Scientific Misconduct Investigations: Who Should Conduct Them?

David P. Hamilton's discussion of the Office of Scientific Integrity (OSI) (News & Comment, 6 Sept., p. 1084) implies that scientists have the dubious prospect of having either OSI or the Office of the Inspector General conduct investigations of scientific misconduct.

I suggest that the investigative function of OSI be lodged within a freestanding, nonprofit foundation that could be called on by universities to perform objective, credible, timely, professional, due process inquiries. A roster of available external experts would conduct such investigations; the results would be reported to the university and, if federal funds were involved, would be available to the government. The government would then be out of the misconduct investigatory business, which seems a positive goal. It could maintain its role with regard to sanctions if it appeared that institutionally applied sanctions were insufficient.

Resolution of this issue requires social action so that Congress recognizes it as a useful advance. Conceivably, such a foundation could be monitored by the National Academy of Sciences. Many scientific organizations have not yet recognized that public discussion is necessary with respect to just what the nature of "scientific misconduct is," just what the appropriate means of investigation are, and just what the appropriate sanctions are. If we don't do it, it will be done for us or to us.

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Phylogeny and Diversity

Terry L. Erwin's Perspective (16 Aug., p. 750) is a welcome call for the involvement of phylogenetic systematics in biodiversity studies, but I question whether "phylogenetic theory" can make the sort of predictions that he suggests. If we have some reason to expect that monotypic lineages are all living fossils, evolutionary dead ends, or other unregenerate life forms, then perhaps we should place a higher priority on saving more speciose groups. There is, however, no strictly phylogenetic theory that makes this prediction. Extinction probabilities, if they can be estimated at all, appear to be functions of population size, geographic range, and similar parameters, but not of phylogenetic branching order. Furthermore, there is no aspect of evolutionary theory that allows us to predict which lineages will speciate in the future, much less where the next adaptive radiation will come from. These processes are contingent upon the circumstances of history.

Even if we cannot peer into the future, phylogeny still provides us with a way to establish the present value of species. The close relationship between taxonomic and genetic diversity is clearly expressed by a phylogenetic tree. If we consider that each species has diverged genetically from its relatives by an amount roughly proportional to the time since their common ancestor, branch lengths scaled to observed genetic divergence between species provide a quantitative measure of diversity within a clade. From this perspective, old, monotypic lineages often make large contributions to diversity and so would be accorded high priorities in conservation decisions.

Phylogenetic systematics in combination with conservation genetics thus provide a critical framework for understanding diversity. The imperative to preserve diversity argues strongly against neglecting platypuses, tuataras, and other less "charismatic" old lineages. We are, in fact, being forced to decide between preserving branches and twigs on the tree of life. It is crucial that we know the difference.

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Extinction "Hot Spots"

Contrary to what Charles Mann asserts in his article "Extinction: Are ecologists crying wolf?" (Research News, 16 Aug., p. 736), there is a good deal of specific documentation of the mass extinction impending. In two recent articles (*1*), I have analyzed a series of "hot spots," these being areas that (i) feature exceptional concentrations of plant species with unusually high endemism and (ii) face exceptional threat of habitat destruction. Fourteen of these areas are in tropical forests and include such localities as eastern Madagascar, western Ecuador, western Amazonia, Atlantic-coast Brazil, northwestern Borneo, and parts of the Philippines. Four other areas are Mediterranean-type zones. A good many of these areas have already lost 90% of their natural vegetation, a few as much as 97%. The area-by-area assessments are supported by several hundred references.

The analysis shows that the 18 hot spots contain 49,955 endemic plant species, or 20% of Earth's known plant species, in 0.5 percent of Earth's land surface. Plants are well documented; we can be sure we have identified and described all but a few thousand species. The situation is far less clear with respect to animal species, but according to local inventories of better known taxa (mammals and other vertebrates, butterflies, and certain other invertebrates), it seems that each endemic plant species in the areas listed is generally accompanied by at least 20, and perhaps as many as 50, endemic animal species. So in just these 18 hot spot areas, we face the prospect of an extinction spasm to surpass anything that has occurred since the late Cretaceous crash.

Were the hot spots analysis to be extended to other species-rich and acutely threatened areas, such as localities in woodlands and wetlands, the total of species facing imminent elimination would be all the greater.

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Toxic Waste Cleanup

In his editorial "Toxic chemicals and toxic laws" (30 Aug., p. 949), Daniel E. Koshland, Jr., cites a case where a program intended to help "minorities and the underprivileged in Detroit" might have to be canceled because of provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (or Superfund). In fact, it is hazardous waste, not Superfund itself, that threatens the health of lower-income communities in the United States. Current polluters—including factories, landfills, and incinerators—are located primarily in lower-income communities, as are most known toxic contamination sites. The Superfund statute's "polluter-pays" principle is the only hope these communities have that such health dangers will be eliminated.

Koshland asserts that a significant fraction of the money devoted to Superfund should be dedicated to projects such as the U.S. Environmental Protection Agency's voluntary "33-50" toxic waste reduction program. Without the threat of Superfund liability, manufacturers would have no interest in such voluntary programs. Because our laws and regulations governing hazardous chemicals have so many exclusions, exemptions, and outright loopholes, only the Superfund statute's threat—that polluters will have to clean up their own fiascoes—provides an incentive for manufacturers to explore safer, less polluting processes and to begin reducing their use of toxic chamicals.

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PCBs in the Environment

The editorial "Excessive fear of PCBs" by Philip H. Abelson (26 July, p. 361) argues that there is no justification for the regulation of all polychlorinated biphenyls (PCBs). He bases his argument on the results of experiments with a few highly chlorinated compounds. A working group of the International Agency for Research on Cancer (IARC) evaluated in 1987 the carcinogenicity data on PCBs (*1*) and concluded that there is sufficient evidence of carcinogenicity in animals and limited evidence of carcinogenicity in humans to say that PCBs are probably carcinogenic to humans (*2*).

We believe that it would be most useful to obtain sufficient experimental data to allow an evaluation of the carcinogenic risk of specific groups of PCBs: in the meantime, however, we think that a conservative approach in regulating PCBs, like the one chosen by the U.S. Environmental Protection Agency (EPA) and criticized by Abelson, is preferred. The experimental data on less chlorinated (42%) PCBs are insufficient to exclude a carcinogenic effect. In fact, Aroclor 1260 or similar formulations (about 60% chlorine) have shown a clear carcinogenic effect in rats in a number of independent studies (*3*); 42% chlorine formulations, on the other hand, have been tested in rats only in the study quoted by Abelson (*4*) and in a small, earlier study (*5*), which suggested an increase in hepatic nodular hyperplasia was found in an earlier study (*5*). Moreover, less chlorinated PCBs contain, at different concentrations, many of the isomers present in mixtures with higher chlorine content (*6*). PCB formulations with low chlorine content, such as Aroclor 1254 (about 54% chlorine) contain hexachlorobiphenyls and even heptachlorobiphenyls (*6*). A further aspect of the concern about exposure to PCBs derives from the almost unavoidable contamination by polychlorinated dibenzofurans (PCDFs), which are also potentially carcinogenic to humans. All the commercial PCB formulations that have been analyzed contained PCDFs, including the 2,3,7,8-substituted ones (*6*).

Abelson simplifies the available epidemiological data by stating that PCB exposure "led to no known cases of cancer" in humans. The epidemiological studies on carcinogenicity of PCBs suffer from the limitations encountered for many other occupational exposures, namely lack of large study populations, lack of specificity of exposures, and presence of nonoccupational confounding factors. It is unclear whether (if ever) definitive human data will be available, but we believe it is reasonable for regulatory agencies to take actions before conclusive evidence is reached.

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