LETTERS

Medfly Mating

What has come to be a seemingly ubiquitous misconception is passed along in Eliot Marshall's article (News and Comment, 24 July, p. 417) about the Mediterranean fruit fly. The idea that successful application of the sterile male technique is limited to insect species in which the female mates only once is erroneous (*1*). The success of the so-called sterile male management technique is dependent on (i) the competitiveness of the sterile insects vis-à-vis the fertile insects for mates (fertilization of ova) and (ii) the relative abundance of sterile versus fertile insects. Female promiscuity is immaterial to the issue.

Consider the proposition that members of an interbreeding population of sterile and wild insects with a 1:1 sex ratio are equally competitive for fertilization of mates and that their relative abundance is 1:1. Under these circumstances, the probability that a given female will mate with a sterile male is .5, since one-half of the males are sterile. The probability that a given male will mate with a sterile female is also .5.

Thus, 25 percent of the matings which would be expected to occur in the population would be between sterile males and fertile females, 25 percent between sterile males and sterile females, 25 percent between fertile males and sterile females, and the remaining 25 percent between fertile males and fertile females, resulting in 75 percent of the matings involving at least one sterile parent and thus contributing no viable progeny to the succeeding generation. The probabilities apply regardless of the number of matings (provided the sterile insects are as competitive as the fertile insects).

It is true when two matings are considered that some fertile females which have first mated with sterile males may recover their fertility by a subsequent mating with a fertile male. However, in the example provided, this restoration of fertility will be exactly compensated for by other fertile females that first mated with fertile males and then with sterile males. Postulating a third or even more matings still results in love's labors lost because of the compensatory effect of the equal competitiveness of sterile and fertile insects.

Deductive reasoning alone is sufficient for the college freshman biologist to conclude that insect fidelity is not important to the success or failure of pest management strategies for sterile insects. In-depth mathematical analyses have been available for more than a decade addressing the same point (*2*). This is particularly important in the case of the Medfly, since it mates more than once (*1*).

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References

1. E. F. Knipling, *U.S. Dep. Agric. Agric. Handb.* (1979), p. 343.
2. E. G. Zouros, *Ann. Inst. Phytopathol. Benaki New Ser.* 9, 20 (1969).

Origin of Chlorinated Dioxins

The article "Trace chemistries of fire: A source of chlorinated dioxins" by R. R. Bumb *et al.* (24 Oct. 1980, p. 385) is of potentially great import to environmental chemists and toxicologists. The impact of the article, however, is diminished by an unjustified interpretation of the data and by an important observation that is overlooked.

The article's title and several passages clearly suggest that the authors believe their work demonstrates that chlorinated dioxins may be formed during normal combustion. To prove such a thing one must measure the amount of chlorinated dioxins in materials to be combusted, combust them, and then determine whether or not the amount of chlorinated dioxins has increased. Such an experiment is not reported by Bumb *et al.* The authors show that chlorinated dioxins occur in combustion products, but this is *not* the same as showing that they are formed during combustion. In particular, the occurrence of chlorinated dioxins in combustion products may be caused by a general contamination of the environment with chlorinated dioxins. The article might at least have given data indicating that soil near major combustion sources had higher concentrations of chlorinated dioxins than soil more distant from them, but even such circumstantial evidence of combustion as a source of chlorinated dioxins is lacking.

The authors do not comment on a most interesting aspect of their data: the concentrations of chlorinated dioxins in soil and dust samples from in and around Dow Chemical's Midland, Michigan, plant are considerably higher than those from anywhere else. In fact, the lowest reported concentration of either total TCDD, HCDD, H$_7$CDD, or OCDD (the tetra-, hexa-, hepta-, and octa-chlorinated dioxins, respectively) in soil from Midland, Michigan, is five or more times higher than the highest concentration reported in any other soil sample. The authors neither comment on or refute the possibility that Dow's own plant may have been a significant source of chlorinated dioxins, although their data appear to support such a hypothesis.

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Bumb *et al.* suggest that "chlorinated dioxins appear to be ubiquitous. Their ubiquity is due to the existence of natural phenomena, trace chemistries of fire. . . ." Although their data demonstrate the presence of polychlorinated dibenzo-*p*-dioxins (PCDD) in a wide variety of samples it has not been shown that the source of these compounds is de novo synthesis in fire. Consequently, an evaluation of the principle routes that could lead to the PCDD observed in combustion effluents is necessary to prevent the misconception that the environmental source of these compounds has been determined.

Three routes that could lead to the observed PCDD are:

1) The PCDD are known contaminants of various chloroaromatics (*1, 2*) which have become widely distributed in the environment. Thus, the observed PCDD could be derived from a simple volatilization-particulate absorption mechanism.

2) The combustion of various chlorophenolics will lead to the formation of PCDD (*2, 3*). This mechanism has been suggested as a route to environmental PCDD (*3, 4*). Although this pathway includes the partial synthesis of the PCDD by fire, it still requires the presence of anthropogenic chloroaromatics.

3) The PCDD could be formed de novo in the fire. The formation of aromatic chlorine compounds from polyethylene and inorganic chloride under pyrolytic conditions has apparently been demonstrated (*4*). However, no experimental support for this observation is available, and it is not known if PCDD were among the observed products. This route would suggest a historical environmental role for the PCDD.

Bumb *et al.* do not mention route 1 as a possible source of the observed PCDD, even though they cite several studies which demonstrate that preformed PCDD's are not 100 percent destroyed, even in a very hot fire. They dismiss route 2 because the "data cannot be satisfactorily explained in entirety by attributing the presence of [PCDD] to condensation of preexisting polychlorinated phenols." However, they do not present any evidence on chlorophenolic

Table 1. Chlorinated dioxin content of soil. Detection limits are given in parentheses.

City	Sample set	Approximate distance (feet)	Apparent source	Apparent dioxin concentration, pg/g (ppt)			
				TCDD	HCDD	H_7CDD	OCDD
Chicago	1	100 NE	Incinerator	N.D. (20)	N.D. (30)	140	410
Chicago	1	200 NE	Incinerator	N.D. (10)	30 (30)	240	1000
Chicago	1	400 NE	Incinerator	30	310	3300	22000
Chicago	1	1000 NE	Incinerator	N.D. (20)	120 (40)	1400	8500
Chicago	2	100 NE	Incinerator	6 (3)	140	850	3200
Chicago	2	200 NE	Incinerator	5 (5)	40 (30)	360	1400
Chicago	2	400 NE	Incinerator	5 (5)	90 (50)	960	6000
Chicago	2	1000 NE	Incinerator	N.D. (6)	20 (20)	100	350
Lansing	3	600 ENE	Powerhouse	N.D. (10)	1200	1600	2000
Lansing	3	900 ENE	Powerhouse	N.D. (10)	N.D. (40)	230	960

concentration in their combustion feedstock or on PCDD isomer distribution profiles (*3*, *5*) which would support this conclusion. In fact, the work of Buser *et al.* (*3*) indicates that the majority of the PCDD isomers observed in the fly ash of a municipal incinerator and an industrial heating facility could be accounted for by the pyrolysis of the three most commonly used and environmentally widespread commercial polychlorophenols.

In summary, the route or routes by which observed PCDD is formed has not been established. Consequently, the conclusions of Bumb *et al.* that the ubiquity of the PCDD is due to "natural phenomena" must be reevaluated.

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References

1. C. D. Pfeiffer, T. J. Nestrick, C. W. Kocher, *Anal. Chem.* **50**, 800 (1978).
2. R. H. Stehl and L. L. Lamparski, *Science* **197**, 1008 (1977).
3. H. R. Buser, H.-P. Bosshardt, C. Rappe, *Chemosphere* **7**, 165 (1978).
4. K. Olie, P. L. Vermeulen, O. Hutzinger, *ibid.* **6**, 455 (1977).
5. H. R. Buser and C. Rappe, *Anal. Chem.* **52**, 2257 (1980).

It would be great if a meaningful materials balance experiment could be devised that would be reasonable to perform. However, at the trace levels (parts per billion or less) of PCDD's it is generally considered impracticable at present.

The data that Kriebel suggests would provide "circumstantial evidence of combustion as a source of chlorinated dioxins" were included in the original manuscript, but the table was condensed at the request of reviewers and editors. Some of these data are summarized in Table 1.

These data have been treated by Townsend (*1*), who was able to show a relation between ratios of isomer groups and distance from the source. As would be expected, the concentration of the various dioxins appears to attain a maximum around 300 to 600 feet. Not enough data are available to draw firm conclusions, however.

As a result of our investigation, it was clear that PCDD's were coming from combustion sources of which Dow has several. This was the point of the article.

As part of a continuing program to protect the environment from chemical contamination, the manufacturing plants are monitored for possible leaks. The data from this monitoring, together with new, specially acquired data, were accumulated and restudied to determine if leaks had possibly occurred. None were detected. This was described in a 1978 report (*2*); however, it is not germane to a discussion of combustion phenomena.

Carlson's proposed routes for the formation of PCDD's were previously presented and thoroughly discussed by Lustenhouwer *et al.* (*3*). The fact that a hypothesis such as the "trace chemistries of fire" cannot be proved is common knowledge. Hypotheses are meant to be tested in every conceivable way. Until they are proved false, they are useful in guiding experimentation.

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References

1. D. I. Townsend, *J. Environ. Sci. Health* **B15** (5), 571 (1980).
2. Chlorinated Dioxin Task Force, *The Trace Chemistries of Fire—A Source of and Routes For The Entry of Chlorinated Dioxins Into The Environment* (Michigan Division, Dow Chemical U.S.A., Midland, 1978).
3. J. W. A. Lustenhouwer, K. Olie, O. Hutzinger, *Chemosphere* **9**, 501 (1980).

Abortion, Science, and the Law

As a lawyer with many years' experience at the interface of law and science, I am heartened to read so perceptively sound a statement of the roles of the two disciplines at that interface as that made by B. G. Zack (Editorial, 17 July, p. 291).

The taking of "life," even of human life, however defined, is not now and never has been absolutely illegal in the United States. The broad term denoting the killing of a person is "homicide," literally "man killing." A homicide in American law and custom may be an act which in certain circumstances merits society's highest approval, but in other circumstances, its deepest repugnance. The unacceptability of a homicide varies not only with the conduct of the killer, but also with the quality of the killed. In every culture most homicide has been forbidden, but in varying cultures, varying homicides have been not only tolerated but customary. Examples are sacrifices to the Aztec gods, defeated enemies by cannibal savages, the senile and near senile among some Eskimos, and unwanted infants in the Athens of classic antiquity. Thus, in all cultures, the culpability of homicide depends upon the cultural definitions of approved killers and their approved victims.

As Zack states, thus reinforcing the views of Hickman, Boving, and Libet (Letters, 10 July, p. 154), a human zygote, (or equally ovum or sperm), or fetus are all incontrovertibly living and human. Science, having told us this, has nothing more to add to the question of whether any of them is to be considered legally the potential subject of culpable homicide if killed. That question is for moralists, legislators, lawyers, and the democratic process.

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New Location for Memphis?

After looking at the map accompanying the article on the Tennessee-Tombigbee waterway (News and Comment, 14 Aug., p. 741), I see more clearly the reason for its high cost. It must include moving Memphis from its traditional location on the Mississippi River to the head of the waterway near Savannah, Tennessee.

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The map was indeed in error.
—EDITOR

Erratum: In the report entitled "The posterior pituitary: Regulation of anterior pituitary prolactin secretion," by L. L. Peters *et al.* (7 Aug., p. 659), an error occurred in the legend to Fig. 2. In the description of Fig. 2B, the solid line should have referred to the solvent vehicle and the broken line to dopamine.