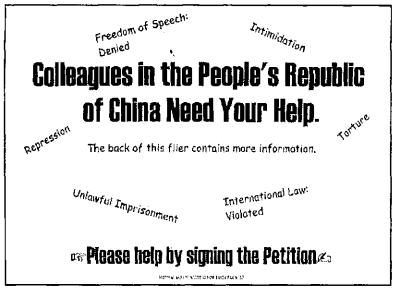
A physicist says it is not clear to him that the low registration for a human rights workshop reflects a lack of interest or concern for human rights among the physics community. A large group of ecologists propose that "students in ecology [should] devote part of their professional lives to stemming the tide of environmental degradation, and the associated losses of biodiversity...and to teaching the public about the importance of those losses." The functions of the cerebellum are elaborated. The origin of homochirality of biological molecules is explored. And suggestions for training graduate students in biology are offered.

Human Rights Workshop

I applaud James Glanz's in-depth study of the shifting landscape of human rights activism in the physics community ("Human rights fades as a cause for scientists," News Focus, 9 Oct., p. 216), but I take issue with his assessments concerning the implications of a failed human rights workshop scheduled to be held at the



Human rights petition displayed at spring 1998 APS meeting

March 1998 meeting of the American Physical Society (APS) in Los Angeles.

The APS erred in scheduling the workshop in competition with scientific and technical sessions. It should come as no surprise that even human rights activists come to scientific meetings to discuss and examine scientific issues. Thus, the inappropriate scheduling made it difficult for people to commit to the workshop.

In addition, it is highly unusual for the APS to ask participants to pre-register for policy forums, and it was our nervousness about asking distinguished invited speakers to risk facing a meager audience that prompted the cancellation. It is not clear to me that the low registration reflects a lack of interest or concern for human rights within the physics community.

Perhaps a better measure of this interest is the number of signers (1970) of a petition expressing strong support of the scientific community for our repressed and harassed colleagues in the People's Republic of China. And it is also noteworthy that the APS Committee on International Freedom of Scientists has no paucity of volunteers clamoring to serve. In addition, as many as 200 volunteers serve on the "small committees" that have organized letter-writing campaigns on behalf of imprisoned colleagues and dissidents around the world.

I regret that I did not make these points more forcefully in my discussions with Glanz. Nonetheless, he has provided a great service in his balanced and penetrating report of the stresses within our community—especially among our Chinese colleagues.

Irving A. Lerch
Director of International Affairs, American Physical Society, College Park, MD 20740–3844, USA. E-mail: lerch@aps.org, and Co-Chair, Committee on Scientific Freedom and Responsibility, AAAS

Ecological Science and the Human Predicament

When we began our careers, good science consisted of two basic activities: (i) doing first-rate research and (ii) publishing it in the technical literature for the benefit of scientific colleagues. We firmly believe that a third activity must now be added by all scientists: (iii) informing the general public (and, especially, taxpayers) of the relevance and importance of our work. We are convinced that this applies to even the most esoteric of "basic" research, because understanding how the world works is fundamental to both satisfying natural human curiosity and solving the human predicament.

As ecologists, we further contend that, because of the central role ecology must play in resolving the predicament, the structure of rewards in our discipline must be changed. Now *all* field research is done in systems altered by *Homo sapiens*, and the degree of disturbance is increasing rapidly virtually everywhere. Sadly, in our countries of origin, even areas nominally designated to preserve biodiversity are to a large extent inadequately inventoried, monitored, and protected. There are many tasks in support of just those areas that can and should be carried out or aided by academic ecologists, and career incentives need to be developed to achieve this. Furthermore, incentives need to be found to promote interdisciplinary involvement of young ecologists, because so many of society's greatest challenges lie at the interface of ecology and the social sciences.

In our view, it is necessary to train students in ecology who will be ready and willing to devote part of their professional lives to stemming the tide of environmental degradation and the associated losses of biodiversity and its ecological services, and to teaching the public about the importance of those losses. We believe that such efforts should be rewarded as part of the process by which ecologists are considered for academic posts, granted tenure in universities, elected to membership in learned societies, and so on. Ecology is a discipline with a time limit, because much of what we study, upon which society is dependent, is fast disappearing. Ecologists have a responsibility to humanity, one that we are not yet discharging adequately. It is incumbent on senior ecologists to take the lead in pressing for the needed transformation—and we pledge ourselves to that task.

Fakhri Bazzaz, Harvard University, Cambridge, MA, USA; **Gerardo Ceballos,** Institute of Ecology, National University of Mexico, Ciudad Universitaria, Mexico; **Margaret Davis,** Department of Ecology, Evolution and Behavior, University of Minnesota, Minneapolis, MN, USA; **Rodolfo Dirzo,** Institute of Ecology, National University of Mexico; **Paul R. Ehrlich,** Department of Biological Sciences, Stanford University, Stanford, CA, USA; **Thomas Eisner,** Division of Biology, Cornell University, Ithaca, NY, USA; **Simon Levin,** Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ, USA; **John H. Lawton,** Director, Centre for Population Biology, National Environment Research Council, Imperial College, Silwood Park, Ascot, Berkshire, UK; **Jane Lubchenco,** Department of Zoology, Oregon State University, Corvallis, OR, USA; **Pamela A. Matson,** Department of Geological and Environmental Sciences, Stanford University; **Harold A. Mooney,** Department of Biological Sciences, Stanford University, E-mail: hmooney@jasper.stanford.edu; **Peter H. Raven,** Director, Missouri Botanical Garden, St. Louis, MO, USA; **Joan E. Roughgarden,** Department of Biological Sciences, Stanford University; **Jose Sarukhan,** Institute of Ecology, National University of Mexico, E-mail:sarukhan@servidor.unam.mx; **G. David Tilman,** Department of Ecology, University of Minnesota; **Peter Vitousek,** Department of Biological Sciences, Stanford University; **Brian Walker,** Division of Wildlife and Ecology, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra, Australia; **Diana H. Wall,** Director, Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO, USA; **Edward O. Wilson,** Museum of Comparative Zoology, Harvard University; **George M. Woodwell,** Director, Woods Hole Research Center, Woods Hole, MA, USA

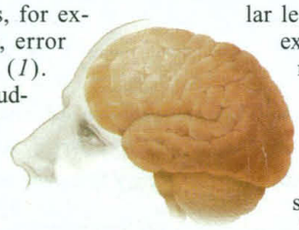
The Cerebellum: So Much More

In her article "The cerebellum: The brain's engine of agility" (News Focus, 11 Sept., p. 1588), Ingrid Wickelgren reviews evidence of cerebellar involvement in motor performance. Although she mentions mo-

tor learning, Wickelgren does not touch on recent findings about the cerebellum's participation in nonmotor functions.

Evidence for a much broader cognitive role of the cerebellum comes from numerous sources. Human patients with cerebellar lesion have demonstrated nonmotor deficits in various domains, for example, in problem-solving, error detection, and language (*1*). Functional neuroimaging studies have shown cerebellar activation for many tasks that do not include motor components. For example, as described in a *Science* report by Gao *et al.* (*2*) and an accompanying News article ("The cerebellum: Movement coordinator or much more?" 26 Apr. 1996, p. 482) by Marcia Barinaga, activations in deep cerebellar nuclei and in the cerebellar hemispheres have been found related to tactile stimulation and discrimination and to proprioceptive feedback (*3*) in the absence of motor performance. The cerebellum also activates consistently during various types of language performance, even when motor speech components are subtracted (*4*). Cerebellar involvement has been further demonstrated for problem-solving (*5*) and working memory (*6*) tasks. While for technical reasons many early imaging studies did not cover the cerebellum, more recent studies suggest that the cerebellum is one of the most consistent loci of activation across a great variety of nomnotor cognitive tasks (*7*). All these findings indicate a general cognitive and sensory role (in addition to movement) for the cerebellum.

Our group demonstrated, in a 1997 *Science* report (*8*), a dissociation between movement-related and nonmotor attentional activations within the cerebellum. We showed that motor activation was located in the anterior paleocerebellum, whereas attention-related nonmotor activations were found more laterally in the neocerebellum. Thus, while our knowledge of its regional functional organization is incomplete, the cerebellum is not a functionally homogeneous structure. Neuroanatomical studies (*9*) underline the extensive and region-specific connectivity between the cerebellum and the cerebral cortex, especially in regions such as the dorsolateral prefrontal cortex (*10*), known to be crucially involved in working memory, problem-solving, and executive functions. Because synaptic survival depends on afferent-driven activation, it is highly unlikely that such massive connections to cerebral association cortices are gratuitous and nonfunctional. Instead, they further support the cerebellar role in diverse nonmotor cognitive and sensory functions across domains.



The cerebellum, which may be involved in motor learning

Trying to account for the cerebellar role in motor and nonmotor domains, we have described (*11*) the fundamental cerebellar functions as prediction and preparation. These functions are based on cerebellar learning of sequences, both of exogenous (for example, sensory) and endogenous neural activity (for example, through afferents from cerebral cortex). After learning to identify initial components of a sequence, the cerebellum can "predict" subsequent components of the sequence and can thus "prepare" the physiological state in remote systems that are required for a given perceptuomotor or cognitive process (for example, by lowering neural response thresholds in a functionally appropriate neocortical region). Feedback from such remote systems leads to continued fine-tuning of cerebellar prediction and preparation in response to changing internal and external conditions.

Ralph-Axel Müller
Department of Cognitive Science, University of California, San Diego, La Jolla, CA 92093, USA. E-mail: amueller@cogsci.ucsd.edu

Eric Courchesne
Department of Neuroscience, University of California, San Diego. E-mail: ecourchesne@ucsd.edu ecourchesne@ucsdedu

Greg Allen
Joint Doctoral Program in Clinical Psychology, San Diego State University/University of California, San Diego. E-mail: dallen@ucsd.edu

References

1. H. C. Leiner, A. L. Leiner, R. S. Dow, *Hum. Brain Map.* **2**, 244 (1995); J. D. Schmahmann, Ed., *The Cerebellum and Cognition* (Academic Press, San Diego, CA, 1997).
2. J.-H. Gao *et al.*, *Science* **272**, 545 (1996).
3. M. Jueptner and C. Weiller, *Brain* **121**, 1437 (1998).
4. J. A. Fiez and M. E. Raichle, in *The Cerebellum and Cognition*, J. D. Schmahmann, Ed. (Academic Press, San Diego, CA, 1997), pp. 233–254.
5. S.-G. Kim, K. Uğurbil, P. L. Strick, *Science* **265**, 949 (1994).
6. J. E. Desmond, J. D. Gabrieli, A. D. Wagner, B. L. Ginier, G. H. Glover, *J. Neurosci.* **17**, 9675 (1997).
7. G. L. Shulman *et al.*, *J. Cognit. Neurosci.* **9**, 624 (1997).
8. G. Allen, R. B. Buxton, E. C. Wong, E. Courchesne, *Science* **275**, 1940 (1997).
9. J. D. Schmahmann, *Hum. Brain Map.* **4**, 174 (1996).
10. F. A. Middleton and P. L. Strick, *Science* **266**, 458 (1994).
11. E. Courchesne and G. Allen, *Learn. Mem.* **4**, 1 (1997).

Cosmic Chirality

Experiments designed to discriminate between the left- and right-handed helical conformations of a synthetic variation of the nylons led to the discovery that attachment of a random distribution of nearly an equal population of mirror isomers as pendant groups to the helix led to a complete excess of the helical sense preferred by the

ILLUSTRATION: K. SUTLIFF