## Fluorescence of Yellow Budgerigars

**IN THEIR BREVIA "FLUORESCENT SIGNALING** in parrots" (4 Jan., p. 92), K. E. Arnold and coauthors use mate choice experiments to demonstrate that fluorescence in wild-type budgerigars (*Melopsittacus undulateus*) is probably functional and not incidental. However, there is further evidence to support this hypothesis in the feathers themselves.

The green chest feathers of wild-type budgerigars actually reflect negligible "green" wavelengths—rather, blue and yellow reflections are superimposed. They contain structural reflecting elements (submicrometer holes in a keratin lattice) to produce blue and also a pigment to produce yellow. Conceivably, the structural reflector could affect fluorescence, because it scatters/reflects ultraviolet light. In the yellow variety of budgerigar, only the yellow pigment remains in the chest feathers, and to the human eye, the chest appears to be the same yellow hue as the throat (see left panel of figure). But there is a difference in intensity.

**The yellow variety of budgerigar illuminated with (left) white light and (right) ultraviolet (peaking at 360 nm) only, documenting fluorescence (ultraviolet reflections are removed by a 400-nm pass filter).**

The yellow throat (and crown) of the wild-type budgerigar fluoresces. In the yellow variety, the throat and crown also fluoresce, but the yellow chest does not (right panel). Hence, there is a transition in fluorescence (and, consequently, intensity) in the apparently homogeneous yellow plumage of the yellow-variety budgerigar (see figure).

These observations indicate that fluorescence is not simply a consequential character or by-product of the pigment causing yellow in budgerigars. There must be an additional, fluorescent chemical in the yellow regions of the head that absorbs ultraviolet light and reemits yellow light. Although circumstantial on its own, in combination with the behavioral tests conducted by Arnold *et al.*, this is evidence toward a biological function for the yellow reemitted light. Fluorescence enhances the pigmentary yellow coloration, a region of the spectrum of lower sensitivity to budgerigars.

**ANDREW R. PARKER**
Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, UK. E-mail: andrew.parker@zoo.ox.ac.uk

## Another Look at $MgB_2$ and YBCO Wires

**ROBERT F. SERVICE OMITS SOME KEY FACTS** in his article "$MgB_2$ trades performance for a shot at the real world" and sidebar "YBCO confronts life in the slow lane" (News Focus, 1 Feb., p. 786).

The picture of the reel of magnesium diboride ($MgB_2$) wire on page 786 shows the reader that long-length wires are being made today. Yet performance figures for this wire are not given in the article. We checked with the manufacturer and learned that 1 cm of the wire has been tested: At 30 K and a 1-T applied field, the critical current density was 10 kA/cm$^2$. No one has tested longer pieces of this wire.

This can be contrasted with the successes of yttrium, barium, copper, and oxygen (YBCO) wires. Continuously processed 1-m-long samples of YBCO wire have 10 times this critical current density in nitrogen at 1 T. Also, inadequate weight is given to the low value of the upper critical field of $MgB_2$ and what this implies for applications such as motors and generators. For example, at proposed operating temperatures of 20 to 25 K, even the best $MgB_2$ materials cannot sustain large loss-free currents at the required magnetic field levels of 3 to 5 T.

Operating temperature can make much more of a difference than the article suggests in terms of cost, performance, and reliability, for not only the cooling system, but also the power equipment containing the superconducting wire. In the example of a superconducting transformer application, erroneous assertions are reflected in the "cheap shot" bar graph (page 787) for total ownership costs. Regarding the cryogenic refrigeration system, this graph shows about a 30% penalty from a reduction in operating temperature from 68 to 25 K, whereas a 3 to 4% penalty for operation at the lower temperature is a more realistic number. These lower temperatures imply significant costs in input power to the cryogenic system, in addition to a more expensive refrigerator. Finally, the specific heat of most materials increases by at least a factor of 10 from 25 to 68 K, which allows greater stability margins when YBCO conductors are used in power applications.

Oak Ridge National Laboratory physicist Dave Christen is misquoted in the article. Beyond a certain film thickness, it is the critical current density, not the critical current, as given in the article, that declines with increasing thickness of YBCO films. Critical current continues to increase with superconductor thickness, and Los Alamos demonstrated last year that critical currents in excess of 300 amperes are achieved for thick films of YBCO conductor in nitrogen (*1*). It's 20 K that's the "slow lane." The electricity superhighway's future is closer to 70 K.

**ROBERT A. HAWSEY[1] AND DEAN E. PETERSON[2]**
[1]Superconductivity for Electric Systems, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA. [2]Superconductivity Technology Center, Los Alamos National Laboratory, Los Alamos, NM 87545, USA.

References

1. Data presented at the Annual Review of the Department of Energy Superconductor Program, July 2001.

## Cryopreservation: Freezing and Vitrification

**RECENT DEVELOPMENTS IN CRYOPRESERVATION** of organs and tissues are reported by Jocelyn Kaiser in "New prospects for putting organs on ice" (Bodybuilding: The Bionic Human, 8 Feb., p. 1015). The article focuses almost entirely on vitrification (ice-free cryopreservation) and contends that cryopreservation by freezing is an inferior technique, because of "damaging ice crystals." Although it is true that ice growth can cause damage in some organs by overdistending luminal spaces (*1*), there is scant evidence that interstitial crystals, such as those shown in the micrograph accompanying the article, are deleterious. In