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LETTERS

Speaking metaphorically

D. ZITNAN

Fable, comparison, and example are enlisted by this week's correspondents. Apparently contradictory aspects of geologic observation and theory are related to the fable of the blind men and the elephant. Imagining that math skills are totally inherited, one writer asks: Would we then still teach addition and subtraction? In response to earlier Letters and a Policy Forum about changing career prospects for those with new science doctorates, some writers give examples of innovative programs that can boost job opportunities; others "take exception" to the view that science can be pursued for the love of it, as if new Ph.D.'s could aspire to be "19th-century gentlemen of leisure." And the transformation of a chrysalis (triggered by a hormone released by epitrachial glands, one of which is shown at right) evokes memories of an oft-frowned-upon human diversion.

Hormonal Activity

I was just reading the 5 January 1996 issue of *Science*, the cover picture caption (p. 7) and the Perspective, "Ecdysis control sheds another layer" by James W. Truman (p. 40). The account of what is taking place within the chrysalis (prompted, in part, by *Manduca sexta* ecdysis-triggering hormone) was most interesting, but something was bothering me—Why did "ecdysis" sound familiar? Then it came to me: "Ecdysiast." Not a butterfly at all. Minsky's and New York City. So I consulted my *Random House Dictionary* (second edition, unabridged). In 1940 H. L. Mencken, author of *The American Language*, coined "ecdysiast" to mean stripteaser. Burlesque vaudeville, 1935 to 1940. What a wonderful way Mencken had with words. The name fits the action, but the hormonal activity is different.

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Biological Determinism

The popular debate about the genetic heritability of intelligence quotient (IQ) scores in humans and the intellectual education of young people has its origin in a widespread misunderstanding of what biological determinism really means.

As a concrete example, let us assume that the cognitive ability to learn how to make simple arithmetic calculations is not only mostly, but totally heritable (*1*). Should we then cancel arithmetical instruction because we have detected that elementary mathematical ability is simply "innate?" Hardly, because from that moment on no child would ever learn how to add and subtract. That is, the heritability of this trait in such an altered environment would change dramatically; namely, to zero.

The Bell Curve (*2*) is strongly criticized in a statement (Letters, 5 Jan., p. 13) by a U.S. federal advisory group (*3*). The statement is correct in asserting, "Change the environment, and the heritability of traits can change remarkably."

Genetic determination of human intelligence does not mean independence of the environment as a releasing factor, but absolute autonomy of the cognitive *meaning* human beings attribute to that same environment. (Only this explains why chimpanzees successfully continue to refuse mathematical instruction.) However, as long as we don't know which individual is provided with exactly which intellectual abilities, it would be a purely arbitrary act to exclude some people from sophisticated education. And, given the fact that evolutionary variation cannot be stopped, every newborn individual (be he white, black, red, or whatever) represents a new chance for unforeseeable progress.

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References and Notes

1. Accepting the alternative possibility, that only instruction by the environment matters, necessarily leads to a lamarckian view of human behavior, and most biologists (me included) don't much like that sort of evolutionary theory.
2. R. J. Herrnstein and C. Murray, *The Bell Curve: The Reshaping of American Life by Differences in Intelli-*

gence (Free Press, New York, 1994).
3. National Institutes of Health–Department of Energy Joint Working Group on the Ethical, Legal, and Social Implications of Human Genome Research (ELSI Working Group).

While not wanting to enter the debate about the merits, or lack thereof, of *The Bell Curve*, I have great difficulty with the assertion in the advisory group's statement that "Genetic arguments cannot and should not be used to determine or inform social policy in the areas cited . . . [and] [s]ince the lessons of genetics are not deterministic, they do not provide useful information on whether or not to pursue various [educational] programs. . . ." This assertion could logically be applied to all nondeterministic science, denying the validity of statistical inference, and rendering it useless for informing public policy. It may be, as argued by the advisory working group, that the scientific jury is still out on the role of genetics in human intelligence, or that the "lessons from genetics are misrepresented" in the book. However, as one of a host of researchers that have tried to apply the lessons of science to inform public policy, I cannot accept the argument that nondeterministic science cannot or should not, together with moral, social, and political considerations, inform public policy.

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Low-Angle Faults

Richard A. Kerr's account of the supposed disparity between observations and theory ("Geologists debate ancient life and fractured crust," Meeting Briefs, Research News, 24 Nov., p. 1300) calls to mind the fable of the blind men and the elephant. Gregory Davis is quoted as saying, "Our job as field geologists is to define and defend what we think we see [subhorizontal normal faults] and to let the theorists tell us how it can work." He may have hold of only the trunk of the elephant. A better objective is to understand the whole beast and how it works. On the theorists' side, Roger Buck says, "No one has ever come up with a viable explanation of how pristine rock could break at [an angle] lower than 45 degrees" during crustal extension. He may have hold of the elephant's ear.

If the debaters at the Geological Society of America meeting reported on by Kerr had considered seismic images of the deep crust (the feet of the elephant?), they would have seen that Earth's crust in these highly extended regions is full of subhorizontal reflections that indicate ductile shearing at low angles (*1*). Below a depth of about 12 kilometers, temperatures are high enough (greater than 350°C) to soften rocks and inhibit brittle earthquake fracture. Most of the faults under debate (excluding those that broke at a high angle and were later rotated to subhorizontal) began their complex histories in this deep realm and were later uplifted, denuded, and exposed at the surface.

Imagine a brittle rock layer floating on a soft sublayer, in the extreme, like ice on a pond. We have no difficulty in observation or theory with high-angle extensional faults in the brittle layer and an abrupt transition to basal shear below. The principal stresses are simply not maintained horizontal and vertical through the transition (*2*), and continuity requires that the bulk strain be nonhomogeneous. There is no contradiction in theory. Add the factor of geologic time, with magmatic heating (characteristic of the metamorphic core complexes where the low-angle faults are exposed) and continued tectonic extension. It is not strange that subhorizontal ductile shears formed at elevated temperatures are overprinted dur-