

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted by e-mail (science_letters@aaas.org), the Web (www.letter2science.org), or 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.

SARS, Wildlife, and Human Health

AFTER WORLDWIDE EFFORT, THE GLOBAL outbreaks of Severe Acute Respiratory Syndrome (SARS) (1) were contained in July. However, a recent case discovered in Singapore has generated additional concerns that SARS may resurface. SARS-related efforts have largely centered on crisis control. There is also a fundamental need to develop long-term strategies that can help prevent outbreaks of infectious diseases.

The SARS virus most likely originated from captive wildlife (2). The first case of SARS was found in China's Guangdong Province, where masked palm civets and



SARS has been detected in masked palm civets.

other wildlife are regularly eaten. Even if the SARS virus did not jump from wild animals to humans, we should pay serious attention to wildlife in general, as they have the potential to infect humans with other deadly diseases and affect human health through changing the ecosystems that humans depend on. Because China was the epicenter of SARS, the following preventive measures are proposed for the situation in China, but may also have important implications for many other parts of the world.

1) Strengthen legislation and law enforcement. The demand for wildlife cuisine in China is high, and illegal poaching and husbandry of wildlife are widespread. Many

wildlife species were banned from being eaten during the SARS outbreaks, but most of those bans have been lifted since mid-August. Rural China is the major supplier of illegally poached wildlife to cities. Severe punishment is necessary to reduce supply and demand. Raids against illegal wildlife activities should be sustained and consistent. Licenses already issued to establishments allowing them to serve wildlife cuisine should be reevaluated and revoked if necessary.

China has issued several laws and policies for the protection of rare and threatened wildlife (3, 4), but enforcement is largely absent. In addition to rare and endangered species, other species posing health threats should be exempted from hunting, husbandry, trading, and consumption. A separate budget should be appropriated to effectively implement wildlife laws and policies.

2) Change attitudes toward wildlife. After civets were reported to be the likely source of the SARS virus (2), they immediately became the top public enemy in China. Many animals perceived as "harmful" are actually beneficial to human health. Unbalancing an ecosystem by removing

"harmful" animals can create unexpected problems. For example, after the entire country was mobilized to kill the "devil" sparrows (which could feed on grain besides insect pests), many insect populations exploded due to the loss of their predators (5) and large amounts of pesticides had to be applied, thus jeopardizing human health. The public should be made fully aware of the interrelationships between humans and wildlife.

3) Enhance wildlife research and training. China has a high number of wildlife species (6). However, little is known about the vast majority of them.

Among the 1472 universities and colleges in China (7), very few offer wildlife programs. This is in sharp contrast to many countries with fewer wildlife species but more wildlife professionals. For example, in the United States, almost every state has at least one university with a wildlife department or program.

Understanding the relationship of wildlife to human health requires a systems approach. Establishing a comprehensive Web-based wildlife database will help to determine pathogen sources easily and quickly in case of an infectious disease outbreak. Interdisciplinary research at multiple organizational levels (from molecular to ecosystem) and across the boundaries

of health and wildlife sciences can help answer complicated questions regarding infectious diseases.

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References and Notes

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2. K. Bradsher, L. K. Altman, "Strain of SARS is Found in 3 Animal Species in Asia," *N. Y. Times*, 24 May 2003.
3. National People's Congress of China (see www.forestry.gov.cn/DB/zcfg/index.asp; in Chinese).
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5. J. Becker, *Hungry Ghosts: Mao's Secret Famine* (Henry Holt, New York, 1996).
6. J. Liu *et al.*, *Science* **300**, 1240 (2003).
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8. Funding was provided by the National Science Foundation and National Institute of Child Health and Human Development.

How Would a Cable Science Network Work?

I FOUND THE PROPOSAL FOR A CABLE SCIENCE Network (CSN) made by Terrence J. Sejnowski in his Essay "Tap into science 24-7" (1 Aug., p. 601) provocative and appealing.

However, there is a substantial practical obstacle to this plan that becomes apparent when the analogy to C-SPAN is examined a bit more closely. C-SPAN's goal—to broadcast official governmental proceedings and statements—is an easy one to achieve from a programming perspective. C-SPAN does not need to exercise editorial discretion in choosing to air Congressional debates, speeches by governmental officials, and governmental administrative proceedings, because there is absolutely no question that the officials and legislators talking are indeed who they purport to be and the proceedings what they appear to be.

The situation would be quite different for CSN, whose stated goal is to provide unbiased, expert information, commentary, and debate concerning scientific issues relevant to public policy. Achieving this goal will be quite difficult, and extensive editorial discretion is required to answer such questions as "who is a relevant expert?," "what positions are unbiased?," and "what topics should be addressed?" The answers to these questions are not self-evident and cannot be obtained through application of any objective or mechanical test.

For example, would a scientist with a

Ph.D. in a relevant field, but who works under the auspices of a “lobbying” organization, be considered worthy of appearing on CSN? What reasoned standard would exclude this “expert,” but not a scientist with similar academic credentials who works at a university? And what about scientists who work at “unbiased” institutions, but who receive funding from “biased” sources?

I think that a CSN could be a valuable addition to the sources of scientific information currently available to the public, to legislators, and to administrative officials, but it is going to be very difficult—if not impossible—to distinguish “biased” from “unbiased” sources of information on the brief time scale required for 24-7 television programming.

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Response

NITABACH RAISES THE IMPORTANT ISSUE OF how to ensure that CSN presents a fair and unbiased view of scientific issues. One cornerstone of avoiding bias on CSN would be a scientific advisory board with stellar credentials (already being formed) that could provide advice about programming.

Scientific societies would also be a source of advice and support. Many scientific societies have media outreach programs that include taped lectures, interviews, and press conferences, and CSN could serve as a central nexus for all of these efforts, disseminating them to a wider audience. It will be essential to present a balanced view of both sides of controversial issues. We see this more as an opportunity to engage the audience with a lively debate.

Nitabach is not quite correct when he says that “C-SPAN’s goal—to broadcast official governmental proceedings and statements—is an easy one to achieve from a programming perspective.” C-SPAN’s mission statement (*1*) talks of providing access to governmental proceedings “with a balanced presentation of points of view”; of providing a forum for people who influence public policy “without filtering or otherwise distorting their points of view”; of providing access, through call-in programs, to decision-makers; and of employing “production values that accurately convey the business of government rather than distract from it.” Substitute “science” for “government,” and you have CSN.

Broadcasting governmental proceedings is only a part of C-SPAN’s schedule. The network also carries a broad spectrum of nongovern-

mental meetings, book readings, history, and advocacy lectures (clearly identified). C-SPAN strives to be an honest broker in allocating air-time. CSN would do the same.

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1. S. Frantzich, J. J. Sullivan, *The C-SPAN Revolution* (Univ. of Oklahoma Press, Tulsa, OK, 1996), p. 2.

A Suggestion for the Multiple Author Issue

DONALD KENNEDY’S SUPERB AND LONG-overdue Editorial “Multiple authors, multiple problems” (8 Aug., p. 733) raises the increasing problem of too many authors on scientific papers. This is clearly a case of dilution of importance—how is one to appreciate the importance of an author of a paper with more than 50 coauthors?

I would like to propose a possible solution that should clarify this issue while allowing recognition of important technical contribu-

tions. Only those individuals who were intimately involved in (i) experimental design, (ii) data acquisition, (iii) data analysis and interpretation, and (iv) writing and editing should be listed as authors. Technical contributions (e.g., a specific measurement) could be acknowledged as a separate list identifying the specifics. This could be done in a small font so that space requirements are minimized. Those listed for technical contributions could cite this in their CV under a separate category, thus getting "credit" for promotion, tenure, and grant applications.

It is important to note that in addition to giving credit where credit is due, this would protect coauthors from any guilt by association if scientific misconduct was discovered in parts of the publication not related to a specific contribution.

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A Heterozygote Advantage

THE EVIDENCE FOR BALANCING SELECTION AT the prion protein gene (*PRNP*) due to kuru in

the Fore group of the Papua New Guinea Highlands is compelling ("Balancing selection at the prion protein gene consistent with prehistoric kurulike epidemics," S. Mead *et al.*, Reports, 25 April, p. 640). That is, their analysis of worldwide haplotype diversity and sequence analysis demonstrates that the major alleles at the *PRNP* locus are maintained by selective factors favoring the maintenance of heterozygotes. In addition, the extent of the "heterozygote advantage" in the Fore in terms of their viability in the present generation can be calculated from Mead *et al.*'s genotypic data (provided by S. Mead). In 30 women over the age of 50 that had a history of multiple exposures to mortuary feasts, 4 were homozygous *MM*, 23 were heterozygous *MV*, and 3 were homozygous *VV* (*M* and *V* indicate methionine and valine at position 129), a large deviation from Hardy-Weinberg proportions. In another sample of unexposed Fore individuals, the genotypes were in Hardy-Weinberg proportions (31 *MM*, 72 *MV*, and 37 *VV*). Using these two groups as the frequencies of the genotypes after (indicated by primes below) and before selection, the viability of genotype *MM* relative to genotype *MV* can be estimated (*I*) as $V_{MM} = (P'_{MM}P_{MV})/(P'_{MV}P_{MM}) = (0.133)(0.514)/(0.767)(0.221) = 0.403$, and

the viability of genotype *VV* relative to genotype *MV* can be estimated as $V_{VV} = (P'_{VV}P_{MV})/(P'_{MV}P_{VV}) = (0.100)(0.514)/(0.767)(0.264) = 0.254$. In other words, the relative viabilities of the genotypes *MM*, *MV*, and *VV* are 0.403, 1.0, and 0.254, respectively, a very strong heterozygote advantage in the face of kuru.

Because adult males participated little at feasts, this heterozygote advantage acts primarily in females. Therefore, the average selection coefficient ($s = 1 - V$) against *MM* homozygotes is approximately $\bar{s}_{MM} = (1 - V_{MM})/2 = 0.299$, and against *VV* homozygotes, it is $\bar{s}_{VV} = (1 - V_{VV})/2 = 0.373$. The expected equilibrium frequency of the *V* allele is therefore $q_V = \bar{s}_{MM}/(\bar{s}_{MM} + \bar{s}_{VV}) = 0.45$, not very different from the observed frequency of 0.55. Although it is not known whether selection has been this strong in previous generations, the strength of balancing selection in this one generation appears to be the strongest yet documented in any human population.

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Reference

1. P. W. Hedrick, *Genetics of Populations* (Jones & Bartlett, Boston, ed. 2, 2000).

CORRECTIONS AND CLARIFICATIONS

News of the Week: "Terrorism futures' could have a future, experts say" by C. Seife (8 Aug., p. 749). The 18th-century economist Adam Smith was Scottish, not English.

TECHNICAL COMMENT ABSTRACTS

COMMENT ON "Rapid Evolution of Egg Size in Captive Salmon" (I)

Ian A. Fleming, Sigurd Einum, Bror Jonsson, Nina Jonsson

Heath *et al.* (Reports, 14 March 2003, p. 1738) quantified an apparent rapid evolution of small eggs in captive-bred salmon and implicated this in the reduced success of hatchery programs in supplementing natural populations. We assert that the role of phenotypic plasticity was markedly underestimated and may be more important in limiting the success of conservation by captive breeding.

Full text at
www.sciencemag.org/cgi/content/full/302/5642/59b

RESPONSE TO COMMENT ON "Rapid Evolution of Egg Size in Captive Salmon" (I)

Charles W. Fox and Daniel D. Heath

Plasticity in salmon egg size is unlikely to have contributed to the observed consistent decline because the hatchery environment was uniform during the original study period. However, the synergistic effects of plasticity and genetic change are critical to the outcome of captive-rearing strategies and should be studied further.

Full text at
www.sciencemag.org/cgi/content/full/302/5642/59c

COMMENT ON "Rapid Evolution of Egg Size in Captive Salmon" (II)

Terry D. Beacham

Contrary to Heath *et al.* (Reports, 14 March 2003, p. 1738), enhancement of captive salmon populations has not resulted in the evolution of smaller egg size. Egg size trends observed in the YIAL broodstock are unique, and generalizations about reduced survival due to egg size should not be extrapolated to other enhanced or cultured salmon populations in British Columbia.

Full text at
www.sciencemag.org/cgi/content/full/302/5642/59d

RESPONSE TO COMMENT ON "Rapid Evolution of Egg Size in Captive Salmon" (II)

Daniel D. Heath, Jordi Moya-Laraño, Charles W. Fox

Our reanalysis of the Beacham data shows that egg size has declined in salmon populations receiving aggressive supplementation, regardless of hypothesized marine regime shifts. These additional data emphasize the need to consider the inadvertent effects of rearing strategies on supplemented populations by agencies charged with animal conservation and management.

Full text at
www.sciencemag.org/cgi/content/full/302/5642/59e



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