

## Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted through the Web ([www.submit2science.org](http://www.submit2science.org)) or by regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

## What Can Be Done To Stop the Decline?

**DONALD KENNEDY'S EDITORIAL "TWILIGHT FOR THE Enlightenment?"** (8 Apr., p. 165) is an articulate summary of one of the most frightening aspects of "progress" in America. I find this epoch in U.S. history quite discouraging, quite frightening, and indicative of a decline and fall of American science and culture. But what is missing in so many summaries is the question, what is to be done?

In my work on K–12 education, I know how easy it is to argue the failure of public education to prepare graduates for life and advocacy in the 21st century. Perhaps the political challenge illustrated by the Editorial and the education challenge that I have been working on can be joined. I suggest assembling CEOs of companies such as Intel, IBM, Motorola, and Microsoft; selected university presidents; scientists; and educators, i.e., those whose profit and joy rest upon rationality, to coherently press for the required dramatic revision of U.S. education.

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## Arguing About the Use of Stem Cells

**IN HIS EDITORIAL "TWILIGHT FOR THE Enlightenment?"** (8 Apr., p. 165), Donald Kennedy makes an interesting ethical argument in defense of (presumably embryonic) stem cell research. By pointing out that beliefs regarding the beginning of a human life are not universal, the author implies that there is no basis for restricting research in the area. If one were to use this yardstick of universal objection to determine when research becomes unethical, it follows that even the infamous medical experiments of the Nazis might pass muster. Rather than being the exclusive domain of Christian fundamentalists, concern over the ethical implications of embryonic stem cell research is widespread and is an area of academic interest (1). I respectfully submit that the author could more

effectively support his position by discussing the point of true contention: when human life begins. Certainly the author would not deny his adversaries the skepticism that he so strongly advocates?

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### Reference

1. S. Holm, *Bioethics* 16, 493 (2002).

## Evangelical Biologists and Evolution

**IN HIS EDITORIAL "TWILIGHT FOR THE Enlightenment?"** (8 April, p. 165), Donald Kennedy expresses concern that the teaching of evolution is being contested in 40 states. Even though I consider myself an evangelical Christian, I, too, share that concern. I was educated in a fundamentalist school where a literal 6-day creation period was taught. Yet over the years, I've come to accept Darwinian evolution.

The evangelical Christian public may be mostly anti-evolutionary, but that may not be true of evangelical Christian biologists. Curious as to how these biologists deal with evolution and creation, I wrote to "the Professor of Biology," at the 104 schools of the Council of Christian Colleges and Universities listed in the CCCU's Web site. Biologists from six schools refused to participate. Sixty-seven schools responded. Twenty-five percent of the respondents affirmed their belief in a young Earth and a 6-day creation period. Twenty-seven percent hold the theistic evolution position, which accepts the common descent of all living things and believes that God acts through natural laws. The remainder were either reluctant to take a specific stance or were what are called old Earth progressive creationists—Earth is billions of years old, but God acted creatively to bridge the gaps, i.e., between amphibians and reptiles and between reptiles and birds. Five of this group merely sent printed statements of their school's position affirming its belief in a Creator God, but that there are multiple ways in which he might have done it.

Although deeply divided in their views of evolution and creation, there is what I think is a small but significant trend among fundamentalist Christian biologists toward accepting Darwinian evolution. Hopefully, it will continue and spread to the fundamentalist public.

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## Debating Whale Sanctuaries

### IN REVIEWING THE INTERNATIONAL WHALING

Commission's whale sanctuaries, L. Gerber and co-authors take a purely ecological viewpoint ("Do the largest protected areas conserve whales or whalers?", *Policy Forum*, 28 Jan., p. 525). Other key considerations when considering the justification for sanctuaries and their boundaries are that these are practical management measures that, as noted by Ludwig *et al.* (1), need to "include human motivation and responses as part of the system to be studied." The decision in 1994 to declare the Southern Ocean a sanctuary for whales was taken in light of the difficulties of regulating whaling in this remote area after revelations that the former Soviet Union had caught protected species for 30 years while systematically falsifying records (2). The boundaries for the sanctuary also recognized geopolitical realities and locations of past catches by the Antarctic whaling industry as well as ecological considerations.



**A pair of melon-headed whales breach the surface off Reunion in the Indian Ocean.**

Whales have a special status in international law as highly migratory species, and decisions as to whether they should be exploited must be shared by all countries and not just those who wish to kill them (3). In particular, although the IWC has a unique competence to regulate whaling in all waters, it is customary for the views of range states to be taken into account in the designation of sanctuaries. The Indian Ocean sanctuary was adopted with full support from the range states, and the Southern Ocean Sanctuary, which has few range states, was adopted with overwhelming support (26 votes in favor, with only Japan voting against). Even Japan has accepted the decision for almost all species by limiting its formal objection only to minke whales.

The science underlying the design and operation of marine protected areas has advanced considerably since the IWC

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sanctuaries were adopted, and Gerber *et al.* make many valuable suggestions for enhancing the effectiveness of these sanctuaries. More recent sanctuary proposals, such as those presented by Brazil and Argentina for a South Atlantic Whale Sanctuary, have already incorporated the development of a management plan to address these issues.

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### References

1. D. Ludwig, R. Hilborn, C. Walters, *Science* **260**, 17 (1993).
2. A. V. Yablokov, *Nature* **367**, 108 (1994).
3. Article 64 of the UN Convention of the Law of the Sea.

### Response

PAPASTAVROU AND LEAPER MAKE AN IMPORTANT point that IWC whale sanctuaries are established for a number of often nonscientific reasons. As commissioned by the IWC Scientific Committee, our review of the Southern Ocean Sanctuary (SOS) examined the costs and benefits of the establishment of the SOS from a scientific perspective only. Our position remains, however, that IWC

sanctuaries—while demonstrating initial goodwill toward preservation of whale stocks—are flawed and that their continued application in their present configuration does little more than provide a false sense of security, by assuming that protections for whale populations are in place.

The science of marine reserves has improved considerably in the past decade. Globally, reserves are being established on the basis of clear ecological principles, seeking measurable objectives, and using sound management plans to achieve these objectives. There does not appear to be any desire by either pro- or anti-whaling nations to incorporate these novel concepts into the management of the IWC sanctuary program. The 2004 IWC meeting in Sorrento, Italy, exemplifies the gridlock gripping the IWC sanctuary program. Anti-whaling nations have co-opted the program into a means to exclude whaling in advance of the application of the Revised Management Procedure/Revised Management Scheme (RMP/RMS), which would replace the current moratorium on commercial whaling, and pro-whaling nations are funding the participation of developing nations in the IWC to garner votes to defeat sanctuary proposals. Meanwhile, scientific whaling continues to occur in

sanctuaries. This is an untenable situation that will only be resolved by the implementation of the RMP/RMS, which should compel IWC members to review existing and planned sanctuaries. We agree that IWC sanctuaries could be effective tools for the conservation and management of marine resources; however, without significant changes to the sanctuary program by IWC members, sanctuaries will remain “paper parks” serving little ecological purpose.

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## When Will the Oil Run Out?

IN HIS POLICY FORUM “OIL: NEVER CRY WOLF—why the petroleum age is far from over” (21 May 2004, p. 1114), L. Maugeri has done considerable double-counting to reassure us

that “the world is not running out of oil.” He cites various upward revisions in historical estimates of oil reserves and resources, culminating in the 2000 U.S. Geological Survey estimate of 3021 billion barrels of ultimately recoverable resources, from which he draws the conclusion that “overall, the world retains more than 3 trillion barrels of recoverable oil resources.”

Unfortunately, that 3021 figure includes the oil that has already been consumed. It consists of “undiscovered conventional oil” (732 billion barrels), “reserve growth” (688 billion barrels), “reserves remaining” (891 billion barrels), and “cumulative production” (710 billion barrels) (1). Deduct the 710 billion barrels already consumed, and the remaining oil totals 2311 billion barrels, a figure closer to other estimates.

Maugeri ignores the fact that the discovery of reserves lowers the estimate for undiscovered oil; it does not necessarily raise the total figure for ultimate recoverable oil resources.

He also calculates a “life index” of 40 years for known reserves, using current consumption figures. Using the 891 billion barrels (reserves remaining) figure would reduce that number to 32 years, but there are flaws in that calculation. Making projections based on

current consumption is meaningless if consumption is rising (which it is). With a projected annual growth worldwide of 1.9% from 2001 to 2025 (2), the 32 years’ supply would decline to about 26 years.

I believe we should draw very different conclusions from the present estimates. First, although the experts may quibble over their differences, they are in broad agreement: All the estimates I have seen agree within a factor of about two as to how much oil remains. The policy implications are not much different, wherever you may stand in that range. Oil resources are running down, and the supply is inelastic.

Second, we should be preparing now for a difficult transition. Europe and Japan, poor in oil resources, have gone much farther in making adjustments in energy use than the United States. Furthermore, they have stable or declining populations and similar requirements for energy and have chosen to limit demand, particularly by imposing high taxes on gasoline.

The United States is putting itself in the worst possible position for the energy transition by encouraging unchecked population growth (mostly driven by immigration) and doing very little to encourage energy efficiency.

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## References

1. USGS Digital Data Series DDS-60.
2. U.S. Department of Energy, Energy Information Administration, *International Energy Outlook 2004*, Table A2, “World Total Energy Consumption by Region & Fuel, Reference Case” (EIA, Washington, DC, 2004).

## Recalculating Future Oil Reserves

**IN HIS POLICY FORUM “OIL: NEVER CRY wolf—why the petroleum age is far from over”** (21 May 2004, p. 1114), L. Maugeri claims that new discoveries of oil and other hydrocarbons will stave off oil scarcity for many generations to come. As the physicist Albert Bartlett (1) demonstrated nearly three decades ago, “When we are dealing with exponential growth we do not need to have an accurate estimate of the size of [the] resource in order to make a reliable estimate of how long the resource will last.” Assume, he said, that the entire volume of Earth is oil ( $6.81 \times 10^{21}$  barrels). At the then prevailing growth rate in oil consumption of 7.04%/year, “this earth full of oil [would] last only 342 years!” Now, with China and

other rapidly industrializing nations dramatically increasing their energy consumption, there seems little hope that exponential growth of hydrocarbon consumption will level off soon (2).

Of course, Earth is not made entirely of petroleum—far from it. Moreover, the alternative hydrocarbon sources that Maugeri mentions, Canadian tar sands and Venezuelan and Russian heavy oil, are no substitute for cheap oil. The petroleum geologist Walter Youngquist has noted that a considerable percentage of the energy recovered from these alternative sources is expended in their processing—two barrels out of every three in the case of tar sands and a similarly low net energy recovery for heavy oil (3). The same statement can be made about oil shale and biofuels. Ethanol from corn or sugar cane sometimes yields a net energy loss. The energy losses in producing and packaging hydrogen for the hydrogen economy will be considerable. Hydrogen is not a primary fuel, and its fundamental properties limit its ultimate utility. Nuclear power has a continuing role to play in generating electricity, but unlike oil, it is not a chemical feedstock, there are intractable safety concerns, and cheap oil and other hydrocarbons still mine

and process the nuclear fuel and build the nuclear plants (4, 5).

By referring to the legitimate concerns about oil scarcity as “hysteria” and “crying wolf,” Maugeri deflects us from the only course that can save industrial civilization from the consequences of its overconsumption of energy. We need to begin a crash program to develop and implement energy-saving technologies in construction, manufacturing, transportation, and agriculture while the world still has enough oil wealth left to pay for the job. And at the same time, we have to speedily change a self-destructive mindset that glorifies waste and unnecessary consumption.

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1. A. Bartlett, *Am. J. Phys.* **46**, 876 (1978).
2. D. Ehrenfeld, *Conserv. Biol.* **19**, 318 (2005).
3. W. Youngquist, *GeoDestinies: The Inevitable Control of Earth Resources Over Nations and Individuals* (National Book Co., Portland, OR, 1997).
4. V. Smil, *Energy at the Crossroads: Global Perspectives and Uncertainties* (MIT Press, Cambridge, MA, 2003).
5. J. H. Kunstler, *The Long Emergency: Surviving the Converging Catastrophes of the Twenty-First Century* (Atlantic Monthly Press, New York, 2005).

#### CORRECTIONS AND CLARIFICATIONS

**News of the Week:** “Extrasolar planets get smaller and (possibly) harder” by R. Irión (17 June, p. 1727). The article incorrectly stated that a new planet circling the star Gliese 876 has the shortest exoplanet “year” yet seen, at 1.94 days. The Optical Gravitational Lensing Experiment (OGLE) has found three distant planets with shorter orbital periods. The fastest known is 1.21 days.

**Random Samples:** “Cetacean culture?” (10 June, p. 1545). Michael Krützen was identified as being at the University of Zurich. However, he did the work while at the University of New South Wales.

**News Focus:** “Structural genomics, round 2” by R. F. Service (11 Mar., p. 1554). Jeremy Berg was not identified. He is the director of the National Institute of General Medical Sciences, NIH. The definition given for a protein being “unique” was incorrect. The rule is that a unique protein structure must have less than 30% of its gene’s sequence identical to the genetic sequence of any protein of known structure. The proper abbreviation for the Northeast Structural Genomics Consortium is NESG. Finally, rather than determining the manner in which an enzyme binds salicylic acid, NESG researchers discovered the manner in which the enzyme cleaves methyl salicylate to produce salicylic acid.

#### TECHNICAL COMMENT ABSTRACTS

##### COMMENT ON “Children Creating Core Properties of Language: Evidence from an Emerging Sign Language in Nicaragua”

Tommaso Russo and Virginia Volterra

Senghas *et al.* (Reports, 17 Sept. 2004, p. 1779) presented Nicaraguan Sign Language as a language created by children who lacked exposure to a developed language. We stress the relevance of social and environmental factors in shaping language acquisition. The different communicative and linguistic inputs that elder and younger generations of Nicaraguans signers were exposed to could have influenced their task performance. Full text at [www.sciencemag.org/cgi/content/full/309/5731/56b](http://www.sciencemag.org/cgi/content/full/309/5731/56b)

##### RESPONSE TO COMMENT ON “Children Creating Core Properties of Language: Evidence from an Emerging Sign Language in Nicaragua”

Ann Senghas, Asli Özyürek, Sotaro Kita

Russo and Volterra suggest that emergent structures were introduced to Nicaraguan Sign Language by Spanish-speakers through expressive channels such as writing, gesturing without speaking, or mouthing. However, these sources do not contain the relevant language structures, nor do their patterns of availability match the inter-generational differences observed. It is more likely that children’s learning processes shaped the language. Full text at [www.sciencemag.org/cgi/content/full/309/5731/56c](http://www.sciencemag.org/cgi/content/full/309/5731/56c)