Retraction

IN OUR REPORT, "EVIDENCE FOR COHERENT proton tunneling in a hydrogen bond network" (*1*), we presented nuclear magnetic resonance relaxometry results for calix(4)arene in the solid state. A peak at 35 MHz in the magnetic field dependence of the proton spin-lattice relaxation rate was interpreted as a manifestation of coherent proton tunneling in a cyclic array of four hydrogen bonds. In the course of further investigations, it has become apparent that the sample supplied to us contained residues of dichloromethane. This brings into question the assignment of the spectral feature because we cannot now rule out the possibility that it derives from quadrupole resonance transitions associated with chlorine nuclei. Thus, we must retract our report. Conclusions regarding the incoherent tunneling of protons in this material are not in question.

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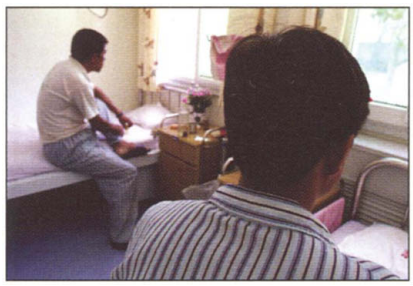
HIV Among Drug Users in China

J. KAUFMAN AND J. JING PROVIDE AN EXCELlent overview of the potentially catastrophic epidemic of HIV/AIDS in China in their Policy Forum "China and AIDS—the time to act is now" (28 June, p. 2339). They note that the Chinese epidemic began among injecting drug users (IDUs) and call for education on safer injection and clean needle programs to reduce HIV transmission among IDUs. HIV among IDUs is clearly a major problem in China: (i) 68.7% of all reported cases of HIV are among IDUs; (ii) HIV infection has spread along drug distribution routes and has occurred among IDUs in all provinces; (iii) extremely rapid HIV transmission has occurred in some populations of IDUs, with incidence rates of over 30% per year; and (iv) transmission from IDUs to noninjecting sexual partners is becoming a substantial public health problem (*1*).

Although education and clean needle programs are urgently needed, such programs alone are unlikely to address the problem adequately. Despite very punitive laws, the number of illicit drug users has been increasing dramatically. There are currently 860,000 officially registered drug users, and the number of registered drug users has increased by 53.3% over the last year (*1*). The actual number of drug users is likely much greater.



Two unidentified AIDS patients in a hospital in Beijing.

CREDIT: AP PHOTO/GREG BAKER

Large-scale programs to reduce the start of illicit drug use (*2*), to reduce transitions from use of noninjected drugs to use of injected drugs (*3*), and to provide effective long-term treatment (such as methadone maintenance) for drug addiction are all needed.

Programs to increase safer injection and programs to reduce drug use should be considered complementary and not competing methods to reduce HIV transmission among IDUs. Although implementing large-scale programs to provide safer injection and to reduce illicit drug use may be more expensive initially, such comprehensive programming is likely to be both more effective and more sustainable over the long term.

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Response

FENG AND DES JARLAIS RAISE IMPORTANT points, and we fully agree with their opinions. Policies and programs to contain the spread of HIV among IDUs require much more than just making clean needles available. We noted in our Policy Forum the crucial importance of formulating laws and policies to support best practice initiatives and the necessity of multisectoral responses, including collaboration between health and public security departments regarding programs for drug users and sex workers. We pointed out that seven provinces have increasing incidence of HIV among IDUs, that there is intravenous drug use by many sex workers, and that these provinces need to act urgently to avoid the high rates of infection found in Yunnan and several other western provinces. The brevity of the Policy Forum did not allow for full discussion of all issues. With more space, we would have offered a more comprehensive proposal for programs to prevent HIV among IDUs along the lines suggested, as well as further suggestions for programs for other high-risk groups and the general population, all based on proven international best practices.

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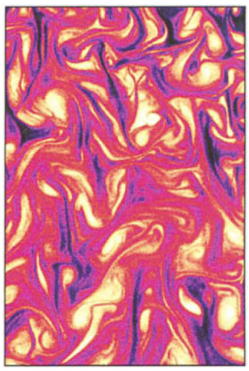
Trying to Make Sense of Disorder

IN HIS ARTICLE "A FRESH TAKE ON DISORDER, or disorderly science?" (News Focus, 23 Aug., p. 1268), Adrian Cho reports on a lively controversy presently raging over what is called "Tsallis entropy," which has been wrongly suposed to be the physical entropy of the natural world, superseding the universal and general Clausius-Boltzmann statistical-thermodynamic entropy. The new definition of entropy developed by Constantino Tsallis is a very useful—and sophisticated—tool for generating a so-called nonextensive thermostatistics, which can be used for adjusting and analyzing experimental data in certain partic-

ular situations, but it is not at all a formidable breakthrough in fundamental physics, as assumed by some. Rather, Tsallis's valuable contribution has been to bring the ideas of mid-20th-century statisticians into physics.

In statistical mechanics, Tsallis entropy takes a convenient form, appropriated for physics, of the entropy used in mathematical statistics and information theory, namely, Havrda-Charvat structural entropy (*1*), one of infinitely many that can be introduced [e.g., (*2*)]. These entropies produce what can be called unconventional statistics, which are useful for fitting purposes (they depend on adjustable parameters). They can be used in the most general and universal entropy [Kullback-Leibler entropy (*3*), whose physical counterpart is the Boltzmann-Gibbs-Shannon entropy] when a researcher is unable to satisfy the principle of sufficiency in statistics, as stated by Fischer in 1922 (*3*, *4*). This means that the reseacher does not have access to all information on the characteristics of the system relevant for the problem at hand.



Physicists look to entropies to get a handle on topics such as turbulence.

The choice of the unconventional statistics to be used depends on each particular experimental/theoretical situation. For example, Renyi statistics appears to be appropriate for dealing with the so-called fractal systems (*5*, *6*). The utility of such unconventional entropies is that they provide a way to generate probability distributions, in the context of statistical physics based on information theory (*7*). In that sense, they are what can be called statistical entropies, and it is utterly wrong to identify Havrda-Charvat-Tsallis "entropy" with the physical entropy of systems in nature. There is only one situation in which informational entropies can be related to the classical Clausius-Boltzmann entropy of thermodynamics, namely, Kullback-Leibler-Shannon statistical entropy in the case of strict equilibrium (*5*, *8*). Tsallis statistics does not supersede Boltzmann-Gibbs statistics; it is one of infinitely many that can be used to "patch" the inconvenience, noted above, that arises when one is unable to satisfy Fischer's principle of sufficiency in Boltzmann-Gibbs statistics.

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ADRIAN CHO'S ARTICLE ON TSALLIS ENTROPY ("A fresh take on disorder, or disorderly science," News Focus, 23 Aug., p. 1268) emphasizes the importance of nonextensive energies when analyzing complex systems. To complement his picture, I would like to draw attention to an alternative way of treating nonextensive energies, developed by Terrell Hill about 40 years ago (*1*–*3*). Hill's approach is based on the fundamental foundation of Gibbs' ensembles and does not involve modifying the definition of entropy. To my knowledge, Hill's work remains the only comprehensive treatment of finite-size effects in thermostatistics.

The heart of Hill's approach, now known as "nanothermodynamics," can be understood by tracing the development of the first law of thermodynamics (*4*). In 1850, Clausius made his clear statement that the change in internal energy of a system is equal to the added heat minus the work done. In 1876, Gibbs extended the first law by including the chemical potential, μ. μ comes from the change in energy when a single particle (e.g., electron, atom, or molecule) is added to a system of particles. Use of μ allows the formal treatment of equilibria between different substances or between different phases. In 1962, Hill extended the first law by including a subdivision potential, $\mathcal{E}$. $\mathcal{E}$ comes from the change in energy when a single small system is added to an ensemble of small systems. Use of $\mathcal{E}$ allows the formal treatment of finite systems that have nonextensive energies, such as clusters with nonlinear interactions or surface terms.

Some experts have said that the success of Tsallis entropy may come from mathematical flexibility in the empirical parameter q. Hill's nanothermodynamics has additional flexibility with no new parameters. In the usual thermodynamic limit, only two intensive variables can be independent. For example, the grand canonical ensemble has μ and T independent, but the volume is fixed by the size of the sample. However, nanothermodynamics has a well-defined "generalized ensemble" where the system is described by three independent variables, e.g., μ, T, and pressure for molecules, or μ, T, and field for magnets. Furthermore, the generalized ensembles allow unrestricted thermal fluctuations, which provide an explanation for the measured response from several complex systems, including glass-forming liquids (*5*) and ferromagnetic materials (*6*).

It is legendary how Gibbs' work remained relatively unknown for 15 to 20 years, until it was translated into German and used by the pioneers in physical chemistry. Even now, after 40 years, Hill's work is still relatively unknown, possibly because, after completing his article and books on the subject (*1*, *2*), he switched his main interest to molecular biology and did not have the time or inclination to promote his many contributions to fundamental thermostatistics.

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CORRECTIONS AND CLARIFICATIONS

REPORTS: "Gene expression during the life cycle of *Drosophila melanogaster*" by M. N. Arbeitman *et al.* (27 Sept., p. 2270). Eileen E. M. Furlong should have been listed as co-first author. Her affilations were also listed incorrectly. She is at the Department of Developmental Biology and Department of Genetics, Stanford University, Stanford, CA 94305, USA, and the Developmental Biology Program, European Molecular Biology Laboratory, 69117 Heidelberg, Germany.

SPECIAL ISSUE ON MAPPING CELLULAR SIGNALING: VIEWPOINTS: "Phosphorelay and transcription control in cytokinin signal transduction" by J. Sheen (31 May, p. 1650). In Fig. 1, all labels reading "APH1/2" should instead read "AHP1/2." Also, the volume number in reference (*18*) is incorrect; it should be 129.

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.

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