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Emission of gas clouds in the active galaxy NGC 1068 observed by the Hubble Space Telescope. The gas is ionized by radiation from the galaxy nucleus, which is thought to be encircled by a dusty torus that allows the radiation to escape only within the conical region indicated on the image. Depending on the orientation of the torus relative to the disk of the galaxy it inhabits, this model can explain many types of galactic activity. See the Perspective on page 40. [Image: National Aeronautics and Space Administration]

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The New Year begins auspiciously for astronomers. The shuttle mission to repair the Hubble Space Telescope (HST) could not have gone better, and that success is as valuable to NASA as a whole as it is to the astronomical community in particular. It will be some weeks before tests of the revamped HST are complete, but there have been no problems so far, and the instrument should at last offer the celestial view its designers originally intended.

The omens are good in optical astronomy generally: the multi-mirror Keck Telescope in Hawaii is coming along well, and innovative designs for large ground-based optical telescopes are emerging from Japan, Europe, and the United States. But perhaps the most significant expansion of astronomers' view of the heavens has come, over the last two decades or so, from observations at wavelengths shorter than optical. Improvements in detector technology, along with the routine availability of satellite launches, have produced maps of the sky in ultraviolet radiation, x-rays, and gamma rays. ROSAT, the German-British-U.S. x-ray astronomy satellite, and the Compton Gamma Ray Observatory, a U.S. project comparable to HST in size, complexity, and cost, are less well known to the public but have been undoubtedly scientific successes. The Extreme Ultraviolet Explorer, whose history and first results are described by Bowyer in this special issue of Science on high-energy astrophysics, has filled in the last gap in the astronomical electromagnetic spectrum, and in the x-ray waveband there is plenty more to come (see the Perspective by Tanaka).

This recitation of successes is not meant to discount the day-to-day problems of astronomers, who like all researchers these days have to scrump and save. A perennial complaint is the difficulty of obtaining enough money to maintain observatories and ground-support facilities once the telescope is built or the satellite launched, but this is not a difficulty unique to astronomy or even to science; it reflects, on a national scale, the fact that it is easier to borrow $25,000 from the bank for a new car than it is to get $1,000 to fix your old one.

In these straitened times, nevertheless, astronomers have an enviable number of new projects in hand, and when most scientists feel increasingly obliged to play up their work for its social relevance and public relations, it is worth remarking that astronomy remains, in these pragmatic terms, a singularly useless endeavor; it saves no lives and generates no improved mousetraps. What it possesses, however, is an enduring fascination. This derives not from the fact that astronomers tackle fundamental problems—they can make no special claim to fundamentalology, against the similar claims of particle physicists or human geneticists—but from simple awe. High-energy astrophysics offers physics on the grand scale: neutron stars and black holes, million-degree plasmas, and tera gauss magnetic fields.

Early observational efforts in high-energy astrophysics yielded a sparse selection of objects, often with no obvious counterpart in the visual sky, but as the field has matured its results have been more fully integrated into the overall astronomical picture. Bignami's Perspective describing the identification of the mysterious gamma ray source Geminga as an unusual pulsar rests on detective work at many wavelengths that would have been technically impossible less than a decade ago. The Perspectives by Bailyn, discussing hot stars in the centers of old globular clusters, and by Kinney, on the nature of active galaxies, also show how observational evidence across the electromagnetic spectrum combines to give a picture greater than the sum of its parts. A corollary is that sources detected exclusively in one energy band are hard to fathom: as Hartmann explains, short bursts of gamma rays are seen randomly and frequently across the whole sky, but still have not been linked to any known phenomenon at other wavelength, and remain mysterious.

The expanding horizons of astronomy constantly bring in new physics. Rogers tells how recent progress in understanding the opacity of highly ionized atoms has resolved some old problems in the interior structure of stars, while Taubes' news story on neutrino "telese" describes how astronomers may be able to see directly into the cores of stars and supernovae. Now that the extreme ultraviolet waveband has been explored, and if an explanation for the gamma ray bursts is found, it is possible that the repertoire of cosmic phenomena across the whole electromagnetic spectrum will soon be essentially complete—but then neutrino astronomy is just beginning, cosmic rays remain poorly understood, and there is dark matter to be found. The edge of the universe is still a long way off.

David Lindley
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Frog Endangernent

In their letter "Tropical poison frogs," Charles W. Myers and John W. Daly (19 Nov., p. 1193), who are undoubtedly experts in the biology of dendrobatid frogs, provide incorrect information about the meaning of the frogs' listing under the Convention on International Trade in Endangered Species (CITES).

All dendrobatid frogs of the genera Dendrobates and Phyllobates are listed in CITES Appendix II, which does not equate to "threatened" status, nor does it require evidence of "endangerment." The listing, designed to regulate trade in vulnerable species, does require that an exporting country first make a judgment that trade will not be detrimental to the species before issuing an export permit. If range countries are refusing to issue such permits, it may be because they have made determinations that trade from their populations is not sustainable, or because they have other, stricter domestic measures separate from CITES which ban such trade, a sovereign right of every nation with or without international treaties.

Perhaps we in the regulatory agencies need to do a better job in working with the scientific community to explain what trade is regulated internationally, and why. Cooperative efforts between scientific researchers and conservationists are crucial if we are to conserve tropical biodiversity and the genetic bank it encompasses.

Marshall P. Jones
Chief
Office of CITES Management Authority,
Fish and Wildlife Service,
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Smallpox Virus Stocks

Having thus far stayed out of the debate about smallpox destruction, I am moved to comment on the thoughtful Policy Forums published recently in Science (19 Nov., pp. 1223 and 1225) where two sets of eminent virologists (B. W. J. Mahy et al. and W. K. Joklik et al.) come to such opposite conclusions. I am persuaded by the arguments of Mahy et al. for destroying existing stocks of the virus. The opponents are not really arguing against destruction, but rather for continued research. They might even agree that if no research is being done on the virus, it might as well be destroyed.

I find it hard to believe that we need to, or even will, continue research on a virus whose release from containment would be such a disaster while its present threat is nil. The opponents of its destruction propose a broad program of "studying in detail smallpox's molecular pathogenesis." They apparently believe that this can be done in a secure P4 facility. I have seen such facilities, and they are cumbersome, to say the least. I cannot see carrying out a wide-ranging program of molecular analysis on an eradicated disease in such a difficult and expensive facility. If any other facility were used, the problem of security would be serious: the opponents of destruction themselves note that in the laboratory in Birmingham, England, where escape occurred, "simple but essential administrative precautions were ignored." The sole insurance against a repeat would be the type of vigilance that only a P4 facility can maintain over the long haul.

While I agree that a deeper understanding of pathogenesis will help counter microbial infections, I doubt that we so desperately need to study smallpox that it would be worth the risk inherent in the experimentation. Much of the value of research can be gained from studying related viruses, especially vaccinia. Eradication of the virus as well as its disease will better serve the long-term interests of humanity as the proponents of destruction have argued.

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The Importance of Restaurants in Superconductivity Research

We were surprised to read in Gary Taubes' Research News article "Holding the lines in high-temperature superconductors" (17 Sep., p. 1521) that the "ultimate solution to the problem" of pinning in high-Tc superconductors "was suggested at a Chinese restaurant in Anaheim, California, in March 1990" when "[John] Clem suggested that since a vortex is a linear object, 'a really keen way to immobilize it'... would be to create...a line-like potential well, a line of normal non-superconducting material, a microscopic hole through the super-
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References


Response: Five recent epidemiological studies (1) show an increased risk of cancer for humans who have been exposed to high concentrations of dioxin. Several studies have also shown that dioxin causes cancer in both sexes of four species of animals exposed to dioxin—mice, rats, guinea pigs, and fish. A panel of outside experts in epidemiology recently reviewed the data on dioxin and agreed that "the human data are compatible with the animal data," says toxicologist Linda Birnbaum, director of the Environmental Toxicology Division at the Environmental Protection Agency's Health Effects Research Laboratory and one of the leaders of the agency's reassessment of dioxin risk.—Ann Gibbons

References


Accelerator Power Plants

An accelerator-driven energy production system at Los Alamos, as described by Peter Aldhous in News & Comment article "Rubbia floats a plan for accelerator power plants" (26 Nov., p. 1368), could provide an "unlimited" energy source and concurrently burn both long-lived fission products and highly radioactive actinide waste. The system essentially would have no long-term high-level waste stream. The thorium-uranium cycle would be much more practical in this regard than is the uranium-plutonium cycle. We also believe it could be economically competitive.

Is Dioxin a Human Carcinogen?

The statement in the article "Dioxin tied to endometriosis" by Ann Gibbons (Research News, 26 Nov., p.1373) that "[i]n human beings, there is evidence that high doses of dioxin cause cancer. . . ." is incorrect. Dioxin’s link with human cancer has not been established. Among others, the International Agency of Research for Cancer (IARC) considers the data "inadequate" for such a conclusion (1), and the particular publication that Gibbons’ article is based on (2) clearly states that "[a]lthough dioxin is a carcinogen and teratogen in rodents . . . the true biologic effects . . . in humans are not clear."

Alex Apostolou
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References

With accelerator-driven thorium–uranium power plants consuming most high-level wastes, it should then be possible to handle remnant waste from nuclear electric power production with man-made containers (engineered storage) that would need to retain continence for only a few hundred years—an attractive alternative to storage of untransmutated waste for tens of thousands of years by reliance on geologic containment in deep underground repositories. We cannot be certain at this point that our technology can meet the objective of economically competitive electric power production without a long-term high-level waste stream. Therefore, worldwide programs to develop geologic storage should continue, if only to take care of existing waste. Eliminating wastes, rather than bequeathing them (no matter how well stored) to distant generations is, we believe, appealing.

The use of a subcritical system in a thorium-driven power plant would absolutely prevent a runaway chain reaction such as that which occurred at Chernobyl. A loss-of-coolant accident such as that which occurred at Three Mile Island could be prevented by passively draining the liquid fuel.

We welcome the developing interest at CERN in this field, which may in some part be the result of our many presentations to the European Community over the past 3 years. However, eliminating only actinide waste, but not fission product waste (which is the most difficult to confine by geologic storage), would not justify the development of this advanced technology. We believe the CERN group eventually will recognize the need to address the whole waste problem, and we expect that their approach will evolve toward using the same liquid fuel (molten salt) that was studied thoroughly at the Oak Ridge National Laboratory and elsewhere, and which we have adopted.

Charles D. Bowman
Los Alamos National Laboratory,
Los Alamos, NM 87545

Basic Research and Weather Prediction

The shortsightedness of current attacks on basic research (E. Marshall, "Senate turns up the heat on NSF," News & Comment, 17 Sept., p. 1512) is well illustrated by the National Weather Service's (NWS) modernization program (R. A. Kerr, "Upgrade of storm warnings paying off," Research News, 15 Oct., p. 331). The concept and development of Doppler radars, which are at the heart of the NWS's ongoing $4.4-billion modernization program, and the demonstration of their utility for the detection of severe storms, were carried out by the meteorological basic research community in the 1950s through the 1980s. Now, within less than 2 years of the initial deployment of Doppler radars by the NWS, it has been shown that they greatly improve the operational forecasts of severe storms: forecasts are more accurate and there are significantly longer warning times for tornadoes.

However, in the immortal words of Al Jolson, "You ain't seen nothin' yet." Not, that is, if research into short-range weather prediction continues to be supported. The enormous quantity of high-quality data that will be provided by the NWS modernization program, when combined with a rapidly increasing understanding of weather systems and their representations by high-resolution numerical models, has the potential to provide spectacular improvements in short-range weather forecasts nationwide. A blueprint for realizing this potential has been developed by a multiagency task force (1). Implementation of this program requires an investment of just a few percent of the cost of the NWS modernization program. The social and economic payoffs will be enormous. Let's get on with it!

Peter V. Hobbs
Department of Atmospheric Sciences,
University of Washington,
Seattle, WA 98195

References

1. United States Weather Research Program: Implementation Plan (Subcommittee on Atmospheric Research, Committee on Earth and Environmental Sciences, Department of Commerce, Washington, DC, in press).

Corrections and Clarifications

In the report "Carbon monoxide: A putative neural messenger" by A. Verma et al. (15 Jan. 1993, p. 381), the first full sentence in column 3 on page 381 should have read, "Like NO, CO is a noxious gas that activates guanylyl cyclase (8), and it has been postulated that CO, derived from heme by the action of heme oxygenase, has physiological functions (9)." Reference 9 should have referred to an article by G. S. Marks et al. [Trends Pharmacol. Sci. 12, 185 (1991)], which was erroneously included in reference 8. References 9 through 24 should have been numbered 10 through 25.

In the report "The drift of Saturn's north polar spot observed by the Hubble Space Telescope" by J. Caldwell et al. (16 Apr., p. 326), the revised System III rotation rate of the drift was incorrectly calculated. It should not have been "810.737 ± 0.008" per day, as stated (fine 21, col. 1, p. 329), but rather "810.851 ± 0.008" per day."
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General Articles (3000 to 5000 words or three to five printed pages) are expected to review new developments in one field that will be of interest to readers in other fields; describe a current research problem or a technique of interdisciplinary significance; or discuss some aspect of the history, logic, policy, or administration of science. Readers should be able to learn from a general article what has been firmly established and what are unresolved questions or future directions. Many general articles are solicited by the editor-in-chief, but unsolicited articles are welcome. Both solicited and unsolicited articles undergo review.

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Figures and tables together with their legends should occupy about one printed page for General Articles and Research Articles.

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Book Review selections are made by the editors. Instructions and length specifications accompany items to be reviewed when they are sent to the reviewers, who are chosen by the editors.

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Use double-spacing throughout the text, tables, figure legends, and references and notes, and leave margins of at least 2.5 centimeters. Put your name on each page and number the pages starting with the title page.

Texts and subheadings should be descriptive clauses, not complete sentences or questions. The maximum length for titles is 102 characters and spaces for general articles, and 98 characters and spaces for research articles and reports.

Abstracts should explain to the general reader why the research was undertaken and why the results should be viewed as important. The abstract should convey the paper’s main point and outline the results or conclusions.

Text. A brief introduction describing the paper’s significance should be intelligible to readers in different disciplines. Technical terms should be defined. All tables and figures should be cited in numerical order.

Figures and tables should be submitted on separate pages from the text. For each figure submit four high-quality prints, laser prints, or original drawings no larger than 22 by 28 centimeters (8½ by 11 inches). On the back of every figure write the first author’s name and the figure number and indicate the correct orientation.

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On acceptance of a paper, authors requesting the use of color will be required to pay $600 for the first color figure or figure part and $300 for each additional figure or figure part to help defray the cost of obtaining color separations. There will be an additional charge for color figures in the reprints.

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- if there is a need in exceptional cases to publicize data in advance of publication, the AAAS Office of Communications (202-326-6440) must be consulted.

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Manuscripts should be addressed to the Editor-in-Chief, Science, 1333 H Street, NW, Washington, DC 20005, or to the senior editor, European office, at Thomas House, George IV St., Cambridge CB2 1NH, UK. Submit four copies together with a letter giving:

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Acknowledgments, including funding information, should be gathered into a brief statement at the end of the references and notes and will be edited to conform to Science style.

Equations and formulas should be typed with quadruple-spacing if they are to be set off from the text. Define all symbols and number all equations.

Figures. Most figures will be printed at a width of 5.9 cm (2.3 inches or 1 column) or 12.2 cm (4.8 inches or 2 columns). Some illustrations (for example, bar graphs, simple line graphs, and gels) may be reduced to a smaller width. Symbols and lettering should be large enough to be legible after reduction. Composite figures should be labeled A, B, C, etc. If mounting is necessary, use cardboard. Legends should be typed double-spaced in numerical order on a separate page. No single legend should be longer than one page. Nomenclature, abbreviations, symbols, and units used in a figure should match those used in the text. The figure title should be given as the first line of the legend.

Line drawings should be labeled on the ordinate and abscissa with the parameter or variable being measured, the units of measure, and the scale. Scales with large or small numbers should be presented as powers of 10. Definitions of symbols should usually appear in the figure legend and not in the figure. Simple symbols (circles, squares, triangles, and diamonds, solid or open) will best survive reduction.

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Avoid the use of light lines, shading, and stippling. Use heavy lines or boxes for emphasizing or marking off areas of the figure, and use black, white, hatched, and cross-hatched designs in place of stippling in bar graphs and ball-and-stick molecular models. Authors using computer graphics should choose screens between 20 and 60%.

Halftones, such as electron micrographs, should be submitted as high-quality prints or originals (do not send irreplaceable artwork). Use boldface type for axis labels and for the labels A, B, C, etc. in composite figures; use italic type only as it would be used in the text (for example, for variables and genes). The first letter of each entry should be uppercased; otherwise, use uppercase letters as they would be used in the text (for example, for acronyms). Avoid wide variation in type size within a single figure. In the printed version of the figure, letters should be about 7 point (2 mm) high.

Sequences may be reduced considerably, so make sure the typeface in the original is clear. There should be about 130 characters (including spaces) per line for a sequence occupying the full width of the printed page and about 84 characters per line for a sequence occupying two columns.

References and notes are numbered in the order in which they are cited, first through the text and then through the table and figure legends. List a reference only once. References that are always cited together may be grouped under a single number. Reference to unpublished data should be given a number in the text and placed, in correct sequence, in the references and notes. Use conventional abbreviations for well-known journals; provide complete titles for other journals. Do not use op. cit. See "Science Reference Style" (at right) for examples.

Symbols, abbreviations, and acronyms should be defined the first time they are used.

Tables should supplement, not duplicate, the text. They should be numbered in the order of their citation in the text. Each table should be generated on a separate page with its legend double-spaced above the table. The first sentence of the legend should be a brief descriptive title. Three horizontal lines are used in tables: at the top and bottom of the table and between the column headings and the table body. Vertical lines are not used between the columns.

Every vertical column should have a heading consisting of a title with the unit of measure in parentheses. Units should not change within a column. Centered headings of the body of the table can be used to break the entries into groups. (See the section on lettering for use of italic type and uppercase letters.)

Footnotes should contain information relevant to specific entries or parts of the table. The sequence of symbols for footnotes is *, †, ‡, §, ¶, ††, ‡‡, ‡‡‡, ‡‡‡‡, ‡‡‡‡‡, ‡‡‡‡‡‡, ‡‡‡‡‡‡‡, ‡‡‡‡‡‡‡‡, ‡‡‡‡‡‡‡‡‡.

Units of measure are given in metric. If measurements were made in English units, give metric equivalents.

Science Style Sheet

Science Reference Style

Journals
3. J. C. Cheesbrough III, S. Traynor, J. T. Yang, EMBO J., in press. [three to five authors]
4. G. Sunshine et al., Lancet, 711 (1975). [more than five authors]

Technical reports

Proceedings
3. Title of symposium published as a book, sponsoring organization, location of meeting, dates (publisher, location, year).

Paper presented at a meeting (not published)
1. M. Konishi, paper presented at the 14th Annual Meeting of the Society for Neuroscience, Anaheim, CA, 10 October 1984. [Sponsoring organization should be mentioned if it is not part of the meeting name.]

Theses and unpublished material

Books
(Zymed); plakoglobin (Pierce); desmosomal proteins (Sigma); desmoplakin (ICN, Cleveland, OH); and ZO-1 (Zymed). Incubations with secondary antibodies [donkey antibodies to rabbit or to mouse immunoglobulin coupled to fluorescein isothiocyanate] and visualization of stained cells were as in (9). Photomicrographs were prepared with a Codonics (Middleburg Heights, OH) NP600 printer.


18. Tumor tissue was surgically excised, fixed in formaldehyde (formalin), embedded in paraffin, sectioned, and stained with antibodies (16) or with 1% toluidine blue. For TEM, solid tumor areas were identified and cut from the paraffin block, deparaffinized, cut into 0.5-mm³ cubes, fixed in 2.5% glutaraldehyde for 2 hours at 4°C, washed four times with PBS for 30 min each, and post-fixed with 1% osmium tetroxide for 1 hour at 4°C. After washing with PBS, the samples were dehydrated in an acetone series and embedded in Epon 812 (Polyscience, Warrington, PA). Sections were cut with an LKB NOVA (Uppsala, Sweden) ultramicrotome. Semi-thin sections were cut with a glass knife and stained with 1% toluidine blue in 1% borax. Thin sections were cut with a diamond knife. Post-embedding immunoelectron microscopy was performed as in (9).


25. Serial sections of 11.5-day mouse embryos were processed as in (16) but were stained with antibodies to Metnu (SP260) (9, 24), cytokeratin (1:20 dilution), or vimentin (1:20 dilution). Immunofluorescence was analyzed by CLSM (16).


32. S. Rong et al., Cancer Res. 53, 5355 (1993).

33. We thank E. Rosen for the antibodies to HGF/SF; M. Arver and the Pathology Histotechnology Laboratory at the National Cancer Institute (NCI)--Frederick Cancer Research and Development Center for their assistance; D. Kaplan, M. Strobel, M. Murakami, and L. Parada for helpful comments; and M. Reed for preparation of the manuscript. Supported in part by NCI, U.S. Department of Health and Human Services (DHHS), under contract NO1-CO-74101. The contents of this publication do not necessarily reflect the view or policies of the DHHS, nor does the mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

24 June 1993. accepted 8 November 1993

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formity in the terminology of the field has suffered from a long-standing lack of consensus as to whether or not sound can be considered to have the attributes of an object.

Although cognitive, hearing, and speech scientists all have an interest in the topic of auditory cognition, this book will probably appeal most to cognitive psychologists. For full appreciation of all the material, it is helpful to have a reasonably good command of music notation and theory. However, even those without musical experience will find this a useful book for broadening their view of human cognition.

William Yost
Parma Hearing Institute,
Loyola University of Chicago,
Chicago, IL 60626

Books Received

Hormonally Induced Changes in Mind and Brain. Jay Schullin, Ed. Academic, San Diego, CA, 1993. xvi, 407 pp., illus. $64.95.

Vignettes: Mentoring

I tried to teach Fermi to fish, and it seemed to me he liked it. However, he once returned [to Los Alamos] from Chicago with a lake fishing rod and reel. I told him that it was not suitable for mountain streams, but to no avail. Fermi developed a theory on how trout should bite and on how to catch them. The theory was disproved by experiment, but this did not impress him in the least. Ultimately he abandoned fishing, but not his theory.

—Emilio Segrè, in A Mind Always in Motion: The Autobiography of Emilio Segrè (University of California Press)

I will never forget the time when a distinguished European physicist, on route to exploring academic positions in the United States, visited the Ewalds; after dinner he was taken aside by Paul, and admonished in all seriousness that the first thing he would have to learn as a professor in the United States is to help in washing the dishes. And so they both disappeared in the kitchen.