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SOLVING THE PROBLEM OF THE TOXICITY OF NEW CHEMICALS IN INDUSTRY

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The prevention of occupational disease requires that knowledge of the potential hazards of the materials handled by workmen shall be readily available to industrial physicians and industrial hygiene engineers. Useful information concerning the more familiar chemicals is widely circulated but every year the research departments of several manufacturers are finding ways to produce economically one hundred or more chemicals new to industry, or sometimes new even to science. Many firms are becoming active in the field and in the aggregate well over 1,000 chemicals are newly available each year. Most of these will never enter commerce because applications justifying their production will not be discovered, but the sales departments of the corporations involved are staffed by resourceful, imaginative men, one of whose jobs is to find uses for new chemicals. Perhaps 250 new molecules will be made and shipped in small amounts each year and about 10 will eventually fill such a large need that tons will be shipped at one time.

The physician knows that an excess of any chemical whatsoever will injure the body, although he has confidence in the industrial hygienist who tells him that any chemical can be used safely once its particular hazards are known and guarded against. Nevertheless, it is pertinent to ask what is being done to prevent injury to the health of workmen by way of discovering the nature and degree of the hazards of these new compounds, and to what extent the health of the public is being protected in the matter of keeping unsuitable chemicals out of the preparations it can purchase for its own use or abuse.

Unfortunately, only broad generalities about hazards can be predicted in advance of pharmacological experimentation. Consequently, research chemists must make a new chemical to obtain a sample for test before they themselves can know how dangerous to handle it may be. If they are wise they will proceed as if the danger is great until the contrary is proven.

It is clearly the duty of a manufacturer to delay production of a chemical until the health hazards are well enough defined so that protection of his workmen is possible. It is also his duty not to sell a chemical for an application in which it would endanger the health of the public, and to inform customers, by proper labelling and otherwise, of the hazards of the compounds they buy.

One may say that the solution of the problem of new chemicals is simple. Turn each one over to a university pharmacology department for study before any is sold. This may be practical for the firm with one or two new compounds, but the manufacturer with more than 100 new ones every year finds that there are not enough pharmacology departments to do his work, and that the professors are reluctant to repeat the same tests over and over upon a continuing series of samples, in spite of the generous subsidies which may be tendered.

More important than this is the objection that it is impractical to spend thousands of dollars studying the health hazards of each of 100 chemicals every year when it is certain from past experience that sufficient applications to justify manufacture will be found for only 10; and that it may be several years before even these 10 will earn a profit. Yet if one compound injures a workman or customer, the direct financial loss may well be measured by thousands.

All producers of chemicals are probably aware of the problem which the flood of new materials presents to the industrial physician and the hygienist. The matter is the responsibility of industry and in only rare instances is it proper to depend upon federal or state agencies to alleviate the situation. Several solutions have been evolved by single manufacturers and it is of interest to examine one of them in some detail. Eight years ago one firm established, at its own expense, an industrial fellowship under my direction at the Mellon Institute of Industrial Research of the University of Pittsburgh. The organization has grown steadily and we now have a staff of 18 technically trained persons, and facilities to house about 3,500 animals, with further expansion visible in the near future.

By means of close contact with the research, production, sales, and medical departments of this manufacturer our group is made aware of all new chemicals which he develops. In most cases we are informed before more than a few pounds have been produced, and always before the compound has been sold for larger than trial orders. Our records of continuous toxicological studies over the years allow us to discriminate promptly between those materials which almost certainly are devoid of hazard to health when handled in industry, and the

smaller number which possibly may manifest injurious action unless precautions are taken to protect workmen from contact.

Upon all chemicals suspected of being potentially injurious to workmen or about which any doubt is entertained, we at once perform pharmacological experiments designed to elucidate the situation. By means of tests upon small animals we investigate the hazard of swallowing, of skin penetration, of inhalation, of skin contact, and of eye contact. The methods are standardized and the quantitative results allow us to select from our files another chemical, more familiar to the manufacturer, whose hazards (which he well knows how to guard against) bear such and such a relation to those of the new one under study. This information, because of species differences, is not quantitatively precise, but it is a guide to plant physicians in observing the first men to handle the new chemical in quantity.

We refer to this procedure as a range finding test.[1] It is performed in a short time at a cost of only a few hundred dollars, and the results can be made known to the producer before the stage of pilot plant operation is reached. If the chemical proves unpopular and is not sold, little effort has been wasted. If it is sold the toxicological data obtained serve as a guide for protecting workmen and also for judging the safety of proposed uses.

After a time it may become apparent that the new material will be made and sold in larger quantities. Not until then is it appropriate to perform more detailed and more expensive studies which will employ several species of animals and perhaps a few human subjects, and which will reveal more precisely the quantitative hazards which must be guarded against in applications of the chemical, and the nature of injury which overexposure may produce. When this information is published in the medical literature, our function is fulfilled in respect to the particular material, and the physician and hygienist are thus informed so that they can intelligently safeguard health.

BIBLIOGRAPHY

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More people in this country are suffering from arthritis or some rheumatic manifestation than the sum of all of the individuals who are affected with cancer, tuberculosis, diabetes, and heart disease. —J. F. in Ohio St. Med. J.

OXYGEN TREATMENT FOR CHLORINE GAS EXPOSURES

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Chlorine is used in a number of industries. It is an industrial hazard among several classes of workers. These include dye workers, laundry workers, bleachers, chloride of lime workers, employees detinning tin plate scrap, and employees working in chemical plants where chlorine is utilized in the manufacture of various chemicals.

Chlorine gas has a characteristic pungent odor with an irritating effect on the nose and throat. It has a high coefficient of expansion and its solubility in water at 20° C. is 215 volumes in 100 volumes. It has been commonly supposed that chlorine reacts with the moisture on the tissues to form hydrochloric acid, and that its detrimental effects arise from the action of this acid. A more probable theory of the action of chlorine is that it affects moist tissues in the same way that it does other moist organic material, namely, by the abstraction of hydrogen from the water present, the liberation of nascent oxygen, and then the formation of hydrochloric acid.[1]

Inhalation of chlorine elicits respiratory reflexes and causes coughing, smarting of the eyes, a general feeling of discomfort in the chest, a hoarse cough, nausea and vomiting. The face may become red and bloated because of venous congestion. Inhalation of chlorine affects, and produces inflammation of, the entire respiratory tract. Edema of the lungs may occur after a severe exposure. The most pronounced symptoms are suffocation, a feeling of constriction in the chest and tightness in the throat. Fortunately, the gas has adequate warning properties provided one can get away from its vapors.[2]

PHYSIOLOGICAL RESPONSE TO VARIOUS CONCENTRATIONS OF CHLORINE[1]

	Parts of chlorine per million parts of air
Maximum concentration allowable for prolonged exposure	0.35 to 1.0
Least detectable odor	3.5
Maximum concentration allowable for short exposure (½ to 1 hour)	4
Least amount causing immediate irritation to the throat	15
Dangerous for even short exposure	40 to 60
Rapidly fatal for short exposure	1,000