Interdisciplinary Research at NIH

Norman Metzger and Richard N. Zare (Policy Forum, Science's Compass, 29 Jan., p. 642) sound cautionary notes about the difficulties of organizing, and obtaining funding for, interdisciplinary research. For biomedical research, the trend toward interdisciplinary approaches appears to be inevitable and accelerating. This is particularly visible in the proliferation of data provided by genomics, in situ measurements, and other innovative technologies that require nontraditional analyses using quantitative skills not commonly found among biomedical scientists. The National Institute of General Medical Sciences (NIGMS) at the National Institutes of Health (NIH) has sponsored or cosponsored several workshops dealing with interdisciplinary, quantitative approaches to complex biomedical problems. Reports of these workshops, and funding initiatives resulting from them, can be found on the NIGMS Web sites (*1*). One initiative focuses on understanding the design principles and dynamics of biomedical systems with large numbers of interacting components, at all levels of biological organization. These goals will likely require the collaborative participation of investigators in the physical, mathematical, and engineering sciences. Other initiatives with interdisciplinary requirements address the analysis of complex genetic traits and the evolutionary dynamics of pathogens and their hosts. Because NIH has a major role in training future biomedical scientists, NIGMS, along with other institutes, has announced support for short courses and workshops that will provide either quantitative training and background to biological scientists or training in biological systems to scientists and engineers in the mathematically focused disciplines. Some large-scale interdisciplinary research projects may require special mechanisms of funding; NIGMS expects to announce these new mechanisms shortly.

James S. Kane (Letters, *Science*'s Compass, 19 Feb., p. 1115) expresses the specific concern that proposals incorporating several different scientific cultures obtain fair reviews. While current reviewers are often drawn from more or less narrowly focused disciplines, the definition of those disciplines is changing. For example, traditional population genetics seldom incorporated molecular biology; today, the field is characterized by heavy reliance on DNA sequencing and molecular methods. What is identified as interdisciplinary today may well be standard practice tomorrow. During the transition, it will be a challenge for the funding agencies to ensure appropriate reviews, and NIH is addressing this issue. For example, Ellie Ehrenfeld, the Director of the Center for Scientific Review (CSR), has commissioned a panel, the Working Group on Review of Bioengineering and Technology and Instrumentation Development Research, to identify obstacles to fair, high-quality, rigorous review of interdisciplinary research. From these discussions will emerge a set of principles to guide CSR in establishing a bioengineering- and technology-friendly review infrastructure.

We encourage members of the scientific community to assist with their advice and counsel—and their proposals. Although we believe that the biomedical science of the future will inevitably take on a more interdisciplinary character, the quality of the transition will be determined in large part by the quality of proposals received and the persistence of investigators.

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Metzger and Zare suggest "integration of social and behavioral science research with biological research" as one possible interdisciplinary research theme. Ecological economics does just that. The primary focus is on integration of the study of "nature's household" (ecology) and "humankind's household" (economy) (*1*). Ecological economics goes beyond our normal conception of scientific disciplines by focusing more directly on problems, ignoring arbitrary intellectual turf boundaries (*2*).

Since its inception in 1988, the International Society of Ecological Economics (ISEE) has grown from the 372 who attended the first meeting to about 1500 members, with roughly 700 of them in the United States. There are currently seven regional societies, including Europe, Australia/New Zealand, Brazil, and China. At the November 1998 meeting of the ISEE in Santiago, Chile, participants from the United States gathered to begin to organize a U.S. Society of Ecological Economics (USSEE). Ecologists and economists in the United States will gather in College Park, Maryland, on 20 and 21 June in conjunction with the annual meeting of the Society for Conservation Biology to establish the USSEE as the newest regional society of the international group. All interested ecologists and economists and others in related fields should join us.

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Cave Painting Hazard?

The art, sophistication, and mystery of ancient cave and tomb paintings fascinate modern society (M. Balter, News Focus, 12 Feb., p. 920). Yet little has been written about an obvious hazard that must have bedeviled the artist: Light required fire; the artist had to be exposed to carbon monoxide (CO) fumes. CO was a mystery to our ancestors because they instinctively associated odors and danger. No instinct warns us of CO poisoning. We know from medical histories of miners that low levels of CO produced visions and hallucinations.

Cave paintings in Grotte Chauvet, France.

Every society has ancient myths of demons who come on cold nights to take the lives of the young and elderly. Poorly vented charcoal fires lead to heart disease, mental health problems, and death. Scientists who investigate the mystery at Pont D'Arc may want to consider that some artists may have died for their art.

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Aging and the Genome

Cynthia Kenyon (E. Pennisi, News of the Week, 30 Oct., p. 856) is quoted as saying that "it's inescapable that aging is regulated deliberately by genes [and because] it happens in both worms and fruit flies, you have to be crazy to think that it won't happen in vertebrates."

There is no convincing evidence that age changes, as distinguished from longevity determination, are governed even indirectly by the genome. In the report to which Kenyon refers (Y.-J. Lin *et al.*, 30 Oct., p. 943), the mutant drosophila gene reveals increased longevity and a reduced mortality rate when compared with the parental strain (figure 1); however, the rate of aging is unchanged. What has been shown in these experiments is that because the slopes of both sets of curves are identical, longevity determination changed, but the rate of aging remained unaffected.

Two alternative conclusions, of several that could be given, are that either the control population is expressing a gene that negatively affects longevity and this has been overcome by gone selection in the experimental population, or the selected population has reverted to the status of feral drosophila, whose longevity may be greater than the controls used.

Longevity is determined indirectly by the genome. Age changes (the increasing disorder in formerly orderly molecules) are stochastically determined and occur as the forces of natural selection diminish after reproductive success. There is a useful analogy with inanimate objects. The longevity of an automobile, like that of an animal, is determined by elements ot design (genes) and manufacture (development). What occurs after the car leaves the show room floor and after the animal attains reproductive success is aging—the increase in molecular disorder that eventually exceeds the capacity of repair processes and increases vulnerability to the ultimate causes of failure or death. The determination of longevity in both cars and animals is manipulable, but the role of the genome in directly modifying increasing molecular disorder has yet to be demonstrated.

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Peptide Bond Formation: Retraction

We recently reported that *N*-acetylphenylalanylphenylalanine (AcPhe-Phe) was produced from the peptidyl-transfer RNA (tRNA) analog N-acetylphenylalanyl-tRNA (AcPhe-tRNA) and phenylalanyl-tRNA (Phe-tRNA) in the presence of the entire 23*S* ribosomal RNA (rRNA) or with domain V alone prepared by in vitro transcription (Research Article, 31 July, p. 666) (*1*, *2*). However, we subsequently discovered that there were problems with the identification of the products by thin-layer chromatography (TLC). We (*3*) and Khaitovich *et al.* (*4*) found independently that the spot on the TLC plate that we pre-