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Fireflies glowing after exposure to the formamidine pesticide, chlordimeform. Of the ten insects, nine were treated with 1 microgram each of chlordimeform. The tenth firefly, which is unlit, was treated only with the acetone solvent. See page 74. [Jeffrey A. Leister, Department of Entomology, Purdue University, West Lafayette, Indiana]

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Zero—What Does It Mean?

Pollution of the environment, additives in food, exposure to radiation, hazards in the workplace, and identification of carcinogens are resulting in calls for zero discharge of pollutants, zero contamination, zero radiation, and zero risk. Congress, state and local governments, and their respective administrative agencies have responded with a stream of new laws and regulations. Some citizens' organizations and legislators are seeking the elimination of all pollution or of what are considered contaminants.

This desire to obtain zero is causing consternation in the minds of many engineers and scientists. When people speak of zero they apparently mean different things. And even in the case of scientific analysis, zero has changed. A few years ago analytical methods might have indicated the absence of a particular chemical in a test sample. Today, with better analytical methods, that same sample would show the particular chemical present; we no longer have the zero we had a few years ago.

Analytical methods are now measuring such minute quantities of chemicals (parts per billion and even parts per trillion) that supposedly identical samples of water from the same effluent, when analyzed, show different concentrations of pollutants. The problem may be one of humans not being skilled enough to get reproducible results with sophisticated equipment (assuming the equipment is not at fault), or it may be like the four blind men trying to identify the elephant—by touching different parts of the elephant, they come up with different conclusions about what an elephant is.

Concern about radioactivity's effect on health is resulting in calls for zero radiation, particularly where nuclear power plants are concerned. And yet there is naturally occurring radiation from space, from rocks, and even from our own bodies and food. Such radioactivity varies from place to place by as much as 400 to 500 percent. Knowing, then, that nowhere on earth is there zero radiation, are we talking about zero based on a particular location—and if so, which location? Or are we talking about a permissible level that is believed to be safe for human beings?

With the advent of new machines, new materials and chemicals, and new modes of living and with a greater knowledge of the things around us, we have suddenly become aware of new risks or risks we were not previously aware of. Through the years society has become used to and accepted certain risks. People learned to control fire, to build homes away from flooding rivers and volcanoes, to control the internal combustion engine. All of these things involve risks. Society has been able to reduce risks in many instances, but where natural forces are involved, risks are always present.

What do we mean when we ask for zero risk? Does zero mean a standard, a limit, or perhaps a goal for each kind of risk? Will we accept (and call zero) 50,000 deaths a year from automobiles, 100 deaths from airline traffic, or 25 to 60 deaths attributable to producing electricity from coal, but refuse to accept any deaths from nuclear power plants producing electricity because we don't want to risk a possible unknown?

Webster's dictionary defines zero (other than the numeral) as (i) a state of total absence or neutrality; (ii) the lowest point, nadir; and (iii) something arbitrarily or conveniently designated zero. In calling for zero, people may be asking for a state of total absence. However, just as it is impossible to stop killer hurricanes and to keep people from falling out of bed, we know we are going to have accidents if we use fire to heat our homes and cook our meals or use other new things that improve the quality of life and lengthen our life-span.

Knowing this, we may have to accept "something arbitrarily or conveniently designated zero" for pollutants, radiation, and risk. The costs of guessing at zero are enormous; laws and regulations must come to grips with this problem. Until they do, costs to society can only continue to go up. Everyone's checkbook will feel it—and there we all know what zero means.—MITCHELL H. BRADLEY, *Washington Office Director, American Society of Mechanical Engineers, Washington, D.C. 20006*

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