

# PROFESSIONAL RELATIONS

# BULLETIN

**Division of Professional Relations**  
**Box 286, Rahway, N.J. 07065**



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## FROM THE EDITOR . . .

### Gremlins Department

Our sincerest apologies for the late delivery of Bulletin 10. We had it ready to go well before the Chicago national meeting, but could not mail it out because of monumental snafus concerning the mailing labels. This was out of our hands, and caused a great deal of vexation. The problem was with the ACS computer spewing out labels that contained numerous errors, and after long delays, Marshall Mead, of ACS staff, promises better service in the future; if it doesn't improve, you may be assured that the officers of this division will make plenty of waves.

While I'm on this subject, I would like to suggest that any DPR members who have not yet received Bulletins 9 or 10 write to our managing editor, Fred Owens, at the above address, and ask for your copy. In addition to any problems we may have with incorrect mailing labels, there is always the additional possibility of lost mail.

### Report from Chicago

The major divisional presentation was a full day symposium, "Occupational Safety and Health: Professional Responsibility." This is an extremely important subject for all who call themselves professional chemists. I am pleased to report that we had on hand several excellent speakers, and for the benefit of those who could not attend the meeting, we are reprinting some of the papers.

I am also pleased to report that we got the DPR Committee on Occupational Safety and Health off to a good start. The chairman is Stephen Sichak (Scholl, Inc., 213 West Schiller Street, Chicago, Ill. 60610), who has been extremely active in this area. We hope that this committee can provide a focal point within the ACS for all activities related to this subject. Any of you who would like to work with the committee are invited to contact Steve.

Your division was represented at the Council meeting by Dennis Chamot and Norman Pinkowski. The session had many interesting moments. Right off the bat, we tried to change the agenda.

Scheduled to take up the entire morning of what promised to be a marathon session was what can only be described as a propaganda barrage by the CPC Task Force studying the A. D. Little Report on ACS structure. Several Councilors felt that it was improper to place such an item so early in the agenda, especially as there was much regular business that had to be acted on at this meeting. Also, there was a well attended discussion with Councilors on the same subject earlier in the week, and so there seemed little reason to devote so much prime time to an item that was not up for action (and won't be for quite some time). Finally, several Councilors, myself included, were prepared to stay far longer than was customary for a Council meeting, and yet could not stay all day. (A large number, as it turned out, left early, beginning at about 3:00 P.M.).

At the very start of the meeting, Chamot moved that the agenda be changed, to place the A. D. Little discussion after the regular business of the Council was concluded. The motion, on recommendation of CPC, was defeated, and we had to waste most of the morning watching the show. Note that I use the word "waste" by choice. All of the reports that were presented by the task force had already been sent to every Councilor before the meeting. And a great deal of comment had already been directed toward the task force earlier in the week. Finally, so much time was taken up by the slick slide shows that very little real discussion was possible. Beware the steamroller !

During the regular meeting in the afternoon, the Nominations and Elections Committee presented a set of proposed guidelines for ACS

elections at all levels. Contrary to expectation, they moved for adoption at this time. Many of us have strong reservations about the limitations spelled out in the guidelines, so after some discussion, Chamot moved that they be recommit- ted. This carried. (Chamot, Pinkowski voted to recommit).

An important petition dealt with the manner of election of Directors-at-Large and Councilors. The part dealing with direct election of Directors-at-Large by the membership was re- committed, because this subject is under review as a result of the A. D. Little Report. A weak argument, of course, but one that, unfortunately, has been used for quite some time now.

Surprisingly, the part that required direct elec- tion of all Councilors by mail ballots sent to all members of the section or division did pass. This should have some effect in those areas where Councilors, some of whom rise to positions of influence within the Society, have been ap- pointed by executive committees or have been picked at section meetings where a tiny fraction of the membership were in attendance. Hope- fully, it will make the Council more representa- tive of the membership. (Pinkowski voted for, Chamot had to leave before the vote).

Another important petition provided for re- ferenda on actions of the Council. This has been presented before and has always been scheduled to come up late in the meeting, after a substantial number of Councilors had already left. This happened again and, as before, was defeated. (Pinkowski voted for the petition). For other actions by the Council, see *C&EN*, Sept. 15th.

### Commercial

1975 is nearing its end, which means that you will shortly be receiving dues notices for next year. When you renew your membership in this Division, why not at the same time get a col- league to join.

— Dennis Chamot

# OSHA AND THE LABORATORY CHEMIST\*

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The subject of occupational health and safety has become increasingly important to the laboratory chemist, whether in a university, a government laboratory or in the industrial setting. While chemists in industry may be slightly more aware of chemical hazards, chemists in general have been inadequately trained in this regard. Most concern, when expressed, has been with the explosive nature of chemicals and not with their toxicity. I intend to concentrate on the possible health consequences of exposure to chemicals.

The problems of the handling of chemicals in research and development or academic laboratories are special in a sense. However, it is not clear that the special nature of the laboratory justifies a "hands off" policy with regard to the control of exposure to potentially toxic materials. There are many more compounds which are synthesized or investigated in laboratories than ever reach commercial or industrial use. For example, it has been estimated that there are 10,000 compounds investigated for every one compound that reaches the shelf as a pharmaceutical. Therefore, the laboratory chemist gets exposed to many more different toxic materials than the consumer or perhaps even a production chemist.

I would like to present a discussion of four factors which must be considered in order to fully appreciate the occupational health and safety problems in the laboratory as well as in the manufacturing setting. The first is a recognition of the difference between toxic materials in general and chemical carcinogens.

The second topic has to do with the nature and dimensions of laboratory exposure to toxic materials and chemical carcinogens.

The third factor is the passage of the occupational safety and health act of 1970 which obliges *private* employers to provide a safe and healthful workplace for their employees, whether in the industrial, the academic, or other non-industrial settings.

The fourth factor relevant to understanding the nature of the occupational health and safety problems in the laboratory is the appropriateness of cost-benefit analysis for the design of policy and the assumption of risk in the laboratory setting.

## TOXICITY AND CARCINOGENICITY

Allow me to review briefly the nature of chemical carcinogenesis. The extent to which a particular health hazard should be controlled is said to depend on both its severity and the dose-response relationship between exposure to that hazard and its effect on the biological system. In simple terms, the dose-response relationship indicates that as the exposure or dose to a toxic substance increases, its effect or response on the biological organism increases. Often the dose-response relationship assumes the existence of a threshold exposure below which no deleterious effect occurs. Considerable doubt has been raised that the threshold concept applies for carcinogenesis. To put it another way, the initiation of cancer may exhibit a "zero threshold", which means that there is no dosage which can be considered safe. Indeed, the two-step mechanism posited for carcinogenesis is quite different than that for ordinary toxic effects.

The irreversible *initiation* process may result from the insult of a single molecule of a carcinogen on a single susceptible cell. Because exposure of a carcinogen, however small, can initiate a cancer, the threshold below which no "damage" occurs is said to be zero. Even if initiation were the rate-determining step in the cause of cancer, every exposure to a carcinogen would not result in cancer. The carcinogen-cell interaction would have to occur "correctly" — just as a full score in a bowling game requires a "correct hit." Thus, as you know, probability considerations can partly explain why all people exposed to carcinogens do not have cancer.

*Promotion* of the cancer to the status of a tumor (or detectable change in the blood or lymphatic system) may follow at different speeds in different species. The body's adaptive or immunological mechanisms may delay or avoid the manifestation of the cancer into recognizable form, but the potential for *promotion* to occur is there if *initiation* has occurred. The observation that skin cancer can be speeded up by the addition of a promoter (e.g. croton oil) after exposure and removal of the cancer initiator indicates that a non-zero threshold may exist for the promotion step, but much controversy exists as to the general correctness of this statement for all cancers.

Decisions about what standards to adopt for carcinogens have to be made with the recognition of the good *possibility* that a zero threshold exists for these substances. This may or may not require the adoption of a zero standard (i.e., zero within the limitations of measurement). For example, if the standard for radiation is set at one-hundredth of the level to which human beings are exposed from naturally occurring uranium in the general environment, a non-zero (but small) standard may be justifiable. On the other hand, since no safe level has been determined for the liver carcinogen vinyl chloride, and persons are not exposed to vinyl chloride from natural sources, the recommendation for reducing workplace exposure "below measurable limits" seems sensible.

For chronic effects the extrapolation from animals to humans is difficult, partly because the species is different, and partly because the lifetimes of different species are not strictly comparable. Whatever problems exist for predicting safe levels for ordinary toxic materials from animal studies, the problems are further complicated in the case of cancer. Many carcinogenic materials are also toxic, e.g., arsenic and vinyl chloride. The fact that a particular cancer is easily produced by certain agents in test animals is useful in identifying potentially powerful human carcinogens. The usefulness of animal data as a predictor of human cancer is diminished where (1) the cancer is a rare occurrence, (thus requiring a prohibitively large number of test animals to demonstrate a statistically significant effect), (2) a long latency period is required (possibly longer than the animal's life span), or (3) in the cases where different species react differently to various carcinogens. Furthermore, the *relative* effects of a chemical's carcinogenic and toxic potential differ among species. Animal data indicated that vinyl chloride did not cause cancer in the majority of species tested. Yet it has turned out to be a powerful human carcinogen. Where animal data indicates cancer, materials should be treated as suspect. However, where no indication of cancer is found, the suspect agent cannot be assumed safe.

Fortunately, we may be on the verge of a very significant breakthrough in the quick and inex-

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pensive detection of carcinogens. Based on the work of Dr. Bruce Ames at the University of California at Berkeley, a test for carcinogenicity has been developed using bacterial strains which mutate on exposure to carcinogens.<sup>1</sup> The new bacterial techniques may eliminate the lengthy, expensive, and often unreliable animal testing. The new test is in its infant stage, but shows much promise.

## THE NATURE AND DIMENSIONS OF LABORATORY EXPOSURE

There are over 13,000 toxic materials in commercial use today, only about 500 of which have been examined for the purposes of setting threshold limit values (TLV's) for "safe" exposure.<sup>2,3</sup> The number of standards for recognized chemical carcinogens is very much smaller. The Occupational Safety and Health Administration has adopted approximately fifteen including the recently discovered carcinogen vinyl chloride.

The problem with estimating the extent or nature of laboratory exposure to both toxic chemicals and carcinogens is complicated by the continued synthesis of new materials and as yet undiscovered effects of both old and new chemicals. However an examination of the prevalence and distribution of cancer in our society gives some indication of the problem.

Cancer is the second leading cause of death in the U.S. today with an annual toll of 300,000. The incidence of cancer has risen rapidly with industrialization: in 1900, 3.7% of deaths were due to cancer, but by 1968 the proportion of deaths from this cause was 16.5%.<sup>4</sup> In part, improved diagnosis and longer life expectancy due to decreasing prevalence of previous health "scourges" are responsible for this dramatic increase. Nevertheless, there are indications that the *true* incidence of cancer has in fact been on the upswing.

Research in the United Kingdom indicates that over 80% of cancer is of environmental origin and therefore, theoretically, is preventable. This conclusion is based upon the observation that the variation among geographic and occupational environments in cancer incidence rates is enormous. The HEW Task Force on Research Planning in Environmental Health Science reported that:

<sup>1</sup> Time Magazine, Aug. 11, 1975, p. 45

<sup>2</sup> NIOSH Toxic Substances List 1974

<sup>3</sup> ACGIH, Threshold limit Values (1974)

<sup>4</sup> Statement of Marvin A. Kastenbaum, Congressional Record, Vol. 113, No. 108 (Friday, June 30, 1972), P.L.

<sup>5</sup> C.E. Searle, "Chemical Carcinogens and Their Significance for Chemists," Department of Cancer Studies, Medical School, University of Birmingham, England.

*There is abundant evidence that the great majority of malignant neoplasms-- probably over 90 percent of the total -- are induced, maintained or promoted by specific environmental factors. Many of the known environmental causes of cancer are physical and chemical agents that directly concern the environmental health professions. Carcinogenesis must therefore be regarded as one of the most significant potential consequences of environmental contamination.<sup>6</sup>*

Of the 80 or 90% of cancer which could be environmentally caused, it is not presently known how much is *occupationally* related. There seems to be a general consensus among cancer researchers and environmentalists that probably one half of this figure is complicated by *occupational* factors. The experience of chemists, asbestos workers, underground uranium miners-- and most recently, rubber workers handling vinyl chloride--as well as other occupational groups amply documents the case that "excess" cancer of various types is indeed occupationally related.

In an examination of the cause of death among 2,152 chemists age 20 to 64, it was found that there were 444 deaths from cancer, whereas 354 were expected -- a finding which was highly statistically significant. It can be speculated that this excess mortality due to cancer was linked to the carcinogenic nature of certain chemical agents to which these chemists were exposed during the course of their occupation.<sup>7</sup>

In 1968 I was told by a statistician for the National Air Pollution Control Administration that he had observed that chemists as a group die five years sooner than physicists or mathematicians whose mortality and morbidity characteristics were essentially identical. These findings would seem to indict chemicals in general as a cause of death and would seem to make the suggestion that only a few chemicals are doing the harm, improbable.

Since the production of petrochemicals in the U.S. has doubled every five years since the end of World War II, the incidence of cancer characterized by long latency periods may be expected to rise significantly over the next 20 to 30 years. This expectation coincides with considerable legislative activity geared towards chemical regulation--especially of chemical carcinogens.

The recent work on cancer variations by geographical regions in the United States released this year provides even more substantiation that

<sup>6</sup> *Man's Health and the Environment--Some Research Needs*, Report of the Task Force on Research Planning in Environmental Health Science, U.S. Department of Health, Education, and Welfare, Public Health Service, National Institutes of Health, National Institute of Environmental Health Sciences (March, 1970), p. 147.

<sup>7</sup> Frederick P. Li, et al, "Cancer Mortality Among Chemists," *Journal of the National Cancer Institute*, Vol. 43, No. 5 (November 1969), p. 1160.

the bulk of cancer in our society results from the industrial process. The high cancer incidence rates (among white males by the way) are found in what is now becoming known as the "cancer belt" -- from Washington, D.C. to Boston; in Gary and Chicago; at the mouth of the Mississippi, New Orleans where the dumped chemicals accumulate; and in Oakland, California. Cancer in different high incidence counties varies as to its type, providing further evidence of the chemical and industrial origin of the problem.

Of particular significance is recent work from the National Cancer Institute in an appropriately titled paper "Cancer Mortality in U.S. Counties With Chemical Industries." The abstract is worth quoting here:

*Geographic analysis of U.S. cancer mortality, 1950-1969 revealed excess rates for bladder, lung, liver, and certain other cancers among males in 139 counties where the chemical industry is most highly concentrated. The correlation could not be explained by confounding variables such as urbanization, socioeconomic class, or employment in nonchemical industries. If the excess cancer mortality in these areas is due to industrial exposures, the actual risk of cancer among certain chemical workers must be very high. The correlation was limited to counties associated with specific categories of the chemical industry; many involve known occupational hazards, while others suggest new leads to chemically induced cancer in man.<sup>8</sup>*

## THE OSH ACT

The Occupational Safety and Health Act of 1970 has been called by students of labor relations the most significant labor legislation passed since the Taft-Hartley Act. In fact, it may also be one of the most important pieces of legislation from the viewpoint of the chemical industry in its impact on the future and nature of chemical production and innovation of new chemical products and processes.

The Occupational Safety and Health Act of 1970 imposes on virtually every employer in the private sector a *general duty* "to furnish to each

<sup>8</sup> *The Implications of Cancer-Causing Substances in Mississippi River Water*, Environmental Defense Fund, Nov. 6, 1974, Washington, D.C., *New Orleans Area Water Supply Study* prepared by Lower Mississippi River Facility, Region VI, Environmental Protection Agency, November 1974, EPA-906/10-74-002; *Preliminary Assessment of Suspected Carcinogens in Drinking Water*, Interim Report to Congress, Environmental Protection Agency, June 1975.

<sup>9</sup> Robert Hoover and Joseph F. Fraumeni, Jr., "Cancer Mortality in U.S. Counties with Chemical Industries," *Environmental Research*, Vol. 9 (1975), p. 196.

of his employees employment and place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm of his employees." In addition, each employer must comply with occupational safety and health standards promulgated and enforced under the Act by the Occupational Safety and Health Administration (OSHA) in the Department of Labor. OSHA has the authority to enter any workplace without advance notice and to propose penalties upon discovery of violations. The OSH Act does not place special responsibility on project leaders, only employers, but a private cause of action in courts could nonetheless succeed against nonemployers.

The Act addresses specifically the subject of toxic materials. It states that the Secretary of Labor in promulgating standards dealing with toxic materials or harmful physical agents under Section 6 (B) shall set the standard which most adequately assures to the extent feasible on the basis of the best available evidence that no employee will suffer material impairment of health or functional capacity even if such employee has a regular exposure to the hazard dealt with by such standard for the period of his working life. By these words, one can see that the issue of exposure to toxic materials or carcinogens which have long latency periods are covered by the Act in specific terms. The Act makes no distinction between industrial and academic workplaces or between industrial and non-industrial workplaces. The obligation imposed upon employers by the Act occurs in all non-government workplaces.

The Act, in Section 19, States:

*It shall be the responsibility of the head of each Federal agency to establish and maintain an effective and comprehensive occupational safety and health program which is consistent with the standards promulgated under Section 6.*

Let me point out that absent an executive order or a suit against a Federal Agency like HEW to adopt a health and safety program, none would have to be adopted. HEW chose to go forward in developing its own carcinogen policy, but Federal and state places of employment generally have abysmal safety and health records, and no visible programs.

The American Chemical Society in testimony supporting OSHA's adoption of standards for 14 carcinogens supported the concept of a use permit which would have enabled certain laboratories and operations to be exempt. OSHA sought not to adopt the mechanism of the use permit, allegedly because it was impractical to administer such a program. The question then remains whether private laboratories dealing with small amounts of carcinogens need to comply with the rigid manufacturing control requirements for handling of carcinogens. The

simple answer to the question at this time is yes. However, it is also clear that any violation of the Act regarding the handling of carcinogens is reviewable before the Occupational Safety and Health Review Commission which hears contests of any citations issued for a violation of an OSHA standard. The Commission will consider the particular practices and precautions taken by the particular laboratory or operation and decide whether the carcinogens are being sufficiently contained by methods not strictly in compliance with the law. The use permit system would have guaranteed the laboratory that its method of handling carcinogens would not be found in violation of the law. The present requirements shift the burden of proof to the particular laboratory to demonstrate that the laboratory is safe. It requires a gamble on the part of the laboratory that its methods will stand up to be as effective as the control methods mandated by the published standards for the carcinogens. No declaratory judgment will be rendered by the Review Commission so the laboratory will have to have confidence in its methods to deviate from the standards' requirements.

OSHA had at one time proposed specific laboratory standards for handling chemical carcinogens when it proposed its final exposure regulations on 14 carcinogens. The court of appeals, however, remanded them to OSHA because OSHA had failed to give notice of its intent to promulgate them. Although OSHA has recently repropoed the lab provisions in its reinitiated proposed standard for MOCA, there are indications that OSHA is reconsidering the laboratory issue.<sup>10</sup> What effect the HEW protocols for government laboratories might have on the private laboratory remains to be seen.

In our system of government, the passing of federal legislation was the natural response to the expanding problems in occupational health and safety. However, it must be recognized that here, as with the proposed Toxic Substances Control Act, we are faced with the inherent difficulties encountered when the law is used as the predominant mechanism for the social control of science and technology. One of these difficulties is the problem which arises as a result of a lack of knowledge and the absence of a sufficient data base. A good example is the controversy over the adoption of the 14 carcinogen standards of the Occupational Safety and Health Administration. Establishing safe levels for toxic materials on the data presently available is difficult enough. The chronic nature of many diseases, including cancer, compounds the problem by making the unequivocal establishment of causation difficult. In the case of cancer particularly, we have not yet settled the raging controversy over whether there is any "safe level" for exposure to a carcinogen or whether we should

J. R. Long, "Tighter Safety Rules Ahead for Academic Labs". *Chem and Eng News*, July 14, 1975, p 21.

adopt the concept of a "zero threshold", e.g., no permitted exposure. The lack of a firm data base with regard to exposure to toxic materials explains in part why, until recently, only two permanent health standards, those for asbestos and the 14 carcinogens, have been adopted by the Department of Labor. A third standard, for vinyl chloride- was finally adopted after much turmoil.

An insufficient data base raises a question as to the nature of the burden of proof required to make legal-political decisions. The standard of proof required for acceptance of a scientific thesis is much higher than that required by the law. When it comes to safeguarding rights generally under the law, a "scintilla of evidence" may justify legal sanctions, control and even the establishment of liability. This pervasive principle in our system of jurisprudence is not fully understood by "pure scientists" and, indeed, they sometimes view the law as "unscientific". The law attempts to make the best decisions on the information that exists. Absolute certainty or even consensus is not always required. What is required is an opportunity for all the evidence to come in and for all parties to be heard. The evidence being contradictory or poorly substantiated results in the continuation of controversy, long after a standard is set or a decision is made.

Even with the adoption of standards, significant exposure may result. For some of OSHA's 14 carcinogens, substances with less than 0.1% carcinogenic impurities are not considered carcinogenic! I do not have to tell this audience how much 0.1% of a chemical impurity is.

## **COST-BENEFIT ANALYSIS AND THE ASSUMPTION OF RISK**

We come finally to the fourth factor which I would like to discuss: cost-benefit or benefit-risk analysis as it applies to exposure to toxic chemicals or carcinogens in the laboratory. The application of cost-benefit analysis for policy making regarding the appropriate handling of these materials is often seen as a starting point for policy makers.

Cost-benefit analysis has economic efficiency as its only objective. However, the issue of who pays the cost and who reaps the benefit is also important to consider. One person's benefit can not be nicely balanced against another person's cost. A concern for individual justice is a legitimate social goal which may at times conflict with attainment of economic efficiency. One person's cost cannot simply be evenly traded for another person's benefit especially if the risk of harm falls on a selected group of people within an industry or a laboratory.

An analysis of the risk situation for people who work with carcinogenic or toxic materials indicates that there is a significant difference from the risk situation faced by all citizens in the

general environment. If the society collectively decided to tolerate a certain sulfur content in its heating fuels to save costs and is willing to suffer an increase in respiratory disease as a result, there is a certain equity which gives us comfort. All citizens save money, and the risk of disease (within an urban area) is randomly distributed, more or less. But if the society decides to use asbestos wherever it will save money, and a selected group of asbestos workers pay for it with their lives and health, there is a strong argument that the situation is not equitable, even if more lives are saved than lost. For example, by the use of asbestos brake linings more lives may be saved for the public on the highways than are lost by workers in the plant. The non-random selection of those who bear the risk, however, deserves special attention. This distinction is often lost.

Scientists or laboratory personnel who are exposed to toxic chemicals or carcinogens are in a similar risk situation as are workers in an asbestos plant. They are a selected group of people who take the risks in order that the society or the economy benefit from research which involves the handling of these chemicals. It has been argued that the difference between scientific personnel working with dangerous materials and workers exposed to those materials in the manufacturing process is that knowledgeable people can better relate to risks and assess the danger, that their acceptance of employment with dangerous materials is voluntary and further that the salary that a technical person receives incorporates in it the willingness to accept that risk, a sort of "hazard pay" for scientific personnel. I don't think I have to tell members of the chemical community that the relative decrease of wages in the chemical field in any way indicates that the risk that these researchers take, as opposed to physicists or mathematicians, result in a higher wage. Nor do I think it can be successfully argued that man can be economically rational to the extent of relating to extremely low probability risks of an increased incidence of cancer which can manifest its harm or costs far into the future presents a discounting problem which is difficult to perform by even the most far-sighted decision-makers. One additional

point deserves mention: unlike riding a dangerous motorcycle, you can't try out cancer to see if you like it.

It is now recognized that *caveat emptor* (let the buyer beware) in product safety is *not* an equitable principle and imposes an unconscionable contract upon the buyer. Yet, the principle of "let the worker beware" in the manufacturing of that good is retained. The argument that wage differentials in hazardous industries incorporate the appropriate level of workplace risk is about as convincing as the argument, no longer made, that the price the consumer is willing to pay incorporates the risk he is willing to take on being injured by the product he buys.

A recent paper dealing with the difficulties of extrapolating data from animals to man puts it well:

*When people talk about (exposure) levels they "can live with" they must be reminded that these could be the levels that other people might die from.<sup>11</sup>*

Even if we would agree that scientific and technical personnel understand the risk of dealing with toxic chemicals or carcinogens, there is question as to whether the support staff, including assistants and clerical workers in the laboratory, should be exposed to an increased risk of disease as a result of that increased knowledge in the heads of a few. Just as the manager of a factory has a responsibility to see to it that the workplace is kept free of hazardous materials, so does the director of a laboratory or a project leader. I think it would be fair to say that laboratory technicians do not really have a free choice as to whether or not they will work with carcinogens in a project which was established by a director of a laboratory or a project leader. These general support staff move between projects as they are needed. I would submit that while it may be true that the handling of carcinogens can be done more efficiently and better within the laboratory context than within the industrial setting, the mere availability of scientific expertise is not sufficient to justify a free

H.M.A. Schneiderman, et. al., *Annals New York Academy of Sciences* p 244 (1975) *New York Academy of Science*, p 244 (1975)

usage and experimentation with chemicals which are carcinogenic. On the other hand, it is clear that there are technological solutions to the proper handling which apply better in a laboratory than they would apply in the manufacturing process. The Occupational Safety and Health Administration has not yet found a way to officially recognize the difference between laboratories and manufacturing establishments. It becomes a question of the demonstration by the laboratories that safe handling of carcinogens can be effected and that competence can be relied upon by laboratory workers that proper precautionary measures are in fact being taken. While chemical laboratories have shown some concern for toxic materials, carcinogens are not given the serious and different considerations that their nature demands.

The new awareness of toxic chemicals and carcinogens encouraged by the OSH Act and proposed toxic substances control legislation will place new demands on the laboratory chemist. Some new activities will be voluntary; others will be mandatory. Pre-market testing under proposed toxic substances control legislation will affect commercially-oriented laboratories while compliance with OSHA standards will provide the primary legal impact on the university or research-oriented laboratory. It is likely that many substances will either not be required to be tested (because they are already in commerce or considered safe), or that OSHA will be slow in adopting new standards. If this is the case, then personal interest and initiative of the research chemist will be required to make progress in reducing much exposure to toxic materials and carcinogens.

The issue may be illustrated by the following example. As chemists, we have all learned how similar the elements are within a family in the periodic chart. Yet vinyl bromide may remain unregulated for a very long time. Knowing what we do about vinyl chloride, would you work with vinyl bromide in the absence of protective measures? I presume not. Yet, many workers do so without a workplace standard. It would seem that stimulating change in the chemical industry could come from laboratory chemists. I hope they will meet the challenge.

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# OCCUPATIONAL HEALTH AND SAFETY: The Industrial Viewpoint

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I'm happy to be able to speak in this setting because I'm a chemist turned toxicologist and perhaps I have gained some perspective not as easily obtained by chemists, toxicologists, industrial hygienists or whatever alone. It is important, however, for you to understand that I'm an individual and I am employed by the Dow Chemical Company. I can not give the "industrial" viewpoint on the subject of occupational safety and health or any other matter, really. What I do want to tell you is a few of my thoughts and a little about how occupational health and safety are handled at Dow. These views and practices are not necessarily typical of the industry, but they are descriptive of a program of a company which I think handles these problems well.

In talking about health effects related to chemical exposure two definitions are needed: 1) toxicity is the ability of a chemical to cause injury to a living organism by other than mechanical means, 2) hazard is the probability that an injury will occur in a given situation. Probability is a key word in this second definition. The reason for many arguments about chemical hazard, I believe, is lack of agreement or understanding about the question of probability.

I'm glad this seminar was entitled professional responsibility because I think that is what occupational safety and health is, a responsibility of professional people. Industry is people, and the people who are critical in shaping occupational safety and health policy are professional people. Important among these professional people are a variety of disciplines but chemists and chemical engineers are two of the critical professions in this area.

One of the first things we must do is inculcate each and every professional person who is going to make his career in the chemical field with the realization that every compound, every formulation, every manufacturing process carries with it some degree of hazard related to health because of toxicity. Along with this realization should go the knowledge that decisions related to hazard are decisions of risk versus benefit and both the risk and benefit sides of the equation should be evaluated.

The next thing we need to teach professional chemists and engineers is an awareness of what toxicity is and something about hazard evalua-

tion. The reason that chemists and chemical engineers are so critical in this area is because they may be aware of problems or potential problems related to toxicity much earlier than others. To help remind Dow employees of the need to consider toxicity and hazard and to be sure we don't develop products of unknown hazard, we have instituted a product-stewardship program. The aim of this program is to assure that Dow products are developed with careful attention to environmental and health impact. This program involves assignment of stewardship or responsibility for a product or potential product to an individual whose duty it is to be sure that proper testing is carried out and proper evaluations made. The idea extends beyond these individuals in that others become involved in and become aware of the problems and efforts of the product steward. This serves to educate many people to be alert to a variety of problems including occupational safety and health. This program is widely used in the company and has the support of management at Dow. As with many such tools, the actual mechanics of the program are secondary to the awareness of and education about problems related to occupational safety and health and the environment.

I tend to talk about toxicity when occupational safety and health are being discussed because I am a toxicologist. However, there are two other disciplines whose main function lies in occupational safety and, in particular, occupational health. These are industrial hygiene and occupational medicine. Both of these disciplines have important and interdependent roles along with toxicologists in first *preventing* but, when necessary, finding and resolving health problems in chemical laboratories and plants.

In a perfect world, as chemicals are discovered and developed by chemists and chemical engineers, their biological properties would be fully characterized by toxicologists and other biologists. These properties, and the use of the compound would be taken into consideration in a determination of hazard by all involved. The industrial hygienist would monitor the workplace to be sure exposures would be kept below hazardous levels. The medical people would examine all workers to be sure they have no special medical problems which would make them more susceptible to chemical effects. Medical surveil-

lance would continue to be sure that no medical conditions develop which would change the initial judgement. Special medical tests could be instituted to look for effects to be expected from possible exposure to chemicals used in a particular plant.

Now this isn't a perfect world, but I think there are times when we are coming reasonably close to following the sequence of events outlined. Even when we do follow that course of action, with all good intentions, problems still arise and criticisms are made. It seems to me that the source of the criticism in as many cases as not, is our inability to answer all questions because of the complexity of the problem or the state of the art. For example, it seems that many people think our ability to determine toxicity is more refined than it is. Even when our ability is not overrated, our capacity to do this kind of work is overrated.

Since toxicology gets lots of attention these days when occupational health is discussed, I would like to talk, in a general way, about the state of the art with respect to toxicology.

Toxicology, or at least the branch of it with which I am concerned, deals with effects of chemicals on animals. Following collection of data on animals, judgement is applied in an effort to relate the data to potential effects for man. In many cases we may recommend levels of exposure which appear to be reasonable for man based on this data.

What are the kinds of tests and their degree of reliability for predicting effects in man? The place to start toxicity work (and hazard evaluation) is by determining the acute effects of chemicals on animals. That is, what effects are produced after a single or short exposure. The tests that are normally done in this area are tests for acute oral toxicity, skin and eye irritation, tests for absorption through the skin, and acute inhalation tests when appropriate. These tests are reasonably reliable and lead to fairly good judgements when properly interpreted. These kinds of tests have been done for many years and there is reasonable agreement on the general way in which these tests are done.

I'd like to tell you a little anecdote just as an illustration of the advances we've made in this area over the years. One of the problems that led

to the establishment of the Toxicology Laboratory at Dow was deaths, human deaths, resulting from phenol exposure on the skin. Phenol is important Dow product then and now, and of course the company was concerned about how to prevent such deaths. A consultant was hired who advised Dow that the treatment of choice after skin contact with phenol would be to wash the skin with alcohol. This conclusion was based on the fact that phenol is much more soluble in alcohol than in water. So that seemed very logical. However, problems continued to occur so Dr. Don Irish, Dow's first toxicologist, was hired and presented with this problem. He determined that injury or death after skin contact with phenol could be prevented by washing with water. Even though the phenol is not as soluble in water it can be more effectively removed because large amounts of water can be used, and the solution which is formed is so dilute that the material is effectively carried away from the skin. When a solvent such as ethanol is used for washing the phenol off, the solution that is formed is more concentrated and tends to spread the phenol around to other areas of the skin thus increasing the area of contact. For many years the industrial hygiene practice for phenol has been to prevent skin contact, of course, but in the event of skin contact to wash with large amounts of water. One would think that this problem should be pretty well settled. However, a very recent publication from England has revived this question and has tried to establish by use of rabbit tests that washing with water is not as effective as washing with a variety of solvents. And, I suspect, a great deal of discussion will occur on this subject.

I think this anecdote serves to illustrate that there may not be widespread agreement on the best way to do things even after 20-30 years of experience. However, we must do what we can to evaluate acute effects and to make recommendations based on these evaluations that we believe will help to protect people from effects resulting from acute exposure to chemicals. At Dow we have at the very minimum some knowledge of these acute effects of chemicals on animals before any large scale production takes place, and in most cases before even a pilot plant scale operation is initiated. In many cases, we go a step further and perform these kinds of tests on compounds early in the research stages to assess their toxicity. This data can then be used to help assess the risk side of the risk-benefit equation before heavy capital commitments are made to production plants.

After some idea of the acute effects has been obtained, it is necessary to make an assessment of the effects of repeated exposure to chemicals. Ideally, these exposures, like the acute exposures, are by the same route of exposure as those expected for man. For example, if we are talking about a volatile material which people may inhale, then repeated inhalation exposures would

be appropriate. Repeated exposure toxicity studies have generally been classified into at least two types based on duration. Those lasting from several days up to several months are generally referred to as sub-acute or sub-chronic. The other type, chronic exposures, usually last a major portion of the animal's lifetime, for rodents a year or more. Many sub-chronic tests have been done. Usually various parameters are monitored during the course of treatment, and at the end of the studies the animals are killed, broken up into their component parts, and these studied microscopically to look for morphological changes. The skills that have been developed for doing these kinds of studies have been honed to a high degree and these studies can be carried out fairly efficiently. But there is a lot of work involved in these. Probably the most critical parameter is the pathological study done at the end to look for microscopic changes in the organs and tissues. Unfortunately, this is a very empirical science and there is often times much discussion over the significance or, on occasion, even the existence of a particular lesion or finding. In any case many of us feel that these sub-acute or sub-chronic studies short of lifetime are some of the most reliable studies done. Best in the sense that they leave the greatest sense of satisfaction and the fewest unanswered questions as long as cancer is not one of the questions. Included among sub-chronic studies are a variety of special studies. These would include studies of teratogenicity, reproduction and mutagenicity.

The other kind of study which is so critical today is the chronic toxicity study. These are carried out in large numbers (I hope) of animals for a major portion of the animal's lifetime. The main reason these studies are done is to detect cancer. However, I believe that such studies should characterize the total response of the animal to the chemical and not just provide a count of lumps and bumps.

Another very important special aspect of toxicology is becoming more and more important to us. That is the study of pharmacokinetics and metabolism. The studies done in this area have as their aim definition of the kinetics of disposition of chemicals (not necessarily pharmaceuticals) once they have been administered to an organism. Knowledge of the rate processes to which a chemical is subjected in the body may be crucial in forming judgements about the importance of exposure to a given chemical. The assumption that appears to have been made many times in the past is that any size dose of a chemical is handled similarly by an organism. That is to say, its rate of disposition by the organism depends on dose in the same way regardless of the size of the dose. This overlooks the possibility of saturable detoxification processes. For example, when the concentration of a chemical in the body is low there may be an enzymatic process which converts that chemical to another compound at a rate such that it can be readily

eliminated without causing toxicity. If the concentration of a chemical increases, that is if the dose is increased, the original enzymatic process may become saturated, or overwhelmed, and other processes which may proceed at slower rates will become more important as means of clearing the compound from the body. At high dose levels these alternate processes may overshadow the process taking place at low levels even at doses below those required to cause acute poisoning. If the metabolic reactions taking place at high concentrations should produce a more toxic chemical, then the response may be quite different. In some cases an actual carcinogen may be formed by these alternate metabolic routes. How can we be sure that such processes are not taking place at high levels to produce carcinogenic intermediates? We can't be sure of that, but many animal studies have been done at very high dosage levels and resulted in toxicity and in particular, in some cases, in a carcinogenic response. How meaningful are such studies if alternate metabolic processes are induced at these high levels? It is rare that man is ever exposed on a chronic basis to high levels of compounds, so should such studies be assumed valid for making judgements for man? I feel that at the minimum these high dosage levels must be examined with pharmacokinetic techniques to establish that a similarity to the rate processes at lower dose levels exists before a judgement of carcinogenicity for man can be made. Ideally the entire metabolism of the compound should be known and verified in man.

A case in point, and one under study in our laboratory now, is vinyl chloride, a compound of obvious high interest. I don't think any of us would argue at this stage about the ability of vinyl chloride to produce liver tumors in man or animals. However, it took rather high levels and long times to produce tumors in animals. What data is available on exposure of people who showed liver tumors indicates that the levels to which they were exposed were relatively high. Epidemiologic studies at Dow on 30 years experience with vinyl chloride production and handling by 594 employees has revealed no angiosarcomas. Also, there were no cases of acroosteolysis, a wasting of the bones of the extremities, which tends to be associated with vinyl chloride exposure. Based on animal studies done at Dow the levels of vinyl chloride in our plants has been controlled and was sequentially reduced so that the levels to which people were exposed were generally below 50 ppm of vinyl chloride. Workers exposed to higher levels for similar periods of times in other companies, have shown liver tumors but we have not seen any at Dow. There is a good set of experience in the Dow employees indicating that if vinyl chloride is controlled to reasonable levels, in our case 50 ppm, perhaps the risk for liver tumors is not as high as some might think. Another lesson I think we can learn from this

data is to use all data available to us. There sometimes seems to be a tendency to rely on animal studies alone to tell us about carcinogenic effects when there may be large human populations available on which reliable epidemiologic studies can be conducted. All this data should be used in making decisions about future human exposure.

I would like to close with a few points about priorities and resources. Many of you may be familiar with a list that came out not long ago which was taken from the toxic substances list by the National Institute of Occupational Safety and Health. This was a list of over 1,000 chemicals which have been classified as carcinogens or neoplastigens based on various kinds of data, mostly animal studies. Now there is no doubt that some of these chemicals are carcinogens in fact and impose a great hazard for man. But I think it is equally likely that many of these com-

pounds are not really carcinogens at all or are such weak carcinogens as to be easily handled. By no problem I mean the risk of handling or using these compounds is not really very high. However, we can't ignore data which suggests a compound may be a carcinogen. Thus, it will be necessary to study and restudy many of the compounds in that list as well as other compounds, especially new ones which are being developed. Particularly for trying to study carcinogenicity in animals, about the only good choice at the moment is large scale, long term tests. These tests are expensive in both facilities and manpower. The expense *per se* doesn't particularly concern me because I feel the economics of a compound must be able to support an adequate assessment of toxicity. But, since there just aren't enough resources available now to study all of the compounds that need to be looked at, we are all going to be in the position of helping to develop priorities. In addi-

tion to making these priority assessments it is my personal feeling that the final selection of what is to be studied must be communicated more broadly to develop or to prevent duplication of effort by various laboratories. It would be very unfortunate for two or three laboratories to be performing long term inhalation studies on the same compound.

There are a number of other topics which I think should be discussed by an industrial representative to a symposium such as this. However, I don't think you'll want to sit and listen to me all day so I won't bring them up now. One is the subject of what represents an acceptable degree of risk. We hear a lot of talk about safety which seems to imply that people expect absolute safety. Let us remember we all take risks everyday. Some are voluntary and some are involuntary but it is impossible to eliminate risk from our lives.

Thank you for the opportunity to present these remarks.

## NOTES



# THE CHEMICAL PROFESSIONAL'S RESPONSIBILITY IN AREAS OF OCCUPATIONAL HEALTH AND SAFETY: THE CONCERN OF ORGANIZED LABOR

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Director of Industrial Hygiene

United Rubber, Cork, Linoleum and  
Plastic Workers of America, AFL-CIO, CLC

The viewpoints which will be discussed may generally reflect organized labor's attitude, but more specifically will relate to the Union which I represent, The United Rubber, Cork, Linoleum and Plastic Workers of America and Canada.

Having served all sectors including Academia (administrative and research), Industry (research and consultative), Government (consultative and research), and Organized Labor (consultative, research, and administrative) as a professional, I find myself in a unique position to address a group of professionals who have the direct line responsibility of providing workers with the safe and healthful work environment to which they are entitled. This responsibility is social, moral, ethical and, with the advent of OSHA and NIOSH, legal.

My prime responsibility to the International President of our union, Peter Bommarito, is to assist our 190,000 members working in about 600 manufacturing facilities in the United States and Canada, by providing a service that could eventually permit our membership to work and live safely and healthfully. My department is involved in all aspects of Safety and Health, including negotiations, on-site visits and surveys, worker and management training and indoctrination, and providing technical guidance to our current negotiated research studies being conducted at Harvard's and the University of North Carolina's Schools of Public Health.

Our goal is environmental and medical control of workers exposed to the multitude of chemicals which may affect them. These conditions have shattered their lives by early death from cancer and other fatal disease, and have produced lingering and painful occupational diseases which rob them of those so-called "golden years" of retirement.

These comments are *not* speculative, but are based on numerous published reports in medical and technical journals from this country and Europe. The epidemiological studies have indicated an extremely high incidence of death from following causes: leukemia (cancer of the blood), lung cancer, bladder cancer, mesothelioma cancer, lymphosarcoma, and coronary-vascular disease. Morbidity studies have shown heart disease, serious lung disease,

disabling skin disease, diabetes, polyomotor disturbances, cancer of the prostate, brain damage, and damage from physical factors such as heat and noise.

The epidemiological *mortality and morbidity* data leads to the identification of causative agents. Benzene and leukemia; chloroprene and phenylamines and skin cancer; isocyanates, asbestos, talc, mica, free silica, and carbon black producing lung disease and cancer. In essence, they indicate that workers in the rubber industry are at risk. Vinyl chloride and other monomers show the risk to our members manufacturing polymers and using them in the plastics industry.

Workers in this country and in the world are at risk, and *unfortunately*, the risk and hazard potentials are not accepted, recognized, considered, or are generally ignored by the professionals to whom we look for guidance.

In addition to my responsibility in coordinating our Joint Occupational Health Program studies at Harvard and the University of North Carolina, my assistant or I may visit one to three local unions per week in the United States and Canada, where the workers in the plants have problems in areas of safety or environmental health. Problems vary in degree of hazard. We investigate death, serious injury from process equipment and material handling, or conditions and situations which the workers feel are unhealthy or unsafe.

Seldom does a company, large or small, welcome me with open arms. Initially, they fear and reluctantly tolerate my presence. Some, but very few, refuse my entry to evaluate conditions in the plants for fear that I will inform the workers about the serious hazards that exist. Of those few, and only three plants have not permitted me free access, two will never refuse me again, and the third is about to learn a lesson in diplomacy.

This now leads into the area of professional responsibility -- the academician as the teacher and researcher; the industrial researcher and developer; the plant chemist, the plant manager, and the plant engineer.

Two of the speakers this morning are going to address the role of responsibility of the Educator and the Academic Chemist, and I would be remiss if I did not touch on this most germane area.

In June of this year, we responded to a request from the Environmental Studies Board of the National Research Council's Commission on Natural Resources which was established to advise the EPA on its role in research. My recommendations to the Board are summarized as follows:

- I. Initiate action to gather data to realistically set more TLV's --
  - A. Pre-testing of new chemicals
  - B. Testing of currently used chemicals
  - C. Develop techniques for toxicological evaluations
- II. Develop a system to consider synergistic effects -- and to evaluate the hazard potential of mixtures.
- III. Evaluate the additive effect of community air or water pollution on workers exposed to environmental insults in the workplace.
- IV. Develop or use a cancer registry system and initiate epidemiological studies not in conflict with NIOSH or OSHA responsibility.
- V. Initiate studies to evaluate and/or isolate hazardous compounds resulting from chemical, physical, or heat degradation or decomposition of polymers especially in the rubber and plastics industries which produce in-plant and out-plant exposures.
- VI. Initiate studies in the areas of proper disposal or decontamination (deactivation) of potentially toxic or hazardous chemicals.
- VII. Provide support or initiate action to train professionals, specialists, para-professionals, etc., in all areas of environmental health.
- VIII. Provide input to academic institutions to include environmental studies in germane curricula, including schools of medicine, toxicology, pharmacology, engineering and law."

All the items mentioned above do relate to the chemical professional, and items VII and VIII specifically touch the role of the teacher and his responsibility which really should begin in elementary and high school so that the ground rules will be set for undergraduate and graduate school career courses. These courses must incorporate attitudes of responsibility in the rec-

ognition of roles in the total society picture of environmental health and safety problems.

No real effort is made in high school "shop" or chemistry classes to indoctrinate students.

Undergraduate chemistry, engineering, and related science laboratories are in themselves, the worst examples of unsafe and hazardous conditions. Accidents, fires, and explosions are not uncommonly encountered on the campuses that turn out the analytical chemist, the plant engineer, and the plant manager of a large chemical complex. Has the graduate chemist or engineer ever heard of a TLV? Can he relate the lower explosive limit to a worker exposure limit? Has he been taught to become concerned with the toxicity of a chemical, chemical process, or a piece of mechanical equipment? Does his thesis advisor ask him to consider the health aspects of his research project? The answer to all of these questions, generally speaking, is *No*. The graduate school curricula produces the same product - a generally uninformed or misinformed individual who is embarking on a professional career.

Unless the graduate is a product of a school specializing in environmental health sciences, and unless he is employed in a setting where safety and health is emphasized, his ignorance in these areas follows him. He may unknowingly injure himself or his co-worker, or design or operate a system which could seriously injure workers for whom he is responsible.

Even our medical schools may only provide occupational medical input of a single one half or two hour seminar in a four year course.

What do I find in the plants I visit?

— A plant manager who is totally uninformed about the hazards which exist in his plant and who delegates the safety and environmental health responsibility to a minor role and an untrained person.

— A plant manager who doesn't care, and sets his priorities in terms of dollars and cents of production - OSHA, and worker health and safety are unnecessary overhead.

— A plant manager who may be informed and concerned, but has no in-house capability to evaluate or control health or safety problems.

— A plant manager who must rely on an outside source, from the corporate level, a consultant or an insurance carrier.

— A plant engineer who is so involved in production issues that he can't find time to be concerned about worker health or safety.

— A plant engineer who does not know what a velometer or an air sampler is.

— A plant engineer who doesn't know about the design of ventilation systems and hires the local tin smith to put in a beautiful looking system that only wastes electricity.

— A plant chemist who has no awareness of the nature of the chemicals that are used in the plant relative to health hazards.

— A safety man who wears many hats, and his safety activity is just window dressing.

— A doctor or a nurse who are only concerned about fighting workmen's compensation claims to satisfy an employer.

— And finally, an endangered species - the working man and woman employed in industry today.

The above illustrate real life conditions and situations which relate directly to the role of the professional originally responsible for their training in academic institutions.

Perhaps the comments above may not relate specifically to those in attendance at this symposium. Perhaps some may feel that they may be just comments to generate an adversary role. One may feel that the institution or industry he or she represents does not fit into the listed patterns. Certain larger industries *may* have programs and responsible professionals to provide safe and healthful work conditions and environments. Some academic institutions may just be beginning to recognize their responsibility.

The greater majority of workers in this country are working in facilities employing less than 200 workers. These smaller companies are not Dows, Du Ponts, Firestones, Rohm and Haas - they have no in-house or corporate capability on which to rely, but they still have the same responsibility.

I'm not implying that the larger corporate entities are doing the job they should be, but they do have the *awareness*.

OSHA has sharpened professional awareness - informed workers' share in the awareness. How many of us really know how our responsibility is going to be broadened? The new supplementary health standards are going to shock all of us into reality.

Labelling, placarding, development of meaningful material safety data sheets, worker training and indoctrination, and specific requirements for monitoring and medical surveillance on at least 400 chemicals are about to overwhelm you if you had not been preparing yourselves. The chemical professional will be directly involved in all phases. The Toxic Substance Control Act will further delineate your responsibility.

The research or development chemical engineer will be required to recognize and build-in features he previously did not consider when he designed a pilot plant. Older plant will be redesigned. The analytical chemist will be required to develop analytical procedures to monitor not only in-plant, but also out-plant environments. The plant manager must develop personnel capable of complying with all phases of management responsibility in worker health and safety. The plant engineer will be required to understand his responsibility in complying with performance and work practice standards. Equipment manufacturers will be required to develop equipment capable of performing "in compliance."

And most of you will be using the cloak "economic feasibility" to hide behind.

And the worker may still be the pawn.

The complex problem of environmental control is not a singular effort, it is the *combined* effort of a team:

- The academician
- The research scientist
- The industrial hygienist
- The toxicologist, the occupational physician
- The engineer, the safetyman
- The worker
- The worker and his union
- The worker, his union and the company.

Our professional, vocal, social and ethical responsibility, objectively, has been and will be the same when it relates to worker health and safety. The *scope* of our responsibility has changed - let's accept the challenge, face it realistically, but yet objectively, roll up our sleeves, and begin doing what should have been done years ago - today!

Labor's concern is going to try to make sure you assume the responsibility to protect the American workforce.

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## LETTERS

Sir:

*Time does not permit an elaboration of my experiences with the "Letters" column of C&EN. Suffice it to say that they were mostly negative. I do have one suggestion I would like to cover. "Letters" should offer space for a variety of opinions on matters of a subjective nature. Brief correspondence on chemical hazards, misprints, brief technical reports, etc., should be carried in a "Technical Communications" section.*

Regards,  
J. D. Frazee

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