LETTERS

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Curious minds

If experts can't decide on the merits of a medical procedure, how is an ordinary citizen to do so? How many transistors can dance on the head of a chip? Is too much sun bad for coffee? Can great poetry be "cloned"? (Left, Dolly, the muse.) Do mutant *Drosophila* fruit flies provide a good "model" of the sexual behavior of *Homo sapiens* males? And didn't two Italians discover "swollen atoms"?

Forty-Something Breast Screening

I write to comment on a statement in the sidebar "How one radiologist turns up the heat" (News & Comment, 21 Feb., p. 1057) of the article "The breast-screening brawl" by Gary Taubes, in which I am quoted as attributing Daniel Kopans's harsh criticisms of my epidemiologist colleagues at the University of California, San Francisco, to "frustration on [Kopans's] part." I trust that readers understand that no one but Kopans himself would have reasonable insight into what motivates his actions.

In addition, the entire sidebar portrays Kopans as a lone extremist who is anathema to me and to the many others who agree with his endorsement of mammography screening for women in their forties. Quite the contrary, despite his occasional excesses, Kopans has won the support of screening proponents for his tireless advocacy of the benefits of screening and for his numerous, scientifically valid peer-reviewed articles on the subject. It is unfortunate that Kopans is singled out, when the statements of any of several strident screening opponents could also have been criticized.

The recent National Cancer Institute Consensus Conference failed because the only consensus it produced asked each individual forty-something woman to decide for herself whether she should undergo mammography screening. How is a woman (or her primary health care provider, for that matter) to decide on the merits of screening when the "expert" panel could not decide? We need clear, concise statements that promote action rather than indecision.

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Predictive Value of *Drosophila*

The *Drosophila fruitless (fru)* mutant analysis of Lisa Ryner *et al. (1)* discussed by Wade Roush (Research News, 13 Dec., p. 1836) is an important contribution to our understanding of the largely unknown genetic basis for insect behavior. But the evolutionary implications put forth by Ryner *et al.* detract from the value of the work. The discussion of vertebrate, and especially human male, sexual behavior in light of *Drosophila* behavior is problematic. Ryner *et al.* recognize that sex determination is different in *Drosophila* and in mammals. But they also suggest that *Drosophila* sex determination has predictive value for mammals: They seem to imply that the demonstration of *Drosophila* genetic control of courtship behavior would support a homologous genetic component in mammalian courtship and mating. This suggestion rests on one of two assumptions: Either courtship behavior can occur in only one way regardless of what the organisms are, or the most recent common hypothetical ancestor of *Drosophila* and Mammalia had courtship and the same mechanism of determining courtship. There is insufficient evidence to support the former, and the last common ancestor of *Drosophila* and Mammalia was likely a marine invertebrate with external fertilization without courtship behavior (*2*). This hypothetical ancestor would also have to be shown to have demonstrated sexual preference and mate choice.

Ryner *et al. (1)* show that male mutant *fru* flies are unable to differentiate between male and female flies, unlike wild-type males. This observation does not support their interpretation (*1*, p. 1086) that

> sexual orientation in flies is controlled by the same hierarchy of genes that controls all other aspects of sex.

The Poetry Corner

Two readers, inspired by exciting developments in the biological and physical sciences (Random Samples, 28 Feb., p. 1271; L. Spruch, "Long-range (Casimir) interactions," 7 June 1996, p. 1452), *offer the following verse based on William Blake's "The Lamb" and Wallace Stevens' "The Snow Man," respectively.*

"For Dolly"
(with apologies to William Blake)

Little lamb, who made thee?
Dost thou know who made thee?
Gave thee life and bid thee feed,
By the stream and o'er the mead;

I know who made me,
I know who made me,
She is called by my name,
For she is me and I the same.
We are one but she is two,
I a lamb and she a ewe.

She is meek and I am mild;
She became a little child.
I a child and she a lamb,
Go forth together to rule the land.

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"The Nothing That Is"
(with apologies to Wallace Stevens)

Max and Werner once opined
That zero had to be defined
As slightly more than naught,
A point a little fraught
With just a modicum of heat
To make the vacuum beat
Like tireless jungle drums,
A telegraph that hums
With messages in empty space
Carried by photons that race
About but aren't really there
(They're virtual, I swear),
Yet can exert a force
A zillionth of a horse,
Which can be measured I expect,
It's called the Casimir effect,
He's the one who was the wiz
Who measured the nothing that is.

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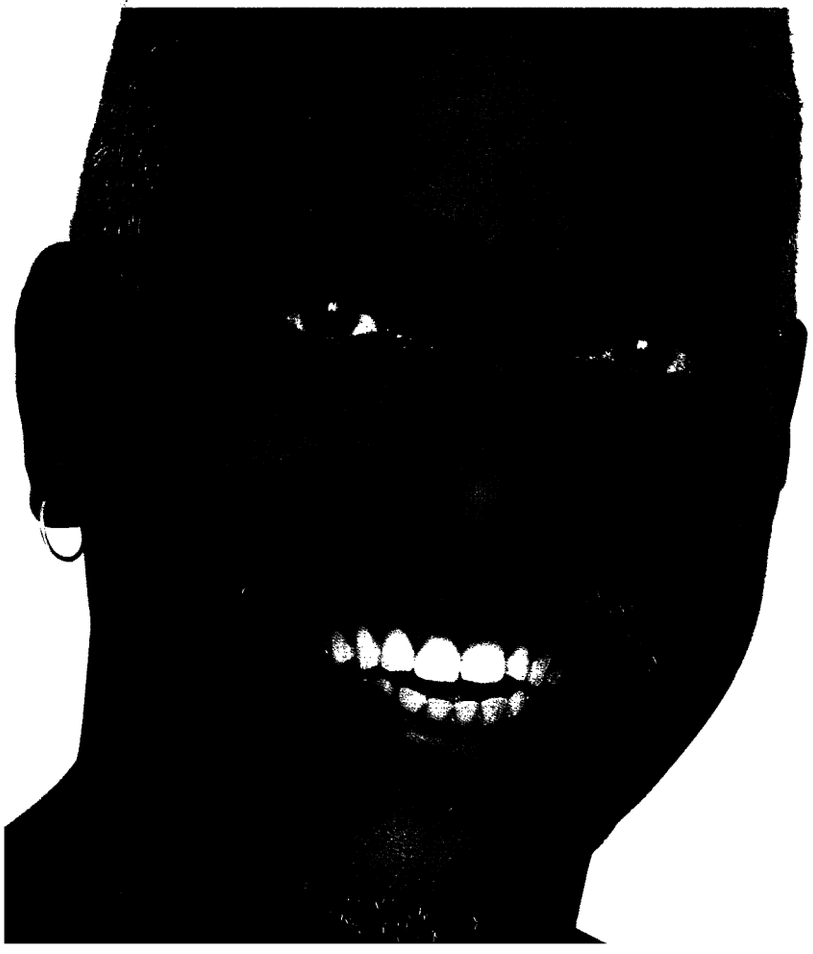
The data are consistent with, but do not demonstrate, a preference for *fru* mutant males to court other males. In fact, it is commonly observed that wild-type male flies will initiate courtship behavior with both males and females and desist if the courtship object does not respond positively. The mutant *fru* data cannot be a basis for inferring that *fru* influences choice per se rather than presence of preference or the inability to perceive rejection.

Alteration of the ability to choose also does not necessitate choice as bimodal in *Drosophila*, and to conclude that it is bimodal in human beings is premature. Many social scientists and behaviorists suggest that sexual preference in humans is best understood as culturally and historically contingent, rather than as a discrete, biological phenomenon. Sexual behavior is difficult to measure because of the unreliability of personal accounts, as well as other methodological problems (3).

It is possible that a human gene with extensive sequence similarity to *Drosophila fru* will be found. It may also have similar molecular functions and even be alternatively spliced to result in sex-specific products. But, in light of the phylogenetic relationship of *Drosophila* and *Homo sapiens*, it is unlikely that such a gene will be a gene for mating preference or mating behavior.



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"Not being a protein chemist, I just want to clone the gene, express it, isolate the protein and move on," says Malcolm Zellars, who's working on his post-doc at Tufts University Medical School in Boston, Massachusetts, USA.

We do not wish to detract from the empiricism of the molecular biology and genetics of the *fru* study, but we suggest that extensions of such work on insects to human beings or any other organisms should be made in a proper evolutionary hypothesis-testing framework.

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Moore's Law

The Research News article "Can chip devices keep shrinking?" by Robert F. Service (13 Dec., p. 1834) represents Moore's Law as a doubling in the number of transistors on computer chips every 18 months. In the graphic by VLSI Research Inc., with a caption heralding the validity of Moore's Law "for more than three decades," two exponential growth curves are drawn for DRAM memory and Intel microprocessor, respectively. As depicted, the doubling times for the two curves are slightly more than 2 years for processors and just under 2 years for memory.

In 1965, when Intel Corporation's founder Gordon Moore first commented on the growth of the microelectronics industry (*1*), he noted a doubling of the number of elements on a produced chip once every 12 months. For a decade, that meant a factor of approximately 1000. Today when Moore's Law is quoted, the time constant used is 18 months. Actually, it was 18 months starting in the mid-1970s, that is, approximately 10 years after the original observation. For a decade, then, the factor was approximately 100.

The 18-month time constant was no longer valid by the end of the 1980s. For example, the number of Intel-80x processors grew from about 29,000 to approximately 1,200,000 from 1980 to 1990—substantially less than a factor of 100. In the 1990s, the time constant has been closer to 2 years. That gives a decade growth factor of approximately 32.

As we approach the physical limits of the technology curve we have been riding so effectively, let alone the economic limits that are also at work, the rate of growth of transistors on chips will further decrease. The Semiconductor Industry Association Road Map (*2*) shows a growth of only about a factor of 10 for microprocessors in the decade between 1997 and 2007. That implies a Moore's Law time constant for doubling of about 3 years.

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2. *National Technology Roadmap for Semiconductors* (Semiconductor Industry Association, San Jose, CA, 1994), p. 11.