transportation" (according to Lapp's own criterion). Detailed studies are currently being made at NASA to document more precisely the payload costs that can be realistically expected for the space shuttle, in the sortie, and also in other operational modes.

MICHAEL BADER
Space Science Division, Ames Research Center, National Aeronautics and Space Administration, Moffett Field, California 94035

References

1. M. Bader and N. H. Farlow, *Potential Reductions in Cost and Response Time for Shuttle-borne Space Experiments* (AIAA Paper No. 71-808, American Institute for Aeronautics and Astronautics, New York, 1971).
2. M. Bader and C. B. Wagoner, *Appl. Opt.* **9**, 265 (1970).

Animal Experiments

On 20 January 1971, the Council of Europe adopted Recommendation 621 on the use of live animals for experimental or industrial purposes. The Council of the International Union Against Cancer, at its meeting in Sydney, Australia, on 18 March 1972, unanimously adopted the following resolution in opposition to Recommendation 621.

The Council of the International Union Against Cancer deplores Recommendation 621 (1971) of the Council of Europe because scientists are always searching for the best method of arriving at reliable information without inflicting unnecessary suffering upon animals. The Council of the International Union Against Cancer believes that information provided by animal experimentation is an invaluable resource and loss of this avenue of research would be a very serious setback for the world scientific community. Furthermore, scientific achievement and the quality of training of medical and scientific personnel resulting from a judicious utilization of animals will be jeopardized should Recommendation 621 be implemented.

In consequence, the Council of the International Union Against Cancer urges its member organizations in each country holding membership of the Council of Europe to inform their government of the objectionable consequences of the application of Recommendation 621 (1971).

W. U. GARDNER
International Union Against Cancer, 333 Cedar Street, New Haven, Connecticut 06510

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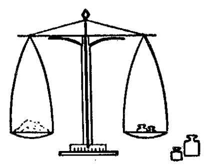

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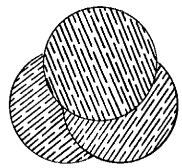

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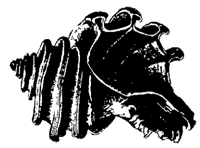

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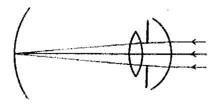

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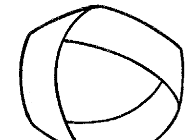

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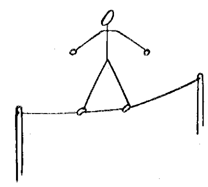

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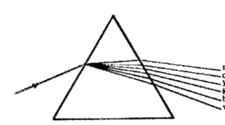

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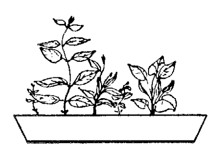

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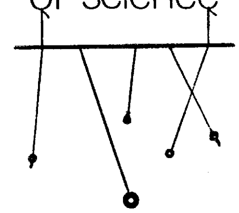

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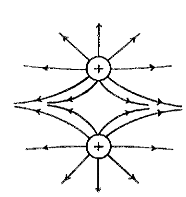

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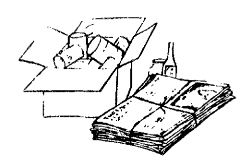

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Are the Data Worth Owning?

Amitai Etzioni has recently (14 April 1972, page 121) raised the question of who should ultimately own the data. He points out that, since data is (sic) often lost or becomes inaccessible, agencies that finance data collection or preparation should require that it be made available to others by deposition in a data bank or library.

A more fundamental question than who should own the data is, Are the data even worth owning? Unfortunately, the answer is usually an embarrassing and costly "No" across the entire spectrum of research. The problem usually lies in lack of knowledge about the trustworthiness of the data. Measures of uncertainty are usually not given at all; even when they are, they are themselves generally untrustworthy. Lancelot Hogben has stated that "less than one percent of research workers clearly apprehend the rationale of statistical techniques they commonly invoke."

Further, David Lide, head of the National Standard Reference Data System of the National Bureau of Standards, estimates that from 50 to over 90 percent of the published raw data available for producing trustworthy, evaluated results for the physical properties of scientific materials cannot, in fact, be used for this important purpose. A good illustration of the basic difficulty has been given by the late W. J. Youden of NBS. He states that, of 15 observations of the mean distance to the sun published from 1895 to 1961, each worker's estimated value is outside the uncertainty limits set by his immediate predecessor.

Both systematic and random errors occur in all experimental situations. They should be estimated, discussed, and cited separately, as Churchill Eisenhart has pointed out. Ideally, systematic errors should be estimated by independently measuring the quantity in question with a different apparatus, preferably one that operates on a different principle from that of the original apparatus. One should strive to make the estimated maximum systematic error comparable to or smaller than the estimated root-mean-square random error of the experiment. When it is impractical to obtain independent estimates of the systematic error, a good rule of thumb is to multiply one's best estimate of it by a factor of 3.

Even when estimates of individual errors (deviations) are calculated, it is unusual for the experimenter to check the deviations for stochastic independence and to state the result of such a check. Rarely indeed does one find mention of the statistical distribution that the deviations appear to follow. Without such knowledge, however, one cannot assess the meaningfulness of such important derived quantities as ordinary confidence limits and standard deviations. When individual measurements are to be analyzed by such techniques as least squares, one seldom finds experimenters replicating the individual measurements closely enough to obtain trustworthy estimates of uncertainties for use in weighted least squares. Yet only thus can one verify the assumptions implicit in even unweighted least squares. Nonlinear least squares analysis is becoming much more common these days, but one never finds it shown that the bias in parameter estimates introduced by this estimation technique is safely smaller than the sampling error. Finally, there are almost always random errors present in the values of all variables measured (except in whole number cases), not just in the "dependent" variable, as is usually assumed in ordinary least squares analysis. Although a generalized least squares technique is necessary and available to handle such situations, it is hardly ever used—nor is the need for it usually recognized.

Clearly, much further education in data analysis, presentation of results, and the need to call in a statistician is necessary before a high proportion of published data can be properly used for more than qualitative purposes.—J. ROSS MACDONALD, *Chairman, Numerical Data Advisory Board, National Research Council.*