



LETTERS

edited by Jennifer Sills

Cancer Filter Déjà Vu

IN A 3 AUGUST NEWS OF THE WEEK STORY ("CANCER TEST DISPUTE PITS RESEARCHER AGAINST a firm she helped create," p. 585), M. Enserink describes a dispute in France about whether a cancer-detection system "first published in 2000" (1) should enter the market. This system uses a filter with small holes that allow ordinary blood cells to pass through, but not larger and more rigid cancer cells. The photograph in the News of the Week story shows a plastic sheet irradiated with highly ionizing particles (so as to produce tracks) and then etched to bore holes of the desired size.

The cover photo from the 23 July 1965 issue of *Science* (2) includes a virtually identical photo. The caption reads in part, "Filtration of cancer cells by means of a plastic sieve. The holes have been etched to a diameter of 5 microns; holes of this size allow blood cells to pass through, but catch most cancer cells." In short, neither the special filters nor the idea of cancer-cell isolation, identification, and measurement is new.

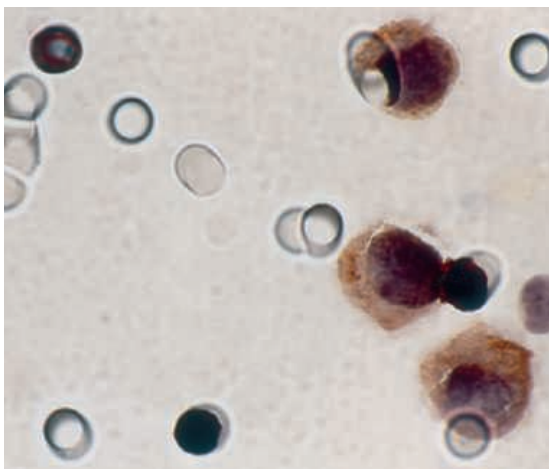
Three of us at the General Electric Research Laboratory (3) produced the earliest plastic filters of controlled hole size. Earlier production of filters from muscovite mica (4) suffered from brittleness. After learning of our success with plastic filters, S. H. Seal at the Sloan-Kettering Institute in New York suggested filtering to isolate cancer cells from blood (5). The filters were used to show that free-floating cancer cells are present early in the development of a cancer (6).

ROBERT L. FLEISCHER

Department of Geology, Union College, Schenectady, NY 12308, USA.

References

1. G. Vona et al., *Am. J. Pathol.* **156**, 57 (2000).
2. R. L. Fleischer, P. B. Price, R. M. Walker, *Science* **149**, 383 (1965).
3. R. L. Fleischer, P. B. Price, E. M. Symes, *Science* **143**, 249 (1964).
4. R. L. Fleischer, P. B. Price, R. M. Walker, *Rev. Sci. Instrum.* **34**, 510 (1963).
5. S. H. Seal, *Cancer* **17**, 637 (1964).
6. J. Song, P. From, W. Morrissey, J. Sams, *Cancer* **28**, 553 (1971).



A familiar pattern. The image in a recent News story (left) of a filter used for cancer detection is reminiscent of the image that appeared on a *Science* cover in 1965 (right).



WE WERE GREATLY AMUSED BY THE NEWS OF the Week story by M. Enserink on identification of cancer cells by filtration of blood (3 August, p. 585). In 1964, the late Sam Seal, then our colleague at Memorial Sloan-Kettering Cancer Center, had the same idea and conceived of a filter for circulating blood that would allow separation of cancer cells by size. Dr. Seal's work led to the invention of the "Nuclepore" filter by the General Electric Corporation. Although Seal's idea to use his filter as a cancer detection system failed (1), the filter was useful in studying the circulation of megakaryocytes. At the time of Seal's contribution, the molecular biology of cancer cell identification did not exist, but the fundamental concept of catching large epithelial cancer cells on a filter apparently remains valid. We wish to remember Seal as a pioneer in this area of cancer diagnosis.

LEOPOLD G. KOSS¹ AND MYRON R. MELAMED²

¹Montefiore Medical Center, Department of Pathology, The University Hospital for the Albert Einstein College of Medicine, Bronx, NY 10467-2490, USA. ²Westchester Medical Center, Valhalla, NY 10595, USA.

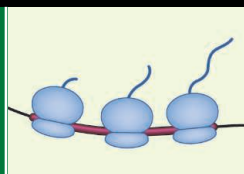
Reference

1. S. H. Seal, *Cancer* **17**, 637 (1964).

One Woman's Balancing Act

THE NEWS OF THE WEEK STORY "POSTDOC survey finds gender split on family issues" (Y. Bhattacharjee, 9 November, p. 897) stressed social isolation of female faculty and the lack of high-quality child care. Looking back on a career as a professor and a single parent, I missed out on networking with colleagues and on presenting at conferences because of family obligations. I continued to miss out on these aspects of my career for many years, because, as most parents know, children can be too old to be left alone, as well as too young. (And, in any case, arrangements for overnight conference travel are much more difficult than daytime care.)

When I reached middle age, I saw that there were special programs to encourage women who had delayed professional education until their families were grown, but little "catch-up" help for those of us who had been



Double duty for
microRNAs

1877



Plastic flow in glasses

1880

juggling all along. As an emerita and consultant today, I still feel the effect of the networking deficit. However, the Internet has helped me develop useful collegial connections to work with, now that my family tasks are minimal. Judging from the attitudes reported by the NIH survey, I would say that young professional women today are also more likely to benefit from electronic communication than from changes in social attitudes about family responsibilities.

JEAN MERCER

Department of Psychology, Richard Stockton College, Pomona, NJ 08240, USA.

Stem Cell Breakthrough: Don't Forget Ethics

THERE IS JUSTIFIABLE EXCITEMENT surrounding the successful induction of pluripotent stem (iPS) cells from human fibroblasts [Yu *et al.*, Reports, 21 December (this issue), p. 1917, and (1)]. The removal of dependence on oocytes frees researchers from serious ethical issues that have hindered medical research. This technology could also be of great value in the area of conservation biology. The genes from endangered animals or even an extinct species could be reintroduced to maintain the survival and genetic diversity of the species. However, although one researcher commented that “[p]eople working on ethics will have to find something new to worry about” (2), it is crucial that discussions of the ethical use of this technology continue.

Even though the technology is in its early stages, its implications are both enormously important and troublesome. Jaenisch and his colleagues (3) have shown in mice that such reprogrammed cells can form viable chimeras and contribute to the germline when injected into blastocysts. When transferred to recipient females, we have confirmed that embryonic stem cells injected into mouse blastocysts or aggregated with 8-cell-stage morulas can contribute to all of the organ systems and to more than 90% of the resulting fetuses and live pups (4).

These animals also had the LacZ gene from the embryonic stem cells in their gametes and produced LacZ-positive off-

spring when crossed with females, confirming that the DNA from the stem cells could be genetically passed on to subsequent generations. The success of this technology in model organisms opens up the possibility that humans might be able to pass on their genes (or genetically modified genes) to future generations from just a few skin cells.

At present, the technique for generating iPS cells requires serious genetic modification, which itself has been associated with an increased incidence of tumors. As with cloning, it would be scientifically and ethically irresponsible—indeed, unscrupulous—to use this technology for reproductive purposes. However, while the technology to clone a human being does not currently exist, the ability to use iPS cells to make a chimeric human (i.e., using iPS cells to contribute to an embryo that would be a chimera) may be much closer to reality.

Considering the immense power of this technology, it is imperative that an effort is made by scientists and governments to understand the ramifications of this new breakthrough and to ensure that it is used in an ethically responsible way for the benefit and progress of humanity.

ROBERT LANZA

Advanced Cell Technology and Institute for Regenerative Medicine, Wake Forest University School of Medicine, Winston-Salem, NC 27157, USA.

References

1. K. Takahashi, *Cell* 10.1016/j.cell.2007.11.019 (2007).
2. G. Vogel, C. Holden, *Science* 318, 1224 (2007).
3. M. Wernig *et al.*, *Cell Stem Cell* 1, 55 (2007).
4. Y. Chung *et al.*, *Nature* 439, 216 (2006).

CO₂ Emissions: Getting Bang for the Buck

IN HIS POLICY FORUM “CRITICAL ASSUMPTIONS in the Stern Review on climate change” (13 July, p. 201), W. Nordhaus’s continued argument for high discount rates—i.e., leaving the problems for future generations to deal with—is part of the thinking that got us into trouble in the first place. A fixed and high discount rate has been shown to be inconsistent with human behavior (1) and inadequate for long-term environmental decision-making (2).

Data from atmospheric and related

sciences should guide the scale of society’s emissions. Once a safe scale is determined (3), an ethical discussion should guide how we divide the remaining emissions, as suggested by N. Stern and C. Taylor in their response to Nordhaus (Policy Forum, 13 July, p. 203). Only after the scale and ethical distribution have been decided should economics step in to help us decide how to use the remaining emissions efficiently.

Nordhaus’s argument is “let’s get the most bang for our buck,” and this is laudable. However, if we look at why we are burning fossil fuels in the first place (i.e., to improve human welfare), then we come to a conclusion very different from Nordhaus’s tax-the-future suggestion. In basic economics, we learn that investment should be directed toward factors with the greatest return per unit input. If we rightly assume that CO₂ emissions are a consequence of a growing economy (4), and the goal of growing the economy is increasing human welfare, then we need to invest where increased GDP (read CO₂ emissions) returns the most welfare per unit input. Data on proxies for welfare other than GDP, such as life expectancy, quality of health care (5), and self-reported levels of happiness (6), suggest that our remaining emissions should be allocated to developing and least-developed countries, where the greatest returns are realized.

BRENDAN FISHER

Centre for Social and Economic Research on the Global Environment, University of East Anglia, Norwich NR2 3UF, UK.

References and Notes

1. K. Knetch, *Env. Res. Econ.* 32, 91 (2005).
2. R. K. Turner, *Env. Res. Econ.* 37, 253 (2007).
3. W. S. Broecker, *Science* 315, 1371 (2007).
4. CO₂ emissions data are available from Oak Ridge National Laboratory (2003); http://cdiac.ornl.gov/trends/emis/tre_tp20.htm.
5. WHO, “World Health Report 2006: Working together for health” (WHO Press, Geneva, 2005).
6. C. Kenny, *Soc. Indic. Res.* 73, 199 (2005).

WILLIAM NORDHAUS (POLICY FORUM, 13 July, p. 201) criticizes the ethical assumptions behind the 0.014 year⁻¹ discount rate used in the Stern Review (1). Stern’s rate, however, is roughly consistent with a well-known theory of policy analysis in which the discount rate is set equal to the sum of two terms: the market rate of return on safe investments plus an appropriate risk premium for uncertainty (2, 3).

Safe financial assets such as money-market funds yield inflation-adjusted returns of ~0.01 year⁻¹. Moreover, this theoretical framework implies that the risk premium should not be positive for precautionary actions such as buying insurance. For precautionary actions, the discount rate should thus be no higher than ~0.01 year⁻¹.

Climate stabilization is a precautionary investment, similar to buying an insurance policy that secures the livelihoods of future generations (4). The Framework Convention on Climate Change calls for preventing “dangerous anthropogenic interference with the climate system” (5). By mitigating uncertain—but potentially catastrophic—impacts, climate stabilization reduces the statistical variability of future well-being.

The 20th century began with strong faith in progress and ended with a sense of trepidation about the lives our grandchildren will lead. Returns on past investments in a fossil-fuel economy were high because climate change costs were ignored. Protecting our progeny’s environmental rights will result in wholly new prices, including lower discount rates (6).

RICHARD B. HOWARTH¹ AND
RICHARD B. NORGAAARD²

¹Environmental Studies Program, Dartmouth College, Hanover, NH 03755, USA. ²Energy and Resources Group,

University of California, Berkeley, CA 94720, USA. E-mail: RBHowarth@dartmouth.edu (R.B.H.); norgaard@igc.org (R.B.N.)

References

1. N. Stern, *The Economics of Climate Change: The Stern Review* (Cambridge Univ. Press, Cambridge, 2007).
2. A. Sandmo, *Int. Econ. Rev.* **13**, 287 (1972).
3. D. A. Starrett, *Foundations of Public Economics* (Cambridge Univ. Press, New York, 1988).
4. R. B. Howarth, *Land Economics*, **79**, 369 (2003).
5. United Nations, *Framework Convention on Climate Change* (<http://unfccc.int/resource/cscites/senegal/conven.htm>), Article 2.
6. R. B. Howarth, R. B. Norgaard, *Am. Econ. Rev.* **82**, 473 (1992).

Response

FISHER SUGGESTS THAT “WE NEED TO INVEST where increased GDP (read CO₂ emissions) returns the most welfare per unit input.” I agree with the basic premise that the point of economic activity is to improve the standards of living of present and future generations. However, GDP (gross domestic product) def-

initely does not equal CO₂ emissions, nor is there an iron law relating the growth of GDP and of CO₂ emissions. Indeed, the cross section of economics and human experience indicates that if the price of carbon emissions is raised above zero—best accomplished by a carbon tax, in my view—then the CO₂ trend line will be flatter, or even turn down. The need for a high global price of carbon is common ground between my work and the Stern Review. The necessary (and probably the sufficient) condition for doing anything substantial in climate policy is for scientists, political leaders, and the public to accept the inconvenient economic truth that the prices of goods and services that contain CO₂ must be raised relative to those of other goods and services.

How sharply or fast should countries individually and collectively bend down the CO₂ trend line? Studies differ on the answer to that question, and the major difference between my work and the Stern Review involves the

CORRECTIONS AND CLARIFICATIONS

Letters: “Virtual worlds, real healing” by A. Gorini *et al.* (7 December, p. 1549). Two author names were omitted. The complete list of authors is Alessandra Gorini,^{1,2} Andrea Gaggioli,^{1,3} Giuseppe Riva,^{1,3} and their affiliations are as follows: ¹Applied Technology for Neuro-Psychology Laboratory, Istituto Auxologico Italiano, 20100 Milan, Italy. ²Research Institute Brain and Behaviour, Maastricht University, Netherlands. ³Psychology Department, Catholic University of Milan, Italy. The authors and affiliations have been corrected in the HTML version on the *Science* Web site.

Essays: “GE & *Science* Prize for Young Life Scientists: regional winners” (7 December, p. 1566). The photograph of Bo Huang was placed next to the biography of Takeshi Imai, and the photograph of Takeshi Imai was placed next to the biography of Bo Huang. The photographs were correct in the online version.

News Focus: “Should oceanographers pump iron?” by E. Kintisch (30 November, p. 1368). A table describing the size of the area to be seeded by Planktos in upcoming experiments was incorrect. The company’s planned releases would cover a patch of ocean from 2000 to 7750 km², not one as large as 31,000 km².

This Week in *Science*: “Short DNAs stack and order” (23 November, p. 1213). The correct credit is “Giuliano Zanchetta/University of Milano.”

Reports: “Transposase-derived transcription factors regulate light signaling in *Arabidopsis*” by R. Lin *et al.* (23 November, p. 1302). In the sixth sentence of the third paragraph on page 1304, an incorrect Web site was referenced. The correct Web site should be The Arabidopsis Information Resource (www.arabidopsis.org). Also, in reference 13 on page 1305, the accession numbers for *Arabidopsis* FAR1, FHY1, and FHL (AAD51282, AAL35819, and CAB82993, respectively) were mistyped as NP_567455, NP_181304, and AAC23638.

Books *et al.*: “Simple maths for a perplexing world” by D. J. Rankin (9 November, p. 919). In the first paragraph, “hoards” should have been “hordes.”

Perspectives: “How does radiation damage materials?” by B. D. Wirth (9 November, p. 923). Throughout the Perspective, “Burger’s vector” should be “Burgers vector.”

This Week in *Science*: “Nearest and dearest” (2 November, p. 713). The correct credit is “Norman Lim/National University of Singapore.”

News Focus: “Do wandering albatrosses care about math?” by J. Travis (2 November, p. 742). The bird identified as a wandering albatross (*Diomedea exulans*) in the photograph is a black-browed albatross (*Thalassarche melanophris*).

News Focus: “Malaria treatment: ACT two” by M. Enserink (26 October, p. 560). The UNICEF report referred to is Malaria and Children: Progress in Intervention Coverage, by UNICEF and the Roll Back Malaria Partnership (2007). That

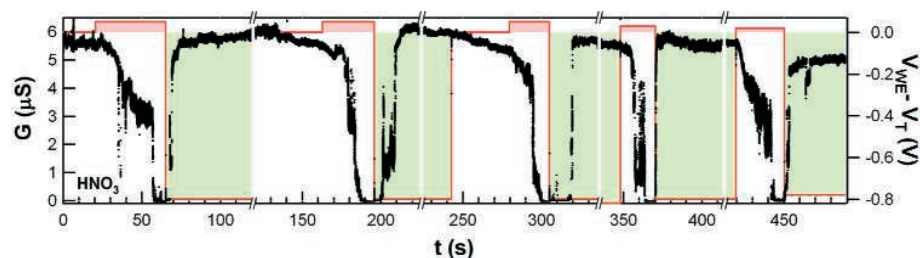
report is also the source of the graphics on pp. 560 and 563, as well as the graphics in “Battling over bed nets” on pp. 557 and 559.

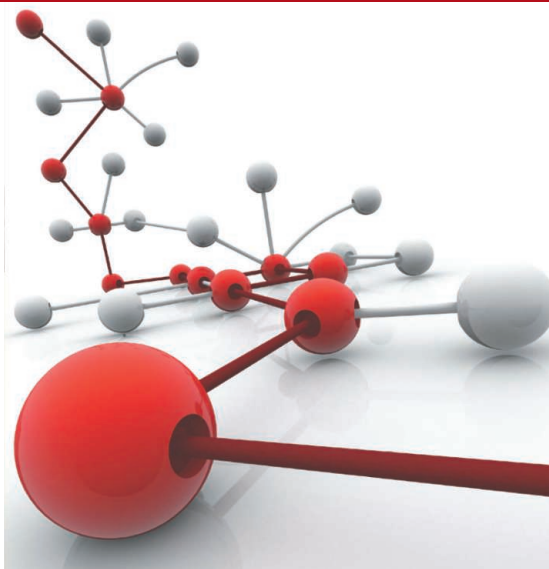
Reports: “Permuted tRNA genes expressed via a circular RNA intermediate in *Cyanidioschyzon merolae*” by A. Soma *et al.* (19 October, p. 450). The last sentence on p. 452 referred to an incorrect subunit. The sentence should begin “Permuted noncoding RNA (ncRNA) genes have been reported for *Tetrahymena* mitochondrial large subunit (LSU) ribosomal RNA (rRNA) (15).”

News Focus: “Tooled-up amateurs are joining forces with the professionals” by J. Bohannon (12 October, p. 192). The light curves in the figure should have been credited to Stelios Kleidis in Greece, Paul Van Cauteren in Belgium, and C. W. Robertson in the United States.

Research Articles: “An evolutionarily conserved mechanism delimiting SHR movement defines a single layer of endodermis in plants” by H. Cui *et al.* (20 April, p. 421). In two instances in the fifth paragraph on page 424, one of the rice homologs for *SHR*, *Os03g31880*, was mistyped as *Os03g31750*.

Reports: “Conductance-controlled point functionalization of single-walled carbon nanotubes” by B. R. Goldsmith *et al.* (5 January, p. 77). The horizontal axis in Fig. 1C should have included breaks to indicate that the five redox cycles were not performed continuously. A corrected version is shown below. The caption should conclude, “The reduction portions of *G* in (C) have been scaled up by 1.32 ± 0.10 to adjust for the electrostatic gating that occurs at the reducing potential.” To clarify these corrections, raw data underlying Fig. 1C has been added to the revised Supporting Online Material, accompanied by a complete description of the processing. The caption for Fig. 2C should read, “A composite of AFM topography in grayscale and SGM in red identifies a local region responsible for the gate sensitivity of a device like (A).” The Supporting Online Material has also been corrected to state, “Figs. 3D and S4 depict three different chemical configurations: H₂SO₄ oxidation, Ni deposition, unpassivated Ti electrodes (Fig. 3D); H₂O oxidation, Ni deposition, unpassivated Ti electrodes (Fig. S4A); H₂O oxidation, Pd deposition, unpassivated TiN electrodes (Fig. S4B)” (p. S11). The authors apologize that these errors were incorporated during manuscript revision but note that they do not affect the results or conclusions of the paper.





STKE

Signal
Transduction
Knowledge
Environment

STKE is a weekly review journal that is indexed in MEDLINE and features reviews and perspectives by leading researchers. Stay abreast of the latest developments with the STKE Virtual Journal, with primary research articles from 49 publishers. Give your own research a boost with detailed protocols that guide you through the latest techniques. Learn about the relationships controlling cell behavior from the Connections Maps pathways. STKE is the resource you need to stay ahead in this rapidly advancing, multidisciplinary field.

As a AAAS member, add STKE access for only \$69—\$30 off regular price. To order go to: www.stke.org or call 202-326-6417



discount rate. The primary point in my Policy Forum (13 July, p. 201) and the background studies (1, 2) is that we need to choose a discount rate for climate investments (such as emission reductions) with a return that is as high as the return on social investments with which climate investments compete. I suggested that it would be difficult to rationalize a rate of return on investment much below 5 to 6% per year in inflation-adjusted terms. Howarth and Norgaard object, arguing that “[s]afe financial assets such as money-market funds yield inflation-adjusted returns of $\sim 0.01 \text{ year}^{-1}$.” Their number is too low and only marginally relevant. The closest thing in the world to a safe financial asset is the U.S. Treasury 20-year inflation-protected bond, the yield of which is currently around 2.5% per year. However, this is hardly the relevant cost of capital for the firms borrowing at a real interest rate of 3 to 10% per year, or households paying 18% on credit-card debt, or students around the world who face liquidity constraints and for whom the real returns on educational investments might be 5 or 10 or 20% per year. There are many, many investments with yields far above Howarth and Norgaard’s 1% per year.

Both letters make an important point with which I agree: The desired carbon tax or emissions reductions would have a substantial component of risk premium to reduce the chance of triggering poorly understood, low-probability, high-consequence climatic outcomes. Their proposed remedy—to lower the discount rate—is off target, however. The appropriate response is primarily to undertake the scientific studies to better understand the risks, and then to design effective steps to avoid them. Manipulating discount rates does neither.

WILLIAM D. NORDHAUS

Department of Economics, Yale University, New Haven, CT 06511, USA.

References

1. W. D. Nordhaus, *The Challenge of Global Warming: Economic Models and Environmental Policy* (Yale Univ. Press, New Haven, CT, in press); available at http://nordhaus.econ.yale.edu/recent_stuff.html.
2. W. D. Nordhaus, *J. Econ. Lit.*, in press; available at http://nordhaus.econ.yale.edu/recent_stuff.html.

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 3 months or issues of general interest. They can be submitted through the Web (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.