SCIENCE

16 January 1976

Volume 191, No. 4223

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

OPTICKS:

OR, A

TREATISE

OF THE

REFLEXIONS, REFRACTIONS,
INFLEXIONS and COLOURS

OF

LIGHT.

ALSO

Two TREATISES

OF THE

SPECIES and MAGNITUDE

OF

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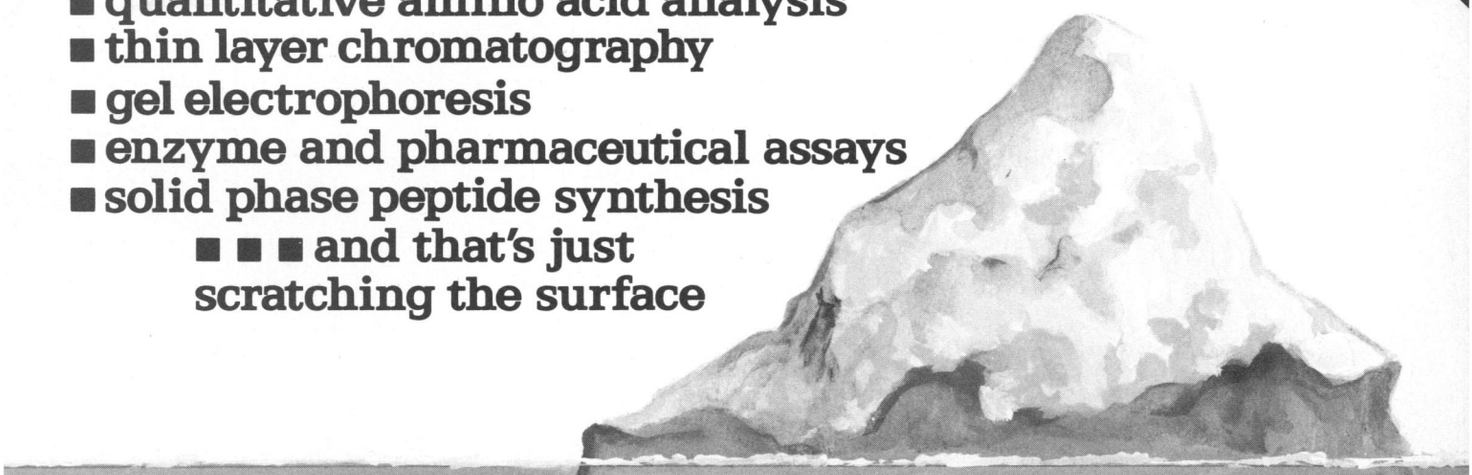

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16 January 1976

Volume 191, No. 4223

SCIENCE

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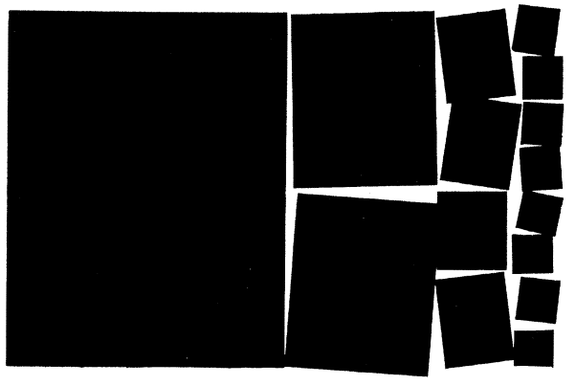
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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. Postmaster: Send Form 3579 to SCIENCE, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005.

COVER

Title page of the 1704 edition of Isaac Newton's *Opticks*. Newton's interests spanned the perception of color as well as the production of color. His original observations (1671–72) on primary or basic hues in the photic spectrum have proved essentially correct. See page 201. [M. H. Bornstein, Princeton University]



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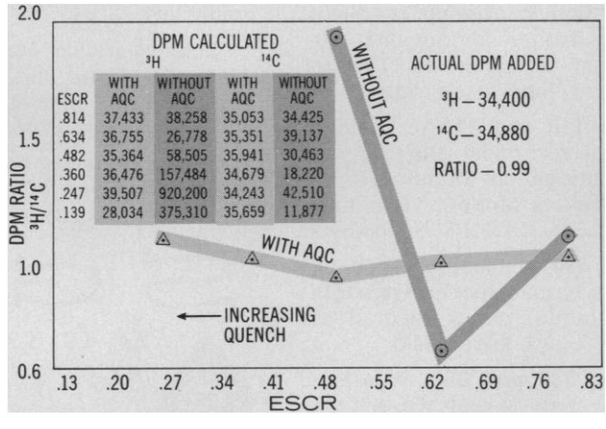

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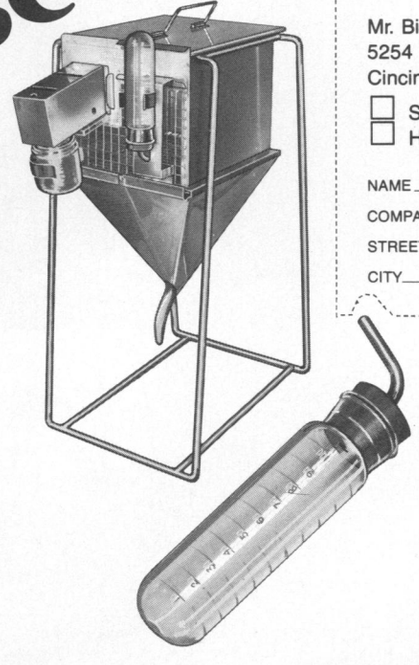

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1. Experimental "micro balloons"

Hollow glass spheres (∽ 50 μm diameter) to be used as fuel pellets for laser-induced fusion. Jamin-Lebedeff interference contrast. Negative magnification: 250X.

2. Chromosomes

From a human lymphocyte showing trypsin-induced Giemsa bands (G-bands). Transmitted light. Planapo 63/1.4 Oil objective. Negative magnification: 1250X.

3. Plutonium microspheres

Autoradiograph of 10μm zirconia spheres containing alpha-emitting plutonium. Nomarski differential interference contrast. Negative magnification: 800X.

Photomicrographs 1, 2 & 3: Julie Langham Grilly, Los Alamos Scientific Laboratory.

4. Semiconductor

Tapered cross section after etch, showing emitter base, buried layer, isolation and resistor diffusions. Nomarski differential interference contrast. Negative magnification: 528X.

Photomicrograph: Motorola Semiconductor Products Division.

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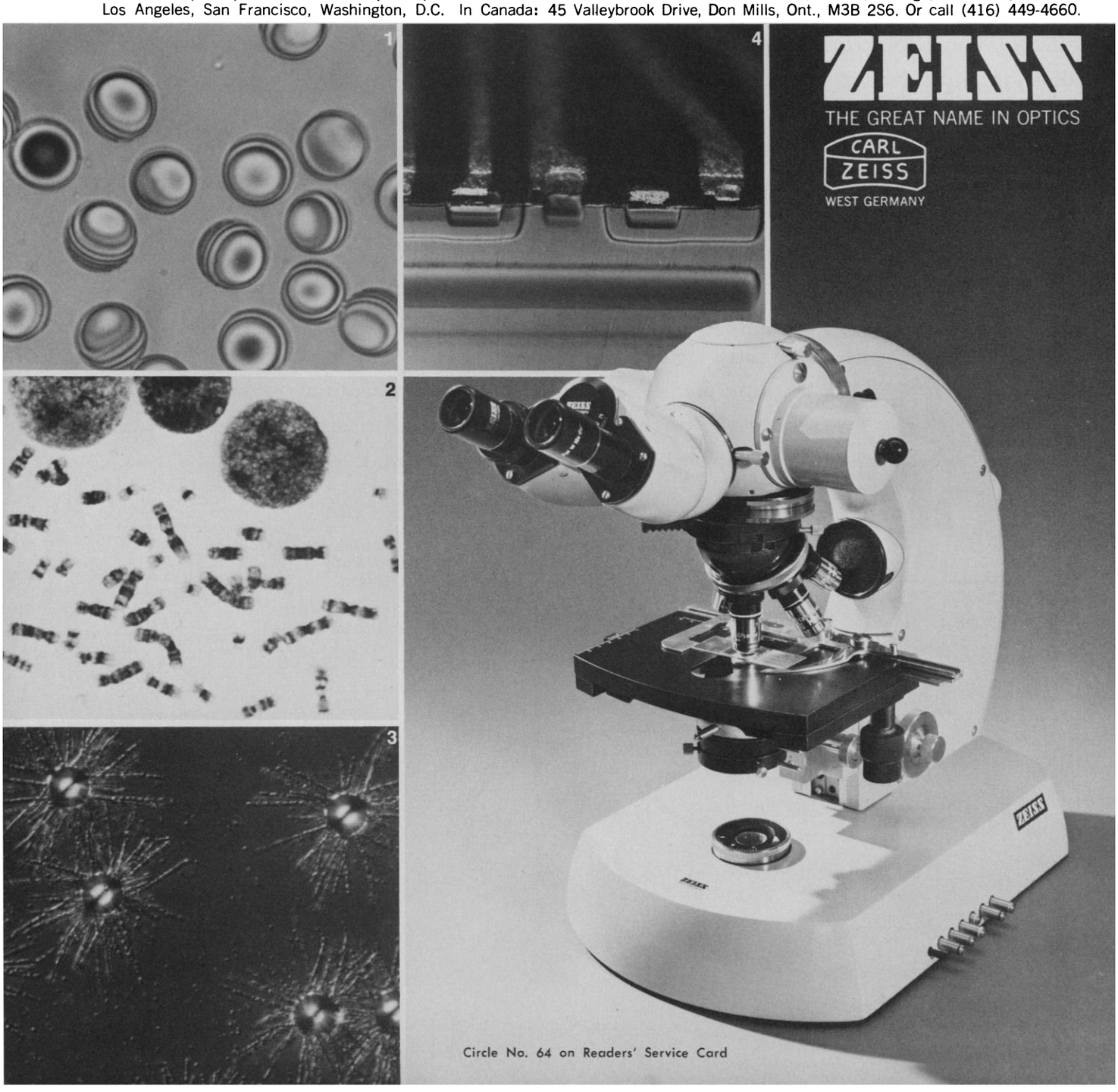

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...compared with what you'd pay for the same individual policies from insurance companies selling to the general public. That's not exactly a revelation for most educators, of course. They already know that TIAA is traditionally their best buy in life insurance. What's news is that...

New, lower premium rates now apply to TIAA policies issued beginning October 1, 1975.

In addition, with "quantity savings" dividends,

Net costs are less than ever before for the larger size policies educators are purchasing these days.

To illustrate the effect of the new rates and dividend scales, **A $100,000 20-Year Decreasing Term Insurance policy costs just $122 for a man aged 30 or for a woman aged 35.** Here are premium and dividend figures for this policy issued at different ages:

Age at Issue	MALE / FEMALE	25 / 30	**30 / 35**	35 / 40	40 / 45	45 / 50
Annual Premium (Payable only 18 years)		$187	**$235**	$328	$487	$747
Cash Dividend End of First Year*		97	**113**	142	188	265
First Year Net Payment		$ 90	**$122**	$186	$299	$482

**Subsequent yearly dividends will be in the same amount, according to TIAA's current dividend scale which is not guaranteed.*

Decreasing Term policies provide their largest amount of protection initially, reducing by schedule over the years to recognize diminishing insurance needs and increasing savings, retirement benefits, etc. TIAA issues such policies for 15, 20, 25 and 30 year periods, depending upon age. Decreasing Term insurance is available in amounts of $20,000 or more to persons under age 56.

To use a different illustration,

$100,000 of 5-Year Renewable Term coverage costs only $180 for a 30 year old man or for a 35 year old woman.

Here are the cost figures for this policy issued at various ages.

Age at Issue	MALE / FEMALE	25 / 30	**30 / 35**	35 / 40	40 / 45	45 / 50
Annual Premium		$258	**$288**	$373	$530	$774
Cash Dividend End of First Year*		101	**108**	140	185	254
First Year Net Payment		$157	**$180**	$233	$345	$520

**Dividends at end of years two through five will be in the same amount, according to TIAA's current dividend scale which is not guaranteed.*

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Eligibility for TIAA policies is extended to persons employed (full-time or part-time) by colleges, universities, private schools, and certain other nonprofit educational or scientific institutions, and to the spouse of the employee when more than half of their combined earned income comes from such an institution. Individuals can purchase low cost TIAA life insurance regardless of whether their college or other eligible employer participates in a TIAA benefit plan. Policyowners can retain their TIAA plans without any change in policy provisions whether they stay in educational work or not.

TIAA policies cost less than others because TIAA is a nonprofit service organization created by the Carnegie Foundation for the Advancement of Teaching in 1918; it insures without the expenses of sales personnel; most important of all, the limited group eligible to purchase TIAA life insurance enjoys favorable mortality experience, and individuals once insured rarely permit their TIAA policies to lapse.

Besides term insurance, Ordinary Life and other kinds of cash value insurance are available from TIAA at comparable savings.

Note to present TIAA policyowners. Although the new premium rates do not apply to policies issued prior to October, dividends will be adjusted to provide equitable treatment for similar policies issued under different rate bases.

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LETTERS

Freedom of Information

In his letter of 21 November 1975 (p. 736) Edward D. Korn discusses the serious ethical and practical questions raised by the Freedom of Information Act that now allows one scientist to have access to the grant proposal of another. Korn and many others suspect that there may be abuses. A scientist's ideas are his prime commodity. The manner in which he develops them is an essential ingredient in his professional advancement.

Korn's letter includes a statement of scientists at the National Institutes of Health (NIH) and the National Institute of Mental Health (NIMH) who strongly urge their colleagues not to request copies of grant applications.

If the Freedom of Information Act allows one scientist to see the grant proposal of another, surely it will allow the rest of us to know who has made the request. I suggest, therefore, that the names of all individuals who have requested copies of the grant proposals of others be published, possibly in *Science*, together with the titles of the requested proposals and the names of those who submitted them.

Should a list of those who invade the privacy of their fellow scientists be published, its length might quickly approach the vanishing point.

JOHN A. MOORE
Department of Biology, University of California, Riverside 92502

We wish to add our own concern to that of Edward D. Korn regarding the decision of the District of Columbia Court of Appeals not to exempt grant applications to NIH for research support from disclosure under the Freedom of Information Act. The court's decision conflicts with the right to privacy of each investigator. Grants are often awarded on the basis of the uniqueness of expressed ideas and the proved or potential ability of the investigator to complete the proposed experiments. Accessibility of these "privileged communications" to the general scientific community preempts the grantee's own right to test his formulations without concern for wholesale distribution of his ideas. The proliferation of scientific journals, meetings proceedings, and newsletters for the exchange of research experience and ideas has never been greater and continues to expand. The need for scientists to have access to their colleagues' grant applications under these circumstances seems suspect.

Communication between scientists has traditionally been very open. Our own inquiries for information from individuals in areas of "direct" competition have always been answered with the most courteous, informative, and genuinely helpful kinds of responses. As Korn suggests, this intervention may encourage secretive competition and the involution of the current expressive and open scientific attitude. As far as research grants are concerned, there seems very little to be gained through the Freedom of Information Act, but a great deal to be lost. It encourages "scientists" with questionable ethics to seek new and stimulating ideas via the easy route of obtaining successful grant applications for their own professional advancement. We agree with Korn that *all* scientists should adopt a policy as outlined by the Inter-Assembly Council of NIH-NIMH to consider the ethical questions of obtaining such grant applications and not to make such requests.

Publication of the names of those individuals making requests would inform the scientific community of the extent of this activity and discourage the use of the grant applications for any purpose other than general background information.

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Hershey 17033

FRED RAPP
Department of Microbiology,
College of Medicine,
Pennsylvania State University

I endorse the suggestions of the NIH-NIMH Inter-Assembly Council and of Edward D. Korn and suggest an additional policy. Inasmuch as the provisions of the Freedom of Information Act and the interpretation of that act by the District of Columbia Court of Appeals places grant applications in the public domain and requires that copies be made available to anyone who asks, it seems reasonable that granting agencies, journal editors, and members of the scientific community should henceforth consider a grant application (approved or not) a professional communication whose contents can be cited by the writer of the application for the usual scientific and professional purposes, as evidence of prior publication.

IRWIN PESETSKY
Department of Anatomy,
Albert Einstein College of Medicine,
Yeshiva University,
1300 Morris Park Avenue,
Bronx, New York 10461

I take strong exception to the comments of Edward D. Korn regarding the usage by scientists of their fellow scientists' grant applications. It is sad indeed that a court of justice had to intervene to safeguard the rights of the public. Korn's suggestion to scientists to refrain from exercising their legal right is inappropriate in an open and free society. In addition to its pervading implications in science, the suggestion may have far-reaching social, ethical, and legal repercussions.

Korn raises the questions of the possible adverse effect of public distribution of grant copies on the task of evaluation by study sections, on scientific exchange, and on secretive competition among scientists. Knowledgeable scientists fully conversant with the disadvantages of peer review include as much material in their grant proposals as they feel will land them the grant without jeopardizing their originality. Contrary to Korn's fear, I feel scientists will continue to be as explicit in their grant proposals as they deem necessary in their self-interest. In fact, with the knowledge that their proposals may be made public, scientists are likely to submit better proposals in the future, taking the same care and caution that they take when submitting articles for publication. This will facilitate, rather than make more difficult, the task of study sections in weeding out the less desirable proposals.

An open grant system will provide an additional forum for scientific communication among investigators in diverse geographical and professional areas, as publications do now. Furthermore, successful grant applications will also serve to educate the uninitiated in the art of grantmanship. Competition, secretive or open, engenders productivity. Besides, many would agree that as mortals we scientists fare no better than others when it comes to vices associated with self-survival.

G. K. BATRA
Department of Pediatrics,
School of Medicine,
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Bicentennial Bells: A "Precedent"

Constance Holden's article "The Bicentennial: Science loses out" (News and Comment, 8 Aug. 1975, p. 438) opens with the sentence, "It has been rumored that someone's idea of an arresting way to celebrate America's science and technology for her 200th birthday is to build a firecracker that could be seen from the moon"; in closing, the article mentions

the American Revolution Bicentennial Administration's plan for 4 July 1976: "The afternoon is to be devoted to town meetings and speeches, and at 4 p.m. (11 a.m. Hawaii time) all the bells will ring out simultaneously." Regarding this last item, Darlene C. Schmidt (Letters, 26 Sept. 1975, p. 1045) raises the question: "Has anyone considered what the effect might be of all that simultaneous sound vibration?"

This brings to mind a report of another experiment along the same lines. I quote the report in extenso:

> Once on a time, a notion was started, that if all the people in the world would shout at once, it might be heard in the moon. So the projectors agreed it should be done in just ten years. Some thousand shiploads of chronometers were distributed to the selectman and other great folks of all the different nations. For a year beforehand, nothing else was talked about but the awful noise that was to be made on the great occasion. When the time came, everybody had their ears so wide open to hear the universal ejaculation of Boo—the word agreed upon—that nobody spoke except a deaf man in one of the Fejee Islands, and a woman in Pekin, so that the world was never so still since creation.

This report is from "The autocrat of the breakfast table (Everyone his own Boswell)" by Oliver Wendell Holmes.

ARTHUR F. SCOTT

Department of Chemistry,
Reed College,
Portland, Oregon 97202

References

1. O. W. Holmes, *The Writings of Oliver Wendell Holmes* (Houghton Mifflin/Riverside, Boston, 1891), vol. 1, p. xi.

"Greenhouse Effect": Definition

The discussion of the term "greenhouse effect" in the letters section of *Science* (12 Dec. 1975, p. 1042) provides an example of a popular lexicographic fallacy. The etymology of a word should not be confused with its meaning. No matter that the coinage of "greenhouse effect" may have been based on an incomplete analogy between the processes of heating by natural radiation of a greenhouse and of the earth's surface and lower layers of atmosphere. Once the word is in use, meaning is determined by usage and not by its derivation. Of the 41 citations for "greenhouse effect" in the Merriam Company research files, 28 apply to heating of the earth's surface and surrounding layers of atmosphere, and seven refer to a supposed similar phenomenon on other planets. Only six citations are inexplicit or can be construed as including the heating of a greenhouse itself. Based on this evidence of usage, the term "greenhouse effect" was entered in Webster's New Collegiate Dictionary and will be included in the forthcoming addenda to Webster's Third New International Dictionary. The discussion in *Science* was particularly useful, since it brought to light the fact that the definition needs to be revised to emphasize the earth's surface as well as the lower layers of the atmosphere, as follows.

> : warming of the earth's surface and the lower layers of atmosphere that tends to increase with increasing atmospheric carbon dioxide and that is caused by conversion of solar radiation into heat in a process involving selective transmission of short wave solar radiation by the atmosphere, its absorption by the earth's surface, and reradiation as infrared which is absorbed and partly reradiated back to the surface by carbon dioxide and water vapor in the air.

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Maytenus: A Folk Medicine

Interested in both *nomina generica* and folk medicine, I was curious about Kupchan's reference to "ack-ack" (Letters, 14 Nov. 1975, p. 612) as the only common name found for any species of *Maytenus* (in Africa?). Uphof (*1*) notes that African *Maytenus* (alias *Gymnosporia*) *senegalensis* has several colloquial names, among them *bazimo*, "confetti tree," *kisambila*, *mmoza*, and *umiviesa*. It is reportedly used as an aphrodisiac, for treating blennorrhagia, and for wounds.

In Brazil, *Maytenus* (alias *Nemopanthus*) *ilicifolius* is called *cancerosa* (*2*). It is sold in markets and is recommended for ulcers and stomach disorders. In Argentina, it is called *congorosa* and *sombra de toro*. It is also called *congoasa* and *mayteno*. It has been called "holy thorn tree" in English. Containing tannin, the foliage is used as an analgesic, aperient, astringent, cicatrizant, and stomachic. Sometimes the leaves are used to adulterate maté, the Paraguayan tea. Remillard *et al.* (19 Sept. 1975, p. 1002) reported that maytansine, which comes from *Maytenus*, inhibits mitosis. Is the name *cancerosa* a coincidence?

JAMES A. DUKE

Plant Taxonomy Laboratory,
Agricultural Research Center,
U.S. Department of Agriculture,
Beltsville, Maryland 20705

References

1. J. C. Th. Uphof, *Dictionary of Economic Plants* (Cramer, Lehre, Germany, ed. 2, 1968), p. 334.
2. C. Stellfeld (G. M. Hocking, translator), *Q. J. Crude Drug Res.* **8**, 1301 (1968).

ANOmALIES

Anomalies catch the scientific eye because, like the wayward "m" above, they are unexpected. Are anomalies important to science's future? To help answer, the Sourcebook Project sifts 200 years of scientific literature and retrieves records of anomalous events and discoveries.

EXAMPLES OF SCIENTIFIC ANOMALIES

Scientific journals are full of anomalies: ball lightning, mountain-top glows, the Yellowstone Lake whispers, earthquake lights, the Carolina Bays, musical sands, precolumbian contacts, intramercurial planets, and thousands more.

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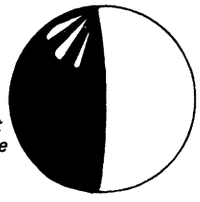

Peculiar fingers of light seen during lunar eclipse

A RESPONSIBLE APPROACH

The objective of the Sourcebook Project is to collect, organize, and reprint anomalous data extracted primarily from the scientific literature. *Nature, Science, Scientific American, Meteorological Magazine,* and the *American Antiquarian* are typical contributors to the sourcebooks. The older literature is a special target because few have access to it. The sourcebooks beat no drums and promote no wild hypotheses. However, they are strongly biased toward the strange and unusual aspects of the universe because there lie the frontiers.

A LIBRARY OF FUTURE SCIENCE?

The sciences of tomorrow, whatever they may be, are not in our current textbooks anymore than quasars, mascons, charmed quarks, Stonehenge astronomy, or tectonic plates were in the schoolbooks 20 years ago. The sourcebooks are no final answer, of course; they provide only starting points. They are intriguing, mind-expanding, and sometimes infuriating because no dogma, scientific or pseudoscientific, is sacred.

The sourcebooks appear in several series; one series for each major branch of science; Within each series, entries are separated into such categories as ball lightning, megalithic circles, boulder trains, and whatever logic demands. A ringbinder format permits like categories to be interfiled as new material is published. Each volume is indexed. The colorful hard-cover binders are specially printed and make handsome additions to any library.

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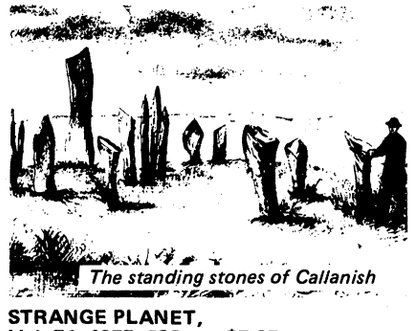

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Vol. G1, 1974, 277 pp., $7.95.

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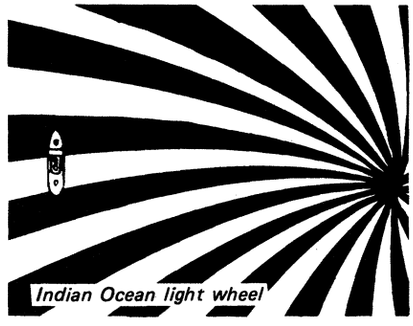

Indian Ocean light wheel

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Vol. M1, 1974, 262 pp., $7.95.

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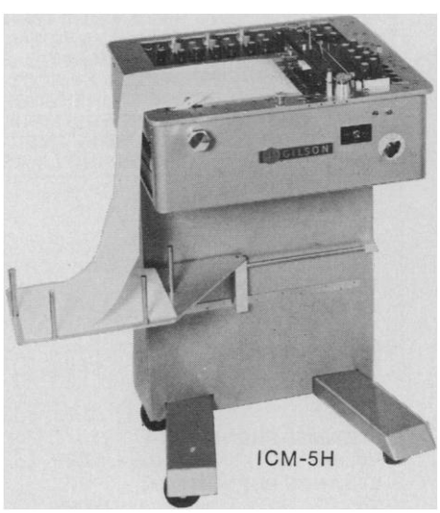

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16 January 1976, Volume 191, Number 4223 **SCIENCE**

Milestone Legislation for a Metric United States

The President's signing the Metric Conversion Act of 1975 is a milestone in the history of the U.S. measurement policy. The United States is now committed to providing a national program that will make the International Metric System the predominant but not exclusive system of measurement throughout the country. Metric conversion remains a voluntary activity for the next ten years.

The use of the metric system has been legal in the United States for more than a century, but only in the last few years has actual usage become widespread and increasingly visible. Since 1971 when the Secretary of Commerce issued the report "A Metric America," which strongly favored a coordinated program of conversion, metrication has taken place in industry, government, and education. Many corporations, including four of the nation's ten largest firms, have announced conversion policies. In government agencies the use of metric units appears in an increasing number of reports, studies, and public announcements. At the Office of Education of the Department of Health, Education, and Welfare, $2 million was appropriated in 1975 to establish a metric education program to support model projects for improving metric education throughout the country.

Various metric education programs are under way in all 50 states. In many schools steps have been taken to incorporate the metric system, especially through the new science and mathematics curriculums of the past decade. Professional associations have also been concerned with metric education. A recent questionnaire to 100 scientific societies affiliated with the AAAS showed that science and mathematics education associations have been producing metric education materials.

Public awareness of the metric system has increased steadily, according to Gallup polls conducted in 1965, 1971, and 1973. More than half of the adults polled in 1973 were aware of the metric system, nearly twice as many as in 1965. However, only about 30 percent of the sample gave an accurate description and, of this group, 60 percent favored adoption of the metric system.

Until now metrication in the United States has been voluntary and uncoordinated. The Metric Conversion Act of 1975 is the congressional response to this absence of coordination and direction. The new law establishes a U.S. Metric Board to coordinate voluntary conversion to the metric system within the next ten years.

The composition and method of selection of the members of the board is a recognition of the importance of metric conversion and its diffuse impacts upon American society. The chairperson and 16 members of the board are to be appointed by the President with the advice and consent of the Senate. Twelve members are to be chosen from lists of individuals submitted by organizations and groups with the following interests: engineering, science and technology, manufacturing (including retailing and commerce), labor, state and local governments, small business, building construction, standards making, and education. Four members are to be selected at large to represent consumers and other concerned groups.

The board will have three functions: to prepare and implement a comprehensive program of planning and coordinating metric conversion; to carry out a program of public information and education at all levels of society; and to conduct related research and submit recommendations to Congress and the President.

The great barrier to the public acceptance of metric measurement appears to be anxiety—the fear of the unknown, the dread that learning to use metric will be difficult. Scientists and science educators can help smooth the transition to metric by (i) continued participation in the discussions and planning of metric conversion, (ii) initiating and assisting in formal and informal public education activities, (iii) contributing to research on any unresolved problems or questions associated with metric conversion, and (iv) by scrupulously using the metric system themselves.—MINA REES, *Chairperson, AAAS Metric Education Committee,* and ARTHUR H. LIVERMORE, *AAAS Office of Science Education*

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RESEARCH NEWS

(Continued from page 170)

separation of Greenland and Spitzbergen formed the Norwegian Sea and thus opened the Atlantic to the Arctic regions for the first time. The event precipitated major changes in the oceanic environment, transforming what had been a tranquil regime into what Berggren and Hollister describe as "commotion in the ocean." Before 50 million years ago, calcium carbonate sediments were deposited throughout the latitudinal range of the Atlantic in what apparently was a relatively homogeneous environment. Since then, however, the sediment patterns reveal an environment characterized by latitudinal and vertical temperature gradients, upwelling, and vigorous bottom currents that eroded and transported sediments over large distances on the sea floor.

More recently, the elevation of the Isthmus of Panama about 3.5 million years ago severed the marine connection to the Pacific and may have contributed to a more vigorous Gulf Stream. Shortly thereafter the initiation of Northern Hemisphere glaciation helped to form the cold Labrador current, displacing the Gulf Stream southward to its present position south of latitude 45°N. And during the subsequent ice ages, there appear to have been repeated invasions of cold polar water into the Atlantic.

A somewhat different type of environmental change discovered in the sea floor sediments is the temporary drying up of the Mediterranean Sea, an event so surprising to many scientists that they refused to believe the initial reports, which have subsequently been confirmed. The Mediterranean is a deep basin, the remnant of the Tethys seaway, which was apparently closed off at the eastern end by the intersection of Africa and Eurasia about 18 million years ago. Then about 6 million years ago the western opening to the Atlantic was also closed off for about 1 million years. Because the rate of evaporation from the sea is so high—more than can be supplied by river inflow—the sea dried up until all that was left was a series of lakes. In the process, huge beds of salt and other evaporites were precipitated. (The beds are so thick that they have not yet been drilled completely through.) Then, according to Kenneth Hsü of Technical University of Zurich, Switzerland, the Gibraltar gate opened again, initiating what must have been the world's most spectacular waterfall as the sea filled again. The episode not only dramatically altered the climate of the surrounding region, but also withdrew a substantial amount of salt from the world oceans. Similar processes during the early history of the Atlantic, according to William Ryan of the Lamont-Doherty Geological Observatory, may have withdrawn as much as 10 percent of the salt in the world oceans, forming huge salt beds off the coast of Africa.

Although much of the research on the deep sea sediments has focused on biogenic materials, currents often carry eroded continental materials some distance from land. Ash from explosive volcanism can be distributed even further. Kennett and Robert Thunell, also of the University of Rhode Island, find that the amount of volcanic ash in sediments from the past 2 million years is at least four times as high as the average for the past 20 million years. The increase was observed over wide areas of the oceans. The finding is significant because the period of exceptionally intensive volcanism coincides closely with the period of the earth's climatic history that has been most unstable, marked by repeated ice ages and alternating interglacial climates. Which is cause and which is effect is still uncertain, but the investigators believe that the association is not coincidental.

Cause and effect for most of the other environmental changes described earlier also remain somewhat speculative, especially the causes for major extinctions of life forms such as mark many of the geological time-zone boundaries. The most sweeping of these changes, at the boundary between the Mesozoic and the present Cenozoic era, is still a mystery. But the deep sea sediments are in many ways a good place to look for important environmental changes in the past, since they are so stable that only really global changes show up. According to William Hay of the University of Miami, the areal distribution of major sediment types has not changed significantly over the last 100 million years. He finds, for example, that sediment patterns in the past are similar to those of the present as measured either by maps of the dominant types or by the content of calcium carbonate, corrected for sedimentation rate.

With such a good data base for the deep sea, Hay believes, it will be easier to tackle the problem of the continental shelves and margins, where the sediment columns are much thicker and largely unsampled. It should be possible, for example, to make estimates of the amount of organic carbon—and hence possibly oil—trapped on the ocean shelves. Hay foresees working from what was on land and what is measured in the deep sea to do an element-by-element mass balance and thus to model a closed geochemical system.

The oceans, no longer a blank spot on geological and geochemical maps, are becoming one of the most active areas of research directed at understanding the planet we live on.—ALLEN L. HAMMOND

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(Continued from page 178)

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