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False-color image of the velocity distribution in a cloud of rubidium atoms that have formed a Bose-Einstein condensate. Color indicates the density of atoms having the velocity specified by the two horizontal axes. The high-density blue and white spire is an image of low-energy atoms that have condensed into a single quantum state. The average speed of the atoms in the spire is about 0.5 millimeter per second. See page 198 and the related News story on page 152 and the Perspective on page 182. [Image: M. R. Matthews]
Native. N-terminal, 6xHis mouse dihydrofolate reductase (DHFR, 19.5 kDa) was expressed in E. coli. 600 µl of the clarified lysate was applied to 100 µl of TALON. All bound protein was eluted with 300 µl of 100 mM EDTA, pH 8.0. 20 µl of lysate and 40 µl of each subsequent fraction was loaded onto a 12% polyacrylamide/SDS gel. Lane 1: clarified lysate. Lane 2: flowthrough. Lane 3: first wash. Lane 4: third wash. Lane 5: DHFR final elution.

Denaturing. N-terminal, 6xHis mouse DHFR (19.5 kDa) was expressed in E. coli. 600 µl of clarified lysate was applied to a TALONspin Column containing 0.5 ml of TALON-NX Metal Affinity Resin and centrifuged for 2 min at 2,000 x g. 20 µl of lysate (Lane 1) and 40 µl of each subsequent fraction was loaded onto a 12% polyacrylamide/SDS gel. Lane 1: clarified lysate. Lane 2: flowthrough. Lane 3: first pH 7.0 wash. Lane 4: second pH 7.0 wash. Lane 5: DHFR, first pH 6.0 elution. Lane 6: DHFR, second pH 6.0 elution.

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The Politics of Science

Fifty years ago, in his office at the Carnegie Institution on 16th Street here in Washington, D.C., Vannevar Bush was putting the finishing touches on a document that was to be the blueprint for U.S. science and technology for the rest of the century. Bush was writing for a world of change and transition, a world where the only clear enemy was Communism and the battle was waged in terms of technological superiority.

We approach the 21st century in a similar period of sweeping change, although we have different enemies than those Bush envisioned. They are not armies; they are new and emerging diseases. They are not missiles, but the threat of rapid global climate change. They are not tanks and submarines; they are poverty, crime, and economic stagnation.

In culture and society, change can be a good force. Change is critical to a democracy and essential to a freely governed people. Change—in the United States and abroad—brought President Clinton into office in 1992, and the last congressional election told us that the tides of change have not yet abated.

For the nation’s science and technology enterprise, there is no resisting these forces of change. The nation’s domestic discretionary budget will be cut and cut dramatically. It will not be possible at any time in the foreseeable future to return to the days when each annual federal budget brought massive increases in science funding and new starts for grand and expensive scientific projects. We must learn to do more with less—less money, fewer facilities, fewer researchers.

The current debates over science funding are not about who would preserve the status quo and who would advocate change. There will be no “business as usual”; the spendthrift budgets of the 1980s and early 1990s were unsustainable and mortgaged much of our national future. To pay that inherited mortgage, we already have made significant changes in the federal research system by downsizing, restructuring, and deregulating. We will need to do even more.

Rather, the question is one of balance: How do we balance the many competing needs of this nation as it enters the 21st century, and in doing so, how do we ensure that research and development (R&D) remain national priorities? We have to balance science funding with funding for hospitals, education, police, and housing. We have to balance our R&D portfolio with funding for environmental protection, antiterrorist activities, and military preparedness.

We will have to balance our zeal for budget cutting with the need to invest in our future. The mechanism we will use to balance national priorities is the political process, and the debate over how and with what speed these changes are accomplished is a political debate. Because science and technology have enjoyed much bipartisan support in the past, many in the research community have come to view science as a sacred cow that is somehow removed from the political agenda. But political debate is one of the inescapable consequences of political change. It is how we shape and define ourselves as a nation committed to democracy.

In the end, it will not be enough for us to simply repeat the arguments of Vannevar Bush in favor of putting money aside for science. It also will not be productive to lament the “politicization” of science. Money is scarce, and the scarcer it becomes, the sharper becomes the politics of how it is spent. We should instead be grateful that research stands as high as it does on the political agenda; it is a mark of the value of science to the U.S. public that the Administration and the Congress are struggling over how best to support R&D. We must use this period of change to secure a productive and peaceful future for the nation.

There are those who believe that scientists should stay out of politics. This is not a luxury we have; in truth, it is a luxury we never had. Each of us needs to be a partisan for science, to embrace a parsipanship born of hope for the future. It is not parsipanship based on party ideology but on concern over the possibility that the work of generations that has put us at the forefront of world science and technology could be undone in a few budget cycles. It is a personal parsipanship based on conviction, and such parsipanship is the moral calling of every citizen in a democracy.

John H. Gibbons
Assistant to the President for Science and Technology
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Succeeding Generations

Journal editors not only edit journals, they often use their bully pulpits to inform, arouse, and lead the scientific and technical communities in times of change. As Ellis Rubinstein points out so well in his editorial “Punctuated equilibrium in scientific publishing,” (9 June, p. 1415), a number of experienced editors and leaders have recently been replaced, in some cases by persons with less experience in the worlds of publishing and public affairs.

What Rubinstein does not mention is a similar phenomenon of even greater importance—changes in the senior leadership of a number of key scientific and technological institutions. Frank Press and Robert White at the National Academy of Sciences and the National Academy of Engineering, respectively, have been replaced by persons less experienced in the ways of Washington. Dan Burton just left.

New opportunities, lost experience? Bruce Alberts (left) and Frank Press (right), new and past presidents, respectively, of the National Academy of Sciences.

rubinstein’s forebodings about the departure of Daniel E. Koshland Jr. from Science (already accomplished) and me from Nature (impending) flatter us with phrases such as “institutions in the profession,” but they are misplaced. Rubinstein appears to forget that the succession of the generations is always enlightening, that people appointed to important positions only in early senescence will not have time themselves to become institutions, and that there has probably never previously been a time when the scientific literature was as much in need of people who know their way about the World Wide Web.

Rubinstein himself may be too young to appreciate that even older people also have other things to do.

I am deeply saddened by Rubinstein’s misleading and inaccurate editorial. I am unable to discern any point or purpose to this mean-spirited attempt to discredit people just taking up important editorial positions in science publishing. The new editors identified by Rubinstein have not been in office long enough to prove themselves. One had yet to even take up her new duties. Where is the sense of fairness and mutual respect that has long been characteristic of the science-writing and communications community? True journalism such as this quickly erodes the credibility of any publication, even the very prestigious.

Rubinstein’s comments to the effect that Madeleine Jacobs is not really qualified to be editor of Chemical & Engineering News (C&E News) and that she may subvert the publication’s journalistic traditions and move it toward becoming a house organ are voices of caution and some opposition to current trends are badly needed; by-and-large they are not being heard.

I hope the new editorial voices of the major scientific publications will move swiftly to help fill the leadership void. The front pages of Science are a good place to begin.

Christopher T. Hill
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graceless and unfounded. They are also inappropriate and irresponsible. But, most important, they are wrong.

It is often said science works only because of the trust and collegiality among scientists. This is true. So I don't understand why Science decided to violate this principle with its own peers.

Michael Heylin
Editor-at-Large,
Chemical & Engineering News,
1155 Sixteenth Street, NW,
Washington, DC 20036, USA

Response: It is understandable that Heylin, as Jacobs's colleague, would wish to defend her. And journalists and C&E News readers alike will be delighted if Jacobs enhances both the vigor and authority of that publication's news coverage. But Heylin's argument goes too far and may mislead.

Hardly a day goes by when a columnist isn't analyzing the odds of success of prominent figures undertaking new responsibilities. Some sports writers predicted from day one that the sensational basketball player Michael Jordan would not make a very good baseball player. Likewise, most scientists would comment if a prominent laboratory plucked from the ranks of its marketing team the next head of basic research. Editorial writers tip us off with prescience; those who are wrong soon find themselves ignored. Jacobs has sought, and is taking on, high responsibility. Like all occupants of powerful positions, she will be scrutinized from the outset. Science journalists, in conducting this scrutiny, should hold themselves to the same standards of journalism that their mainstream colleagues do.

Ellis Rubinstein

Rubinstein's editorial is a brave piece. He is absolutely right to draw attention to a sudden lurch in the direction of lightly qualified scientific editors. All kinds of dangers can result from the appointment of inexperienced and youthful editors. He will probably get some brickbats, but I was pleased to see him take a stand.

Simon Mitton
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Science and Political Reality

Richard S. Nicholson (Editorial, 2 June, p. 1259) expresses a variety of concerns that I would like to address. At times he appears to misunderstand what the new Congress is trying to accomplish, and at other times he does not acknowledge the restraints placed on a responsible government. On the basic issue, however, both of us agree—funding for academic research is a vital investment in our nation's future.

Unfortunately, the political reality of today means that continuing to fund research and development (R&D) alone is not enough to ensure a bright future. We have a huge budget deficit, an inefficient bureaucracy, and government interference in areas best left to private industry. In order to fix these problems, while keeping the strong basic science infrastructure of which Nicholson writes, government needs to establish a coherent philosophy of the role of federally-funded science. As Chairman of the Science Committee, I have been attempting to articulate such a philosophy.

First, we should return the focus of government-sponsored research to the area of basic science where it belongs. Every year the United States pumps billions of dollars into corporate welfare, shelling out money to the R&D departments of huge corporations while accomplishing little. For every hundred dollars spent by government on

This is my system for affinity separations of polyclonal and monoclonal antibodies, enzymes and fusion proteins.
these programs, the return to the American taxpayer is about 20 cents. Corporate welfare is certainly not the best way to spend research dollars.

As an alternative, I intend to focus government research on basic science. This means, contrary to Nicholson’s statements, that I have no intention of discontinuing the basic research conducted at our universities and colleges. I was a teacher myself and know the importance of training a new generation of scientific leaders to keep America the frontrunner of an increasingly technological world. The committee’s current budget protects basic research, ensuring that federal commitment to this area remains strong.

Additionally, by prioritizing basic science, government can leave technological development to industry. Private corporations are much more efficient than government at applying scientific discoveries, and, as our experiences with corporate welfare have shown, work best with minimal federal interference.

Finally, the federal science bureaucracy has become bloated and unmanageable. It does not allocate funds efficiently and forces researchers to spend too much time competing for funds and not enough researching. This type of waste can be reduced without hurting science. Former Chairman of Motorola Inc. Robert Galvin has just completed a study of the government’s biggest labs, and he has concluded that reforms could cut the lab budgets in half without affecting the scientific research done there at all. Clearly, there is room to improve the way that government approaches science.

We must realize that today we live in a time when there are great restraints on government. Even with budgets being cut across the board, I am committed to keeping basic academic research strong and healthy. With an end to corporate welfare and a trimming of bureaucracy we can invest in our children’s future through science without a large budget deficit mortgaging this future at the same time.

Robert S. Walker
Chairman, Committee on Science,
U.S. House of Representatives,
Washington, DC 20515–6301, USA

China’s “Missing” Girls

The report “High sex ratios in China’s future” by Shripad Tuljapurkar et al. (10 Feb., p. 874) is provocative. Although it was not stated in the report, the implication of a high ratio of male to female babies born in recent years in China was that female fetuses were aborted or female infants were killed. However, there are several alternative answers to the question of the “missing girls” in China.

According to Nicholas Kristof (1), two Swedish experts working in conjunction with a Chinese demographer concluded, on the basis of an extensive survey, that up to half of the 500,000 infant girls who appear to be missing each year are adopted informally. A second possible explanation proposed by Kristof is that parents, unwilling to pay fines for their second child if she is a girl, send the infants to be raised by relatives in other areas. A third possibility, according to Kristof, is that, in areas where family planning is lax, parents simply raise their daughters at home without registering them.

The strongest evidence that some of the “missing” girls are indeed hidden is evident from China’s 1990 census. While the sex ratio for newborn infants was a highly abnormal 111.3 to 100, it dropped to about 108 for toddlers and declined further to 107 for elementary school–age children. If all the girls were killed at birth, how could they be resurrected later? It seems likely that, at a young age, the

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Response: The study by Swedish experts that Cheng mentions is almost certainly the work by S. Johansson and colleagues that we cited in notes 3 and 6 of our report. We pointed to these in our first paragraph, where we said that unreported births can affect the reported sex ratio at birth.

Cheng makes an error in discussing the data he reports as being from the 1990 census (which are presumably from a sample of that census). Even assuming his numbers are correct, the sex ratio among children at, say, ages 5 to 6 years in 1990 reflects the sex ratio at birth 5 years before the census date (that is, in 1985). Thus his data in fact demonstrate an increasing sex ratio at birth over time, as is shown by the historical data we cited in our report. Ansley Coale (note 8 of our report) has done such checks correctly and has shown that a large number of females is indeed missing (1).

Shripad Tuljapurkar
Morrison Institute for Population and Resource Studies, and
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References

New Light on Free Electron Lasers

Two new reports indicate an exciting future for free electron lasers (FELs) and recommend construction of user facilities as well as development of FEL technology in the vacuum ultraviolet (VUV) and x-ray wavelength regimes for scientific and industrial applications. An earlier study by the U.S. National Research Council (NRC) (E. Marshall, News & Comment, 16 Sept. 1994, p. 1651; G. Margaritondo and N. Tolk, Letters, 4 Nov. 1994, p. 713) (1) was limited to scientific applications of the FEL in the United States and recommended the construction of an FEL user facility operating in the far-infrared (FIR) wavelength region as well as funding research and development (R&D) for FELs operating in the VUV and x-ray wavelength region of the spectrum.

The first of the new reports, both of which extend the NRC report, was issued in December 1994 and is a "Commentary on the NRC Report" from our committee, appointed by the International FEL Executive Committee (2). We urge that funding agencies around the world take notice of the NRC recommendations regarding FEL R&D for scientific applications and take specific actions to implement them.

Our report (2) emphasizes the important nonscientific potential applications of the FEL in industry, energy, and medicine; highlights advancement and trends in FEL R&D outside the United States, mostly in Europe and Japan; and updates recent developments and trends in FEL R&D. We also recommend three areas of FEL technology development: (i) low-cost, compact FELs that would lead to economical, tabletop FIR FELs; (ii) high-average power FELs producing low-cost photons; and (iii) short-wavelength FELs with low emittance photocathodes. These areas would be important for FEL development in the VUV or x-ray wavelength regimes that use shorter undulators and lower-energy and lower-cost accelerators.

The second of the new reports, issued in January 1995, is the "Report of TMR Study Panel on FELs" (3) from a European panel set up by the directorate of "Training and Mobility of Researchers" (TMR) of DG-XII of the European Commission. The general findings and recommendations of the European and NRC reports are similar. The European report recommends strengthening the activity of the four European FEL user facilities operating in the FIR wavelength regime and foresees a 2.5-fold growth in the availability of FIR radiation user-hours by the year 2000. It calls for support of FEL technology development in the range from x-rays to UV (XUV) to eventually reach "a number of European XUV-FEL facilities and one large-scale facility in the hard x-ray range." It is recommended that high-average power, high-efficiency FELs should be developed for nuclear fusion research and industrial processing by other European agencies.

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**Notes**

1. Available from T. M. Wong, Board of Chemical Science and Technology, National Research Council,  
2101 Constitution Avenue, NW, Washington, DC 20418, USA.

2. Available from J. Thompson, FEL ‘95, National Synchrotron Light Source, Brookhaven National Laboratory,  
Upton, NY 11973, USA.

3. Available from M. Van der Wel, Director, FOM Institute for Plasma Physics, 3430 BF Nieuwegein, The Netherlands.

**Applied Research in South Africa**

The Special News Report on South Africa (2 June, pp. 1282–1287) was very interesting. However, I would like to clarify the quote on page 1285 attributed to me by Daniel Clery. I believe that science has been too divorced from the needs of the community. I have a problem with the kind of academic snobbery that is against applied research, regarding it as second class; in my view this is wrong, scientifically and politically.

G. F. R. Ellis  
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**Correction**

In the report “Motor neuron degeneration in mice that express a human Cu,Zn superoxide dismutase mutation” by M. E. Gurney et al. (17 June 1994, p. 1772) (1), a systematic, 10-fold error was made in calculating the dilutions of brain extract used for determinations of total brain superoxide dismutase (SOD) activity shown in column 6 of table 1 (p. 1774). Each value reported should have been reduced by that factor, for example, the total SOD activity reported for the G1 line should have been 4.26 ± 0.2 SOD (U)/total protein (μg), not 42.6 ± 2.1 U/μg, and so forth.

Mark E. Gurney  
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**References**


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- Prior to Sigma, worked five years in a molecular biology group in the pharmaceutical industry.
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<th>ABSORBENCY</th>
<th>APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GB002</td>
<td>Medium 0.4 mm</td>
<td>Medium</td>
<td>Wicking</td>
</tr>
<tr>
<td>GB003</td>
<td>Thick 0.8 mm</td>
<td>Medium</td>
<td>Gel support</td>
</tr>
<tr>
<td>GB004</td>
<td>Extra thick 1.2 mm</td>
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Vignettes: Boltzmann in Berkeley

On the train there had been less occasion to engage in English conversation than I hoped. . . . My English conversation followed this pattern: I: "When lunch will be served?" He: "le6ô." I: "I beg you, could you say me, at what hour lunch will be served?" His gurgled answer now turned a fifth deeper: "aoouu." I see the mistake in my plan of attack and cry despairingly: "Lunch," "lanch," "lonch," "launch" and so forth. I utter vowels which cannot be found in Gutenberg’s vast collection of minted metal printing blocks. Suddenly a face lights up with dawning comprehension: "Ah! Loanch!" . . . And now I should give thirty lectures in this language?

I soon began to feel more easy and at home. . . . How proud I became when I could easily pronounce tonguetwisters like "blackboard" and "chalk" . . . How smooth and fluent flowed prickly pears such as "algebra," "differential calculus," "chemistry," "natural philosophy," and so forth.

A speculative proprietor had read in an encyclopedia that Berkeley had been an English bishop whose residence had been called "Cloyne Court" which apparently inspired him to build a faculty lodging with that name, and it is here that I lived. But he made little effort to make the architecture similar since his impressionable mind had also noticed that the front street was called "Euclid Avenue." Thus, the building became an exact parallelepiped without a trace of anything non-Euclidean. . . . The food was good. As a rule, at least elements of one type of food placed in front of me could be eaten and kept down.

The women of California are remarkably large and strongly built, and often there is also a rather unwanted wisps of mustache . . . I also had to honestly agree with a colleague when he asked: "Don’t you find that American women have something masculine about them?" But he was reluctant to accept my answer "and the men somewhat feminine?" But by the last I only meant their unbearded chins. In terms of courage, strength of will, adventurous spirit, and constancy of character they hold their jaws at manly height.

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