Department of Chemistry,
University of Southern California,
Los Angeles, CA 90089–0744
E-mail: adamson@chem1.lusc.edu

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Bioresources and "Biopiracy" in Brazil

I congratulate Elizabeth Pennisi and *Science* for the article "Genetic ownership: Brazil wants cut of its biological bounty" (News & Comment, 6 Mar., p. 1445), which calls attention to the initiative to enact a law regulating access to biological resources in Brazil. It is important to show the scientific community the political side of this question and the different interest groups concerned about it. It was also heartening to see that Brazilian authorities have finally decided to speak publicly about the access bill.

Pennisi quotes biologist Thomas Lovejoy of the Smithsonian Institution as stating that the legislation "is potentially a real roadblock ...to scientific progress." This is an argument often invoked by international interests who perceive a national legislative framework as an obstacle to their economic goals. Haven't these same groups used the argument of "scientific progress" when applying pressure for laws protecting their own intellectual property rights in various countries, including Brazil? Exactly what does "scientific progress" mean to the economic groups that sponsor bioresearch in developed countries? A sense of justice would also require a recognition of the contributions and the resulting intellectual rights of traditional rural and indigenous communities. The intent of the proposed law is to protect these rights, while encouraging fair and efficient use of Brazil's bioresources.

Lovejoy's pessimistic prediction is echoed by Pennisi when she refers to "a series of bureaucratic hurdles that anyone who wants to collect and use biological specimens in Brazil must clear." This concern could well have been discussed by business, science, and government representatives with myself as author of the bill, or with Brazilian Senator Osmar Dias, the bill's rapporteur and a member of Brazilian President Fernando Cardoso's political party, Partido de Social Democracia Brasileiro. After $2\frac{1}{2}$ years of public hearings and seminars, however, those sectors' suggestions have not been forthcoming.

It is their apparent silence, perhaps a strategy for opposing this legislation, which may in fact represent the greatest threat to scientific progress. There are many interests awaiting approval of the law (such as Shaman Pharmaceuticals, mentioned in the article) in order to begin working seriously in Brazil, free from charges of biopiracy. The best strategy for avoiding bureaucratic "bogeymen," which frighten us all, is to contribute as soon as possible to the creation of appropriate legislation by democratic means, in the Brazilian Congress.

Marina Silva
Senator,
State of Acre, Brazil

Super-Accelerators and International Collaboration

I enjoyed the article by David Kestenbaum (News, 27 Feb., p. 1296) about the next generation of particle acclerators. I share the opinion that we need an electron-positron collider with a performance exceeding that of the Stanford Linear Accelerator Center (SLAC) Linear Collider by at least a factor of 5 to 10 in energy and perhaps four orders of magnitude in luminosity. I also share the opinion that such a project should be truly international. However, I would like to comment on two statements in the article.

Germany's DESY lab is described as "hard at work" on a linear collider made of superconducting cavities as an alternative to the conventional technology promoted by Japan's KEK laboratory and by SLAC, and this is said to be a bad omen for international collaboration.

Indeed, DESY is making a major contribution to the international TESLA collaboration, initiated by physicists at Cornell University (since 1993, centered at DESY). At present, some 30 institutions from eight countries, including the United States, are collaborating to develop this technology. TESLA is thus a truly international collaboration where outside institutions have contributed some 50% of the total effort. Given the large extrapolation in performance parameters, we feel that it is not detrimental to international collaborations as stated in this article but important and prudent to explore all options in order to arrive at the best solution. A premature decision on the technology will not serve the international user community well.

Moreover, DESY is criticized by the U.S. Department of Energy's Peter Rosen for raising the question of a site at this stage. In the TESLA Conceptual Design Report, two sites were considered—one at DESY, the other at Fermilab. I do not feel that this is bad for international collaborations. To make a meaningful comparison of the options, the availability of a site and the total cost incurred in setting up a new laboratory—if needed—must be known.

Björn H. Wiik
Deutsches Elektronen-Synchrotron (DESY),
Notkestrasse 85,
D-22607 Hamburg,
Germany
E-mail:bjoern.wiik@desy.de

Shifty Eyes

I disagree with the implication that human iris morphology is more "stable" than fingerprints or retinal vasculature ("Eyeball ID," Random Samples, 16 Jan., p. 329). The iris can change with trauma, infection, inflammation of an idiopathic nature, glaucoma, and after cataract surgery. In the young, the likelihood of change is minimal.

August L. Reader
718 Grand Street,
Alameda, CA 94501–7445, USA

Funding Themselves and Others

In reading "Scientists who fund themselves" (Special News Report, 9 Jan., p. 178) by Jon Cohen, we were moved to relate this story of neurophysiologist Alexander Forbes, who not only used his own funds to support his own work (*1*), but went considerably further by helping another scientist, Ernst Theodor von Brücke, escape from Nazi-occupied Austria in 1939, so that Brücke could resume his research (*2*).

Forbes, born in Milton, Massachusetts, was the grandson of Ralph Waldo Emerson. He is one of America's premier electrophysiologists and biomedical engineers (*3*). Brücke, a prominent Austrian europhysiologist of Jewish ancestry, was an excellent experimentalist who postulated spinal cord interneurons and championed the concept of reciprocal innervation of muscles (*2*).

Soon after the Nazis annexed Austria to Germany in March 1938, Brücke was abruptly dismissed from Innsbruck University. Unknown to Brücke, Forbes immediately began to arrange a position for him at Harvard. He offered to underwrite, and subsequently assumed sole responsibility for, Brücke's salary for 2 years. He wrote to numerous scientists (including J. Erlanger, R. W. Gerard, and H. S. Gasser), industrialists (including E. Mallinckrodt), and foundations soliciting

money for Brücke. Brücke, in the meantime, after much delay and frustration, managed to get a visa to leave Nazi Austria once he had a bona fide offer of a position at Harvard that was conditional on Forbes securing the salary. Brücke arrived in the United States to resume his work just 2 weeks before the start of World War II.

It is well known that extraordinary acts of kindness, sacrifice, and what we label "humanity" occur during troubled times. This remarkable story (*4*), which is thoroughly documented in the Forbes archive (*5*), stands as a lasting testimony to Forbes' leadership and humanity and serves as an example for us all.

Herbert F. Voigt
Biomedical Engineering Hearing Research Center, Boston University, Boston, MA 02215, USA
E-mail: hfv@enga.bu.edu
Dana D. Ricciardi
Director/Curator, Captain Forbes House Museum, 215 Adams Street, Milton, MA 02186, USA
Ernst-August Seyfarth
Zoologisches Institut, J.W. Goethe-Universitaet, D-60054 Frankfurt am Main, Germany
E-mail: seyfarth@zoology.uni-frankfurt.de

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4. An exhibition entitled "Escape from the Nazis: The Transatlantic Friendship of two Neuroscientists" (co-sponsored by Temple Shalom of Milton) celebrating the scientific contributions of and friendship between these two great neurophysiologists is currently showing (1 March through 31 May) at the Captain Forbes House Museum in Milton, MA.
5. At the Francis A. Countway Medical Library, Harvard Medical School, Boston, MA.

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Gray Whales in Cold Water

In their report "Thermoregulation in the mouths of feeding gray whales" (7 Nov., p. 1138), John E. Heyning and James G. Mead hypothesize that the special array of arteries and veins found in the tongue of baleen whales may act as a countercurrent heat exchanger. In such arrangements of arteries surrounded by veins, which occur in the appendages of some species, heat from the warmer arterial blood flows into the cooler venous blood that is returning to the core of the animal (*1*). Heat loss from distal tissues is limited because the blood arriving there is pre-cooled. Core temperature (and heat) is preserved because the blood arriving there is pre-heated (*2*). The temperature measurements presented in the report, however, do not demonstrate a counter-current heat exchanger function in this vascular array. There appear to be deficiencies in the report's method, results, and interpretations.

1) Method. Heat transfer from arteries to veins within a purported subdermal vascular heat exchanger (rete) can be demonstrated with measures of blood temperature in vessels proximal and distal to the rete (*3*), but not by, in this case, tongue surface temperatures. Such temperatures alone cannot even indicate the amount of heat flow between the tongue surface and its environment, which would have to be measured with heat flow disks or Peltier meters.

2) Results. Skin temperature data are omitted and a confusing presentation of results is made in the report. A brief sentence could have made the point that, during 1 min when the whale calf was suckling, the tongue surface temperature dropped 2 to 5°C, until it was about 0.5°C above the surrounding water temperature. Also, it is unknown whether the temperature of deeper tissues in the tongue declined, which is more relevant to the hypothesis.

3) Interpretation. Heyning and Mead incorrectly conclude (p. 1139) that "the drop in temperature on the surface of the tongue was a result of recirculation of heat back to the body core via a countercurrent heat exchanger." The fact that tongue temperature was initially well above (2.5° to 5.5°C) water temperature indicates that it contained significantly more heat than the water. The marked decline in the tongue surface temperature during 1 min of suckling indicates heat lost from the tongue. Such heat must be lost to the environment (including the water, feeding tube, or food), because countercurrent heat exchangers cannot gather and recirculate heat already present in tissues.

In sum, the data presented neither support nor refute the countercurrent heat exchanger hypothesis for the vascular array in the whale tongue. It remains a good hypothesis, and as such, is an admirable contribution.

Martha E. Heath
Biodiverstiy Research and Application Association, Post Office Box 22683, San Diego, CA 92110, USA
E-mail: meheath@compuserve.com

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Response: We would like to address each point of criticism in turn.

1) Methods. The measurement of skin temperature relative to ambient temperature does provide a index of heat loss to the environment through conduction [for example, (*1*)]. In fact, the now popular technique of thermal imaging uses this concept to provide a graphically rich, albeit qualitative, depiction of relative heat loss. To quantify this heat loss, a device such as a heat flux transducer, as suggested by Heath, is required. We hoped to use such an apparatus, but the logistics of applying such a device onto the tongue of a free-swimming whale were overwhelming.

2) Results: With regard to skin temperature, the report states that the ambient water temperature was either 12.5° or 19.5°C. After feeding, the temperature of the whale's tongue was consistently 0.5°C above that of ambient temperature, and skin temperature ranged from 0.5° to 2.0°C above that of the tongue. Because of the qualitative nature of the data and the fact that the relationship of the body temperatures to ambient did not vary, these data were presented in relative terms.

3) Interpretation. Our results do show that the temperature of the tongue initially dropped while feeding, and we concur that this result represents an initial loss of heat across the tongue to the environment. If an extremity with a countercurrent heat exchanger is in a warm environment, the blood in that extremity will be warm and the countercurrent heat exchanger has little effect. This is the condition when the whale's mouth is closed and the oral cavity is surrounded by the insulating blubber of the head. When that extremity is exposed to a cold environment, however, the countercurrent heat exchanger cannot retain the heat already in the extremity, but it does serve to prevent further heat loss by recirculating heat (in blood on its way to the tongue) back to the body core. This is what happens when the whale opens its mouth to feed and exposes the warm tongue to the cold polar waters. Initially, the heat within the tongue is lost to the environment, but a continual heat loss is prevented by the countercurrent heat exchangers.

This prediction agrees with our temperature measurements. Theoretically, without these countercurrent heat exchangers, the highly vascular tongue should have registered surface temperatures far greater than ambient temperature, resulting in endless heat loss during feeding. The complex countercurrent heat exchangers in the tongue of the gray whale would seem to meet the thermal challenge that arises when the tongue is exposed to near-freezing water.