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.

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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.

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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

fact, studies demonstrating that the morphological and biomechanical properties of tissues are unaffected by the freeze-thaw process contradict this hypothesis (*2*).

Comparisons between freezing and vitrification are often misleading, whereas either technique can fail spectacularly or succeed brilliantly, depending on the exact protocol used for preservation. Protocol development involves the adjustment of a multitude of process parameters, and the optimal processing requirements are tissue-specific. As reported by Kaiser, researchers at Organ Recovery Systems have achieved an important milestone in successfully vitrifying rabbit veins. However, their claim that "vitrification works better than freezing" is based on the relative performances of a fine-tuned vitrification protocol and an unoptimized freezing protocol (*3*), an inappropriate comparison.

For large organs, heat and mass transfer limitations become a significant obstacle to vitrification, which requires high cryoprotectant concentrations and rapid rates of temperature change. In contrast, freezing techniques use relatively dilute cryoprotectant solutions and low cooling rates. Moreover, the preservation process is assisted by ice formation: Ice sequesters water molecules, causing a gradual and relatively uniform concentration of cryoprotectants, even in large specimens. Paradoxically, when tissue is frozen, its biological components are actually vitrified in an amorphous matrix that envelops the crystals.

The behavior of tissue during freezing is more complex than during vitrification, and optimization of freezing procedures may therefore be more challenging. Nonetheless, optimization of freezing protocols for cells has benefited greatly from the development of mathematical models of the process. Recent efforts to model tissue freezing may thus ultimately improve our ability to optimize freezing procedures for organs (*4*).

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Antiaging Technology and Pseudoscience

CONSTANCE HOLDEN ACCURATELY DESCRIBES the range of opinions in the field of aging research concerning the possible efficacy of future life-extension technologies and the lack of any antiaging medicines today (Bodybuilding: The Bionic Human, "The quest to reverse time's toll," 8 Feb., p. 1032). However, it is crucial to be aware that the term "antiaging" means different things to different people and that in spite of its misuse by some, the term can be and has been used by reputable scientists conducting research designed to understand and eventually modify the rate of aging (*1*). There are thousands of legitimate scientific publications devoted to the study of aging, and we enthusiastically support such research, as successful efforts to delay the onset of age-related chronic diseases and frailty have the potential to yield dramatic improvements in the health of older persons. This legitimate effort must be clearly distinguished from the antiaging quackery that has made its way into the contemporary lay literature. For example, two so-called scientific "journals" (*Journal of Longevity* and *The International Journal of Anti-Aging Medicine*) that appear on the surface to be traditional refereed publications are in fact little more than advertisements for a pseudoscientific antiaging industry. By contrast, the similarly titled *Journal of Anti-Aging Medicine* is a refereed scientific journal. We want to make sure that the public is aware of both the scientific and the nonscientific use of the term "antiaging medicine."

"We want to make sure that the public is aware of both the scientific and the nonscientific use of the term 'antiaging medicine.'"

Those currently selling what they term "antiaging medicines" are promoting the use of products that may in some cases diminish the risk of certain diseases but that have not been shown even modestly to reduce the acceleration of mortality with age in the general population and that in some instances may be harmful (*2*). This misuse of the term "antiaging medicine" has led many scientists (including some of the undersigned) to shy away from using the term at all, for fear of guilt by association. The term "longevity science and medicine" was recently introduced by a group of scientists now working in the field (*3*), but the fear remains that this term will be coopted by the pseudoscientific antiaging industry as well. As such, we urge the scientific and lay population to be sure that they understand that there are currently no scientifically proven antiaging medicines, but that legitimate and important scientific efforts are under way to develop them.

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Nasal Reconstruction in Ancient India

THE SPECIAL ISSUE ON THE BIONIC HUMAN (8 Feb.) was fascinating. However, the timeline ("Historical highlights in bionics and related medicine," p. 996) contained one error, dating nasal reconstruction with tissue flaps to 1597 A.D.

In ancient India, nasal amputation was a common form of punishment for adulterers, creating a broad need for nasal reconstruction. In a remarkably detailed and rational book written at the time of Vedic medicine, perhaps 1000 B.C., the Sushruta Samhita, nasal reconstruction using tissue flaps either obtained from the face or forearm is described (*1*). The first use of a mechanical tissue stapler is also described, intestinal injuries being repaired with the heads of black ants.

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URRs and Nobel Prizes

KENNETH ROGERS DESCRIBES THE ROLE OF university research reactors (URRs) and the current funding difficulties they are experiencing (Policy Forum, "The past and future of university research reactors," 22 March, p.