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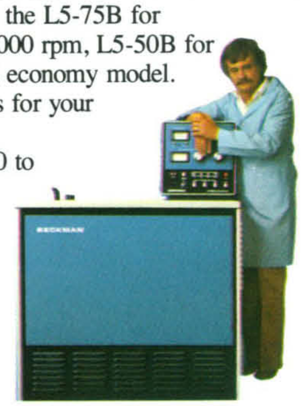

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10 November 1978

Volume 202, No. 4368

SCIENCE

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COVER

Within the Grand Canyon, 161 rapids account for most of the drop in elevation of the Colorado River. The rapids occur in bedrock fracture zones where steep side-canyon tributaries deliver large debris to the parent stream. Before the existence of Glen Canyon Dam (1963), the mean annual flood height was 3.5 times the present 800 cubic meters per second, so the large alluvial fan debris was periodically moved down the river. Since this process is no longer occurring, the alluvial fans are growing and the rapids are becoming larger. See page 629. [Robert Dolan and Alan Howard, University of Virginia, Charlottesville; David Trimble, North American Exploration, Charlottesville, Va.]

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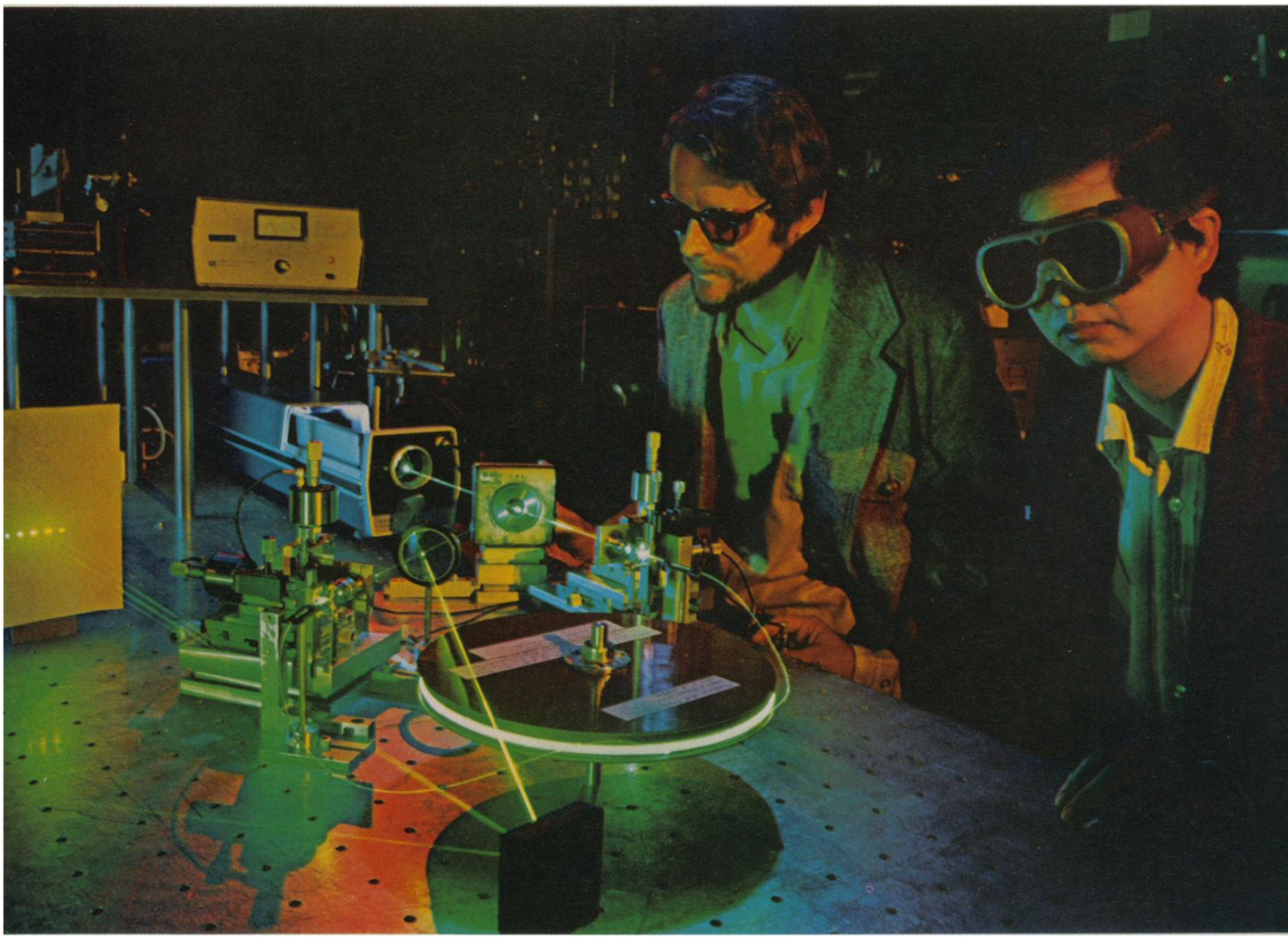

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Murray Hill, New Jersey 07974

Bell Labs scientists Roger Stolen and Chinlon Lin work with a fiber Raman laser, one of a new class of light sources that use optical fibers—up to a kilometer long—to produce tunable laser light. At left, the laser's output—which contains multiple Raman-shifted wavelengths—is taken off a beam splitter and dispersed by an external grating to show the broad range of wavelengths that can be tuned.

Bell Labs has developed some of the world's most transparent glass fibers to *carry* light for communications. We've also devised a way to make these highly transparent glass fibers *generate* light. In fact, they are the basis for a new class of tunable light sources called fiber Raman lasers. They're among the latest, and by far the longest, of many lasers invented at Bell Labs, beginning in 1957 with the conception of the laser itself.

Since the new fiber lasers work best at wavelengths at which they are most transparent, we can make them very long. The longest active lasing medium ever built, in fact, was a fiber Raman laser over a kilometer in length. Studying the ways light and glass interact over such distances is part of our research in lightwave communications.

In these new light sources, a glass fiber with high transparency and an extremely thin light-guiding region, or core, is excited by a pump laser. The pump light, interacting with the glass, amplifies light at different wavelengths through a phenomenon known as stimulated Raman scattering. This light is fed back into the fiber by a reflecting mirror. If gain exceeds loss, the repetitively amplified light builds up and "lasing" occurs.

Fiber Raman lasers have conversion efficiencies of about 50%, operate in pulsed and continuous wave modes, and are easily tunable over a broad wavelength range in the visible and near infrared regions of the spectrum.

We've used these lasers to measure the properties of fibers and devices for optical communications; and studies of the lasers themselves have revealed a wealth of information on frequency conversion, optical gain, and other phenomena. Such knowledge could lead to a new class of optoelectronic devices made from fibers, and better fibers for communications.

Looking back

These long lasers come from a long line of Bell Labs firsts:

1957: The basic principles of the laser, conceived by Charles Townes, a Bell Labs consultant, and Bell Labs scientist Arthur Schawlow. (They later received the basic laser patent.)

1960: A laser capable of emitting a continuous beam of coherent light—using helium-neon gas; followed in 1962 by the basic visible light helium-neon laser. (More than 200,000 such lasers are now in use worldwide.) Also, a proposal for a semiconductor laser involving injection across a p-n junction to generate coherent light emitted parallel to the junction.

1961: The continuous wave solid-state laser (neodymium-doped calcium tungstate).

1964: The carbon dioxide laser (highest continuous wave power output system known to date); the neodymium-doped yttrium aluminum garnet laser; the continuously operating argon ion laser; the tunable optical parametric oscillator; and the synchronous mode-locking technique, a basic means for generating short and ultrashort pulses.

1967: The continuous wave helium-cadmium laser (utilizing the Penning ionization effect for high efficiency); such lasers are now used in high-speed graphics, biological and medical applications.

1969: The magnetically tunable spin-flip Raman infrared laser, used in high-resolution spectroscopy, and in pollution detection in both the atmosphere and the stratosphere.

1970: Semiconductor heterostructure lasers capable of continuous operation at room temperature.

1971: The distributed feedback laser, a mirror-free laser structure compatible with integrated optics.

1973: The tunable, continuous wave color-center laser.

1974: Optical pulses less than a trillionth of a second long.

1977: Long-life semiconductor lasers for communications. (Such lasers have performed reliably in the Bell System's lightwave communications installation in Chicago.)

Looking ahead

Today, besides our work with tunable fiber Raman lasers, we're using other lasers to unlock new regions of the spectrum in the near infrared (including tunable light sources for communications), the infrared, and the ultraviolet.

We're also looking to extend the tuning range of the free electron laser into the far infrared region—where no convenient sources of tunable radiation exist.

We're working on integrated optics—combinations of lightwave functions on a single chip.

Lasers are helping us understand ultrafast chemical and biological phenomena, such as the initial events in the process of human vision. By shedding new light on chemical reactions, atmospheric impurities, and microscopic defects in solids, lasers are helping us explore materials and processes useful for tomorrow's communications.

Also under investigation is the use of intense laser irradiation in the fabrication of semiconductor devices. The laser light can be used to heat selective areas of the semiconductor and anneal out defects or produce epitaxial crystalline growth. Laser annealing coupled with ion implantation may provide a unique tool for semiconductor processing.

We've played an important part in the discovery and development of the laser—an invention making dramatic improvements in the way our nation lives, works and communicates.

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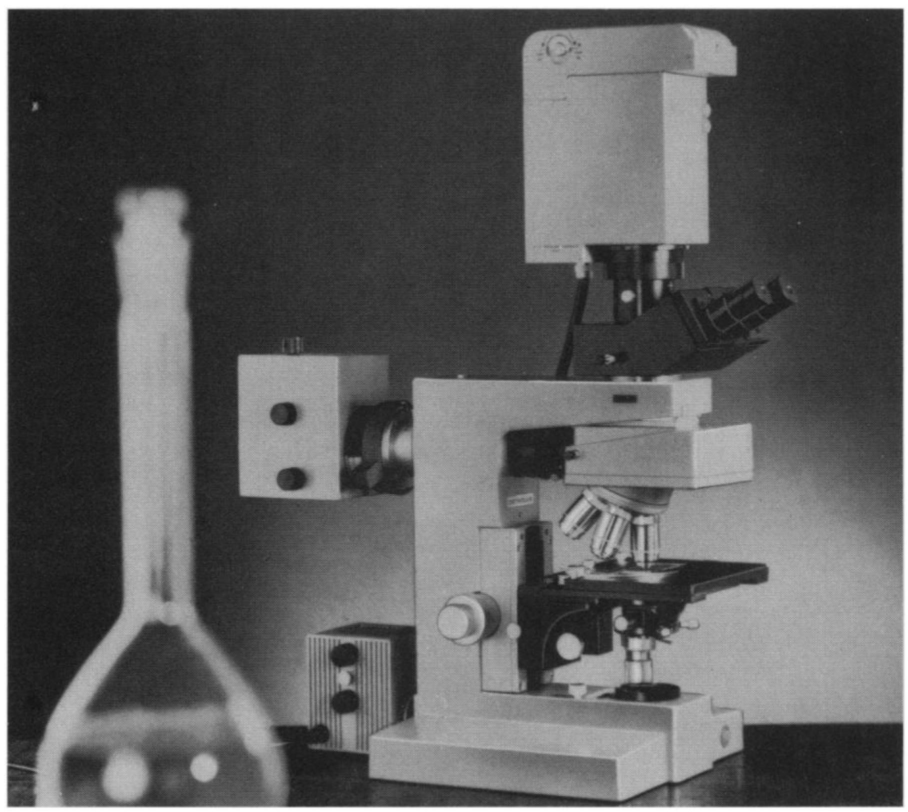

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United States to continue work at Cornell University. Amnesty International has just informed us that T. W. Kamil and I. Made Sutayasa were among the 10,000 prisoners freed by the Indonesian government in December 1977; both have returned to their families and are well. And Claudio Santiago Bermann, an Argentine psychiatrist, has been released from prison and is reported to be en route to Israel.

As for the apology, it is to Sir Andrew Huxley and to readers for an inadvertent distortion of his quotation (p. 505). By dropping a line, his entire meaning was changed. The currect statement follows with the dropped line in italics (*1*).

The persecutions of the present day are not directed against scientific doctrines or against scientific enquiry as such; they are directed against individual citizens who have had the courage to speak up against oppressive features of the regimes under which we live. Among these brave individuals there are, for example, writers and medical men as well as scientists. The appropriate reaction therefore comes from us not as scientists but as citizens; if we wish to join in some corporate protest, it should be through a body whose prime concern *is with human rights and not through one whose prime concern* is with science. If a scientific body publicly takes a step whose justification is political and not scientific, it will lose the right to claim that it is acting purely in the defense of science on some future occasion when it wishes to speak out against, say, a repetition of the Lysenko affair.

I am indebted to Don K. Price of Harvard University for calling my attention to the error in the quotation.

ROBERT W. KATES
Graduate School of Geography, Clark University, Worcester, Massachusetts 01610

Notes

1. Excerpt from an address by Andrew Huxley to the British Association for the Advancement of Science, August 1977. Reprinted in *Chemical and Engineering News* (26 September 1977), p. 5.

Nitrites: The Newberne Report

The News and Comment article (8 Sept., p. 887) on the Food and Drug Administration's (FDA) move toward a nitrite ban states that an FDA-sponsored study by Paul Newberne at MIT provided "solid evidence that nitrites are themselves carcinogens." The MIT final report to the FDA (contract 74-2181 dated 18 May 1978) states, "The spleen . . . exhibited a condition referred to as immunoblastic cell proliferation. This change *may be* associated with developing lymphoma but evidence is lacking . . . *both* spleen and non spleen lymphomas were combined and there were *suggestions* for a nitrite effect; there was *not*, however, a convincing dose response [emphases added]." Further, "the data are *only suggestive* and the biological significance of nitrite associated lesions of the lymphoreticular system is *uncleared* [emphases added]."

The investigator did not report "solid evidence," and in fact carefully stated that "the results do not permit assigning nitrite a proximate carcinogenic role." He did state that "nitrite *appears* more a promotor of the neoplastic process than an initiator [emphasis added]."

It is imperative that the scientific community judge the facts and not the interpretations of advocates, reporters, or politicians. The nitrite issue is complex. Banning nitrite in cured meats would not substantially reduce human exposure (Reports, 30 June, p. 1487) and would in essence be another political nonsolution.

PAUL A. LACHANCE
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Data Evaluation in Biology

Stockmayer's excellent editorial (18 Aug., p. 577) calls attention to the paucity of evaluated data in the various handbooks and tabulations on which scientists must rely for numerical information. The focus of the editorial and its reference to a comprehensive survey sponsored by the National Academy of Sciences is entirely on physical and chemical data. As a life scientist, I must affirm that the need for evaluated data is just as great in biology and the health-related sciences. The Federation of American Societies for Experimental Biology has performed creditably in this field through its Biological Handbooks Office for almost two decades. Regrettably, this "unglamorous activity" is being terminated. I hope that an appropriate body of the National Research Council will take note. A replacement must be created for this critical capability. The alternatives involve (i) reliance on inadequately evaluated data with the attendant errors that would result or (ii) having each biological scientist spend a disproportionate amount of time becoming a data evaluator. Either alternative is considerably less efficient than priority funding of appropriate handbook efforts.

CHARLES S. TIDBALL
Department of Physiology, George Washington University Medical Center, Washington, D.C. 20037

10 November 1978, Volume 202, Number 4368

SCIENCE

Science: Support, Excitement

When President Carter's science budget for fiscal year 1979 was announced, the scientific community was gratified with the proposed increases. Since then, however, there has been a long and difficult series of debates in Congress. In the aftermath of these debates it will not be possible to point to large dollar increases. In consequence, a letdown feeling is likely to affect members of the scientific community. The financial blow is likely to be compounded by a feeling that science is no longer unquestioningly accepted by our nonscientist peers. Two extremes of reaction are possible. One is self-pity and withdrawal, which is self-defeating. The other is Pollyannaism, which is stultifying. Instead, a realistic appraisal can be constructive and useful in furthering the field itself.

At the outset it can be flatly asserted that the support initially requested in the President's budget could have been used effectively. Indeed, even the agency requests might well have been used effectively. So unless it can be shown that the federal support that has been made available is too little to be of any use, it behooves us to apply the funds appropriated to the best effect and move on along the road to support for fiscal 1980.

There are two points that must be made with regard to the seemingly endless struggle to maintain public support of basic science. The first is the desirability of constantly maintaining a certain degree of tension in the allocation of public money. It can be argued that tension in itself is valuable to the field because it minimizes laxness.

The second point is that during the last 10 years of seemingly constant dimunution of support, science itself has flowered. It is appropriate to suggest that science is in a state of revolutionary advance. By this I do not mean great new societal advances, but rather scientific gains. And one can easily defend the proposition that an advance in the understanding of nature is the vital first step to the development of technology. Indeed, that has been true for many of the great inventions, such as McCormick's reaper.

Some examples illustrating the vigor of science may be given. The virtual proof of the concept of plate tectonics and sea-floor spreading certainly is a leading one. So is the enhanced insight that has been gained not only into the structure of large molecules but also into the dynamics of their association into binary spirals, clusters, and sheets. Impressive developments in picosecond spectroscopy make it possible to look at atom groupings in time intervals not previously considered when thinking in terms of stability, and thus the very concept of the molecule may require alteration. Developments in Raman and infrared laser spectroscopy provide a means of exploring the liquid phase that has never before been available, giving insights into particle dynamics that should greatly expand our understanding of critical phenomena and of ion mobility in solutions. And to these we may add microelectronics, computer applications, great new astronomy experiments, and so on.

Two general aspects deserve mention. The first is that outstanding instrumental gains lead the advances. In particular, incisive molecular sensors permit experimentation that unblocks long dormant theoretical paths—for instance, the Debye-Hückel-Onsager theory. The second general point is that the new insights have led to convergence within scientific disciplines as well as between them. In other words, the unity of natural science of a couple of centuries ago, which was lost in the specialization needed to understand the parts, may be more approachable again.

Look at the facts in your own area of interest and it is likely that the same statements can be made. If that is so, how can we say that science is eroding? Of course, we must not be complacent, and we must not destroy ourselves by self-inflicted wounds. Our pursuit of the nature of nature has never been more exciting.—Norman Hackerman, *President, Rice University, Houston, Texas 77001*

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—Richard G. Sommer

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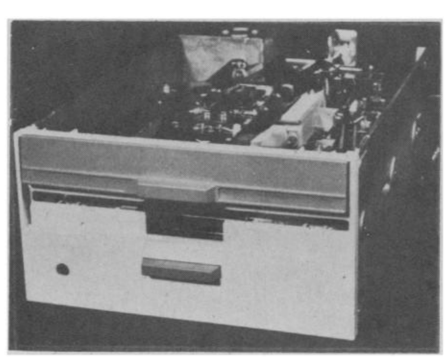

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Literature

Biological Test Diets and Ingredients also includes feeding tubes, blenders, and accessories. Bio-Serv. Circle 718.

Microfilm Terminals describes the IMT-100 reader and IMT-150 reader and printer which are microprocessor-controlled retrieval and storage systems. One magazine (4 by 4 by 1 inch) will store over 10,000 letter-sized documents. Eastman Kodak. Circle 673.

X-ray Fluorescence Analyzer is devoted to the Spectrace instrument with resolution of 150 electron volts. United Scientific. Circle 674.

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Standard Procedures for the Handling and Transport of Diagnostic Medical Specimens and Etiologic Agents is a practical guide. National Committee for Clinical Laboratory Standards. Circle 676.

Biochemicals includes buffers, carbohydrates, enzymes, substrates, pyrimidines, solvents, and many others. Vega Biochemicals. Circle 677.

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(Continued from page 624)

1978 (U.S. distributor, Kluwer Boston, Hingham, Mass.). viii, 408 pp., illus. Paper, $24.50.

Les Clefs de la Recherche Fondamentale. Le Nome et le Nombre Vivants, la Cybernétique et le Sacré. Jean-G. Bardet. Maloine, Paris, 1978. x, 294 pp., illus. Paper, 63 F.

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