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## NEW SCIENTIFIC EVIDENCE AND PUBLIC HEALTH IMPERATIVES

THE two articles in this issue of the *Journal* on occupational exposure to benzene<sup>1</sup> and prenatal exposure to lead<sup>2</sup> confirm the suspicion that very low levels of toxins are capable of causing serious health effects. These impressive studies should quiet the insistence that governmental efforts to control these hazards are excessive and irrational responses to chemophobic social forces. Furthermore, the investigations should make us appreciate the difficulty of reconstructing past exposures to suspected agents in retrospective cohort studies and the value of follow-up, however burdensome, in prospective studies.

These investigations are relevant in terms of regulating exposure to benzene and lead and have implications for social policy regarding scientific evidence in future debates about the advisability of more stringently regulating exposure to asbestos, formaldehyde, dioxin, and ethylene oxide, among other hazardous chemicals.<sup>3</sup> Science is a hard taskmaster, and in the light of mounting evidence that suggestions of toxicity are for the most part ultimately confirmed by painstaking scientific inquiry, perhaps it is time to reexamine whether scientific standards of proof of causality — and waiting for the bodies to fall — ought not give way to more preventive public health policies that are satisfied by more realistic conventions and that lead to action sooner.

In 1980, the Supreme Court invalidated the permissible level of exposure to benzene, 1 part per million (ppm) over an eight-hour day, promulgated by the Occupational Safety and Health Administration.<sup>4</sup> In a tortuous and confused opinion, the Court reluctantly denied a reduction of the permissible exposure level from the previous standard of 10 ppm because of a lack of sufficient scientific evidence. In oral argument, the American Petroleum Institute pleaded that there was no evidence of cancer at 10 ppm. The Supreme Court opined that there must be "substantial evidence of significant risk" to justify a new protective standard. In this issue of the *Journal*, we are presented with evidence,<sup>1</sup> not only that a significant risk of cancer exists at a cumulative dose equivalent to exposure to

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10 ppm for 40 years, but also that a risk appears at a cumulative dose 10 times smaller. Although it can be argued that larger doses over shorter periods cannot strictly be equated with an average smaller dose over a 40-year working life, the results are important for public policy purposes, if we wish to err on the side of caution in formulating regulatory policy.

The new study of prenatal exposure to lead<sup>2</sup> has more complicated implications for both occupational and environmental health. In the case of lead, the Occupational Safety and Health Administration was successful in promulgating a new permissible exposure level of 50  $\mu\text{g}$  per cubic meter of air, with mandatory removal of workers from the work place on the basis of a blood lead level above 50  $\mu\text{g}$  per 100 g or a recommendation by the worker's physician.<sup>5</sup> The Centers for Disease Control considers the acceptable level for children to be no higher than 25  $\mu\text{g}$  per deciliter.<sup>2</sup> Until recently, the implications of exposure of female workers in terms of prenatal risk were debated. Now, the evidence of Bellinger et al.<sup>2</sup> argues strongly that levels well below 25  $\mu\text{g}$  per deciliter (i.e., as low as 10  $\mu\text{g}$  per deciliter) may justify medical removal from the toxic environment of female workers who are pregnant or about to become pregnant. Ironically, the evidence also appears to strengthen the hand of employers who seek to exclude women of childbearing capacity from lead-exposing jobs. However, this discriminatory<sup>6</sup> and differential<sup>5</sup> treatment may not be defensible because, not only is there evidence that the male reproductive system is also damaged by lead exposure,<sup>7</sup> but lead dust carried home by either male or female workers could easily cause "low-level" lead accumulation in a woman's body, which we now know presents a prenatal risk of harm to child development.

The investigation of prenatal exposure to lead also has implications for the ambient-air standard for lead set under the Clean Air Act, which requires the Environmental Protection Agency to "protect public health with an adequate margin of safety."<sup>5</sup> In establishing the level of 1.5  $\mu\text{g}$  per cubic meter, the Agency stated that it was seeking to protect 99.5 percent of exposed children from exceeding a blood lead level of 30  $\mu\text{g}$  per deciliter (the Centers for Disease Control criterion at that time). As it happened, data that became available later<sup>8</sup> indicated that in 1976–1980, fully 4 percent of all children under five years of age had higher blood lead levels (for central-city black children, the rate was above 18 percent). The same data set, however, showed an encouraging trend toward lower blood lead levels in the population, in parallel with the reduced lead in gasoline. The study by Bellinger et al. suggests that it may be wise for the Environmental Protection Agency to review the standards for lead exposure, both from ambient air and drinking water, in the general population.

The reported investigations of benzene and lead are but two examples of new scientific evidence being brought to bear on governmental decisions to protect public health. Another example is the reanalysis of the National Cancer Institute data<sup>9</sup> on human exposure

to formaldehyde, which now indicates a clear risk of cancer to humans.

Recent accusations of chemophobia, conspiracies, and political saber rattling<sup>10</sup> led to a demand for "better science" in the study of occupational and environmental health hazards. All right, now we're getting the better science. It is time to ask: Where is the governmental response? Why has the Occupational Safety and Health Administration still not regulated asbestos as a carcinogen? Why doesn't the Environmental Protection Agency regulate formaldehyde? What will the Occupational Safety and Health Administration now do with benzene, the Environmental Protection Agency with lead, and both agencies with ethylene oxide?

The new scientific evidence is appearing at a time of meager federal funding for occupational and environmental health and a weak federal commitment to the regulation of public health hazards. Better science is always to be preferred, but we cannot wait too long to act, too long to see the patterns of mounting evidence on a particular hazard, or too long to see the collective picture on hazards in general. Let us have a governmental response to the new realities.

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## BONE MARROW TRANSPLANTATION FOR GENETIC DISEASES

FOUR recent editorials in the *Journal* have reviewed the potential for increasing the therapeutic armamentarium for genetic disease.<sup>1-4</sup> Bone marrow transplantation has been considered in each of these editorials.

Now, in this issue of the *Journal*, Lucarelli et al. present impressive data on the use of marrow transplantation for the treatment of  $\beta$ -thalassemia.<sup>5</sup> In severely affected patients 8 to 15 years of age, functional engraftment as measured by correction of the hemato-