LETTERS

Fraud in Science

I disagree with DeWitt Stetten, Jr.'s, suggestion that possible changes in the training process for the Ph.D. degree may be a factor behind the current wave of falsified biomedical research (Letters, 21 Dec., p. 1374). With the possible exception of one or two graduate students, the individuals implicated in publicized fraud have held the M.D. degree. I believe that students in the laboratory sciences are still taught the sanctity of data. Perhaps the greatly diminished time spent by medical students in laboratory courses in contact with basic scientists has something to do with this unfortunate problem. One thing remains true: the scientist who tampers with data will lose his job and his career. The M.D. in the same circumstance can enter into private practice, which need not be an economic penalty.

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Arid Land Crops

In the article "New crops for arid lands (28 Sept. p. 1445), C. Wiley Hinman points out the commercial potential for food and chemical products (for example, seed oil, rubber, and resin) from arid land plants. Hinman does not discuss the opportunity for production of biomass energy sources, including portable fuels, in arid and semiarid regions of the world. One plant discussed by Hinman, buffalo gourd (*Cucurbita foetidissima*), may well have substantially greater economic potential as a producer of seed oil for use as a diesel oil extender and ethanol for blending with unleaded gasoline than as a source of edible oil, protein, starch, and fiber. In fact, processing of buffalo gourd for fuel improves the availability of the stored protein and fiber, but leaves less available seed oil and root starch.

Most buffalo gourd research and development activities have been focused on the nutritional value of the protein, starch, and edible oil. The most comprehensive work has been accomplished at the University of Arizona under the leadership of W. P. Bemis (*1*). With the cooperation of this group, the New Mexico Energy Research and Development Institute initiated a contract in 1983 with New Mexico State University to perform field and processing tests on buffalo gourd focused primarily on liquid fuel production. Preliminary results from the field tests are encouraging; the processing tests are scheduled for early 1985.

The published literature and the New Mexico field tests both suggest that the root yield of 8 tons per hectare cited by Hinman may be exceeded by a factor of 2 or more. A preliminary economic analysis (*2*) based on the conservative use of published data, which is yet to be verified by the New Mexico field experience, indicates that commercial farming of buffalo gourd in the U.S. high plains may result in yields of 100 and 325 gallons per acre per year of seed oil and ethanol, respectively, with cultivation and harvesting costs, respectively, of $0.28 to $0.44 per gallon of liquid fuels (depending on irrigation requirements). Average on-farm processing costs, including amortization of capital, are estimated to be about $0.55 per gallon. These values are extremely competitive with those for conventional crops cultivated for fuel production, even without taking credit for the high-protein buffalo gourd seed meal and fermentation byproduct. Moreover, buffalo gourd grows well on marginal lands with little or no fertilizer.

While much work remains to be accomplished, the preliminary data suggest that an aggressive, broad-based, and coordinated effort to evaluate the commercial potential for production of liquid fuels from arid and semiarid region plants is both warranted and long overdue.

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References and Notes

1. See, for example, W. P. Bemis, J. W. Berry, C. W. Weber, *New Agricultural Crops*, C. A. Ritchie, Ed. (AAAS Selected Symposium 38, Westview, Boulder, Colo. 1979).
2. L. Icerman and E. B. Shultz, Jr., *Energy*, in press.

Icerman presents some new and encouraging data and points out additional potentials for buffalo gourd. A vigorous R&D program is needed to evaluate its use as a liquid fuel.

I would like to point out some errors and omissions in my article. In the second sentence I stated that there are now "200,000 million hectares" of arid and semiarid rangeland in the United States. Obviously, this should have been 200 million hectares. On page 1447, column two, in the first sentence of the last paragraph, I incorrectly stated that bladderpod requires 3 to 4 centimeters of rain from September to April. It requires 20 to 25 centimeters.

I would also like to note that several paragraphs about gumweed (*Grindelia camporum*) in my article were taken from a funding proposal prepared in 1983 by the Office of Arid Lands Studies at the University of Arizona for the Diamond Shamrock Corporation, for which I was then Director of Exploratory Technology. Readers may wish to review some of the published work on gumweed that has resulted from the work carried out at the University of Arizona (*1*).

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Reference

1. S. P. McLaughlin and J. J. Hoffman, *Econ. Bot.* **36**, 323 (1982); S. P. McLaughlin, B. E. Kingsolver, J. J. Hoffmann, *ibid.*, **37**, 150 (1983); B. N. Timmermann, D. J. Luzbetak, J. J. Hoffmann, S. D. Jolad, K. H. Schram, R. B. Bates, R. E. Klench, *Phytochemistry* **22**, 523 (1983); J. J. Hoffmann and B. E. Kingsolver, *Abstracts, Symposium of Biomass Refining: Developing the Whole Plant Concept* (American Chemical Society, Washington, D.C., 1983); J. J. Hoffmann, B. E. Kingsolver, S. P. McLaughlin, B. N. Timmermann, in *Recent Advances in Phytochemistry*, B. N. Timmermann, C. Steelink, F. A. Loewus, Eds. (Plenum, New York, 1984), vol. 18, chapter 9.

Carcinogenesis

Norman Gravitz (Letters, 30 Nov., p. 1022) "readily" calculates the lifetime probability of carcinogenesis resulting from exposure to a single molecule of benzene per liter of drinking water as approximately 10^{-22}, using a "one-hit model, no-threshold."

Such straight-line extrapolations to the origin were roundly criticized by Dinman (*1*), who listed the large number of atoms of "carcinogenic" elements per cell and concluded that "a threshold for biological activity exists within a cell at 10^4 atoms." He also noted the "presence of a multiplicity of interfering substances" and other considerations that invalidate "one-molecule" hypotheses for carcinogenesis. The threshold principle has been aptly described as a "law of nature" (*2*), Delaney to the contrary notwithstanding.

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References

1. B. D. Dinman, *Science* **175**, 495 (1972).
2. G. Claus, and K. Bolander, in *Pollution and Water Resources* (Pergamon, New York, 1982), p. 153; G. Claus, I. Krisko, K. Bolander, *Food Cosmet. Toxicol.* **12**, 737 (1974).