OCCUPATIONAL CANCER HAZARDS FOUND IN INDUSTRY*

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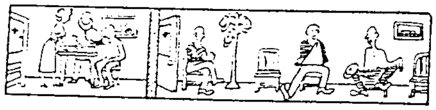

The various occupational cancer-producing agents can be divided into two main groups. The cancer-producing agents of physical nature are ultraviolet rays present in the spectrum of the sun rays, X-rays, and the rays emitted by radioactive material of natural or artificial origin.

It appears from investigations of recent years that excessive exposure of the skin to the rays of the sun may be responsible for a majority of cancers of exposed skin, such as of the face, neck, hands and forearms, and the lower lip, particularly in fair complexioned people working outdoors in dry, sunny climates—farmers, oil field workers, prospectors, cowboys, mailmen, sailors, road workers and ranchers.

During recent decades roentgen rays and radioactive material have found rapidly increasing uses in laboratories and workshops concerned with mining, chemical, pharmaceutical, rubber, metallurgic, aviation, radium, dial painting, refining and shipbuilding industries, bringing occupational cancer hazards to certain groups of workers and technicians employed in or near these specialized operations. Depending upon whether the contact is directly to the skin or by ingestion or inhalation, persons exposed to these rays may develop cancers involving the skin, subcutaneous connective tissue, bones, blood-forming organs, and lungs.

The second main group of environmental agents possessing recognized or suspected cancer-producing properties includes both chemicals of well-established identity and ill-defined chemical mixtures. These different cancer-producing chemicals vary a great deal in their potency, while again as with the physical agents, the type of contact as well as the chemical characteristics of the particular substances decides the location within the body of the resulting cancers.

Inorganic Chemicals

Among the inorganic chemicals having cancer-producing qualities, the ingestion or inhalation of arsenicals may cause cancers of the skin in apparently predisposed individuals. Recent observations indicate that inhalation of arsenical dust may favor the development of cancer of the lung. Inhalation of chromate dust likewise is responsible for a high incidence of cancer of the lung among chromate workers, while the inhalation of vapors of nickel carbonyl results in cancer of the nasal sinuses and of the lungs among nickel refinery workers in plants using the Mond process of refining.

There is increasing evidence indicating that exposure to asbestos dust may create an increased liability to lung cancer in the presence of an asbestosis of the lung. It is still too early to know definitely whether or not contact with beryllium and its compounds may lead to the development of cancer affecting the lung or the bones. So far, no evidence exists suggesting such future developments in humans, although rabbits when injected with several beryllium compounds reacted with cancers of the bones.

Organic Chemicals

While these metallic carcinogenic agents are relative newcomers, and thus our knowledge concerning them and their effects is still highly incomplete, there is much more definite information available concerning the cancer-producing organic chemicals including the undetermined and complex mixtures of such chemicals existing in tar, pitch, asphalt, petroleum and its various processed products, soot, crude paraffin oil, creosote oil, and crude anthracene oil. Among the many thousands of chemicals which modern chemical industry has produced there are only a few for which definite cancer-producing properties have been demonstrated.

There can be no doubt that contact with two important dye intermediates, namely beta-naphthylamine and benzidine, elicits, in exposed workers, cancers of the urinary bladder. Some 1,000 cases of this particular occupational cancer are on record from Europe and America. If such contact is sufficiently severe and prolonged it appears that cancers may develop in all exposed workers. Fortunately such conditions of exposure are not likely to exist now in modern and well-managed dye works. Derivatives of these compounds are used as anti-oxidants in the natural and synthetic rubber industry. In operations in which latex is made and processed, if the anti-oxidants used are contaminated with free beta-naphthylamine left in the compounds during their manufacture, a cancer hazard may be created.

Under certain conditions of exposure, benzol used in the rubber industry as well as in other industries, is strongly suspected of causing cancer of the blood-forming tissues. These diseases are known as leukemias and lymphosarcomas.

Extensive Research Carried On

Cancer research has uncovered several hundred chemically related substances, many of them specially synthesized, and some of them dyes, which produce cancer in experimental animals. To date, none of these compounds has been demonstrated to have causal relation to the development of cancer in man under environmental or occupational conditions. During the past two decades, this intensive search for specific cancer-producing chemicals has been carried on. The initial stimulus for this phase of cancer research can be attributed to the work of two Japanese investigators who, in 1912, showed that tar applied to the skin of rabbits elicits, after prolonged treatment, cancer of the skin. Later, a group of English workers headed by Cook and Kennaway, isolated a chemical, 3, 4 benzpyrene, from large amounts of tar. They found that this chemical causes cancer in mice when painted on their skins. These two discoveries meant that definite proof of the cancer-producing properties of certain types of tars, product of the incomplete combustion of coal, was established.

For five decades these substances had

*Delivered September 14, 1949, at the Congress of International Chemical Workers Union, Mount Royal Hotel, Montreal, Canada.

been suspected of causing skin cancers in workers having occupational contact with them. The rather extensive statistical data collected by the chief inspector of factories on the occurrence and incidence of tar cancer in English workers include a great variety of occupations that have a liability to this occupational disease. Included in the group are exposure to pitch, asphalt, creosote, soot, and anthracene oil, which contain tar or tarlike material as the active principle.

While the majority of the more than 1,500 tar cancers observed involve the skin, recent observations made among coke-oven stokers in Japan and Canada suggest that the inhalation of hot tar fumes may cause cancer of the lungs. The industrial use of tar, pitch, asphalt, creosote, soot and anthracene oil is very widespread and varied. Coming mainly from gas works and coke ovens which furnish the most potent types of cancer-producing tar and related substances, they enter into the manufacture of fuel, dyes, plastics, paints, insulating material of cables and electrical equipment, impregnation materials of wood, paper and textiles, building materials, such as tiles, cork brick and linoleum, road-building materials, embedding material of optical goods, rubber, inks and brushes.

Cancer-producing agents of a chemically similar nature seem to be generated when oil shale is heated in retorts to high temperatures for the production of shale oil. The crude shale oil, as well as its processed fractionation products used extensively as lubricants in English textile plants and for the manufacture of paraffin, has given rise to the development of cancer of the skin in approximately 1,900 workers employed in English industries during the last 35 years. Since the production of shale oil has been carried on almost exclusively in England, only isolated cases of shale-oil cancer have been observed from contact with imported shale oil in the United States. However, this picture may change in coming years, unless proper precautionary measures are taken, because for several years shale oil production has been underway on a smaller scale in Australia and may assume large proportions in the United States following the completion of the experimental work carried on in the Rocky Mountain region.

There is definite evidence on record showing that some of the crude petroleums as well as a number of the fractionization products of petroleum, such as heavy oils used for lubrication, fuel and obtained during the production of paraffin as well as petroleum tars, asphalt and coke, possess cancer-producing properties. Such observations have come from Austria, France, England, Czechoslovakia, and the United States. Since exposure to these agents is mainly to the skin, the great majority of the oil cancers rarely affects other organs such as the lung or the stomach. The total number of oil cancers recorded from all sources is about 100, which is astonishingly small when considering the relatively large number of persons exposed to such products either during their manufacture or during their extensive and varied use especially in the consumer field.

While several recent observations suggest that other and previously unsuspected types of chemicals may be involved in the production of occupational cancers, I hope the data presented have given you an adequate although brief panoramic view of the various physical and chemical agents which may cause cancer under certain occupational conditions. These may affect the skin, nasal sinuses, lungs, bones, urinary bladder, blood-forming organs and connective tissues.

Protection for Workers

However, in listing various occupational agents as cancer-producing, it would be incorrect to conclude that the mere presence of any of these agents in a particular operation is proof of an active cancer hazard for all persons employed there or entering it at regular or irregular intervals. If, for instance, proper precautionary measures are taken and if particularly a perfectly working closed system of production exists, there is no danger for the workers, since there is no exposure to the cancer-producing agent handled. Cancers developing in workers of such operations therefore cannot be charged to an occupational exposure to cancer-producing agents.

Length of Exposure

Past experience, moreover, has shown that there exist rather definite and constant relations between the site and the time of appearance of an occupational cancer on the one hand and the type, intensity and duration of exposure to a particular occupational agent and the nature of the agent on the other hand. Occupational cancers, for instance, require as a rule a minimum time of exposure varying from 1 to 5 years, although occasionally a shorter duration may be recognized as being effective when special conditions are present. Similarly, occupational cancers often develop many years after an exposure to a cancer-producing agent has ceased.

This period of delay in the appearance of an occupational cancer after the start of the exposure may range from 5 to 50 years depending on the type of agent and the intensity of exposure to it. It is, on the other hand, not essential that there be a continuous exposure to a cancer-producing agent. Many observations indicate that discontinued or intermittent exposures, if sufficiently strong, may be quite effective in eliciting cancerous reactions. In evaluating alleged occupational cancer hazards and in adjudging claims made in such matters, the time and type of relations are important and deserve competent and critical consideration for medical and medico-legal reasons.

Proof of Cause

The demonstration of cancer-producing hazards in industrial operations depends on two types of evidence. If epidemiologic studies including a statistical analysis of the disease and death records from cancer show that workers employed in a certain plant or one of its operations have an excessive incidence rate of cancer and that cancer of one or two organs accounts for most of this excess, one must conclude that most likely an occupational cancer hazard exists. Such investigations must cover a period of at least 10 years of plant operation and must take into consideration the length of time elapsed since the plant started to operate. It takes usually some 10 to 15 years after a plant containing an occupational cancer hazard has opened before a statistically significant number of occupational cancers is demonstrable. Even this evidence may be completely obliterated by a rapid labor turn-over, unless the final fate of workers formerly employed in such a plant can be ascertained.

Another epidemiologic approach which is now extensively used in the United States and England is through an analysis of death certificates. In such investigations the occupational history of all persons dying during a

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...nt period from cancers of certain organs is ascertained by various means. With this information available it is possible to obtain through field studies detailed data on occupational exposures sustained by the deceased individuals. From a critical evaluation of this evidence it is possible to spot cancer producing occupational agents. Such surveys are obviously highly complex undertakings which require the participation and teamwork of competent specialists of various types and the wholehearted cooperation of industry. Whenever such a combination of factors can be obtained, the results are generally gratifying and make up for the expense and labor expended.

The second type of significant evidence is of a medical nature. Many, while not all, cancer-producing agents leave some symptomatic telltale footprints along the trail before cancer becomes apparent. Such warning signs when recognized and correctly interpreted by the plant physician can lead to the discovery of a cancer-producing hazard even before any actual cancers have made their appearance. For this type of competent medical care it is essential that the plant physician be intimately familiar with the technical operation of the plant, the products used and manufactured, including impurities and wastes, and that he possesses special knowledge concerning the acute as well as the delayed effects which may be produced by them in human beings through various routes, contacts and physical conditions.

Unfortunately, occupational cancers affecting internal organs are not preceded by any characteristic or appreciable warning symptoms. In fact, in some of them the general health may remain remarkably good, although the cancer may have reached an advanced stage. Thus, while thorough and competent medical studies of workers and the analysis of their medical records may render valuable information on the question of occupational cancer hazards, our knowledge of such matters is at present still too defective to make this a reliable procedure in all cases.

The discovery and study of occupational cancers and of industrial cancer-producing operations and agents is of a practical and scientific importance greatly transcending the rather narrow limits of the industrial field. Results from such investigations add to our knowledge of agents that may cause cancer in man and that may be quite different in part from those that elicit cancers in animals. Such data are of immediate value in ascertaining the role which environmental agents may play in the causation of cancer in the general population. Only to the degree that we discover definite causes of cancer are we able to apply rational and effective preventive measures. Since occupational cancers are practically the only cancers for which well-defined cancer-producing agents are known, the study of these cancers represents one of the main avenues for finding the causes of human cancer. It is to be expected that many of these prospective causes will turn out to have no relation to industry or industrial environment.

In the meantime, in the face of a rapidly expanding industrial activity, it is essential that research into all phases of occupational cancer be carried on with increased energy, so as not only to conquer the recognized industrial cancer hazards, but also, to keep ahead of future developments and to discover environmental and occupational cancer-producing agents before any major damage can be done by them.

A. M. A. Reports on Study Of Aluminum Therapy For Silicosis

The Council on Industrial Health and the Council on Pharmacy and Chemistry of the American Medical Association have made a report on the present status of aluminum in the therapy and prophylaxis of silicosis.* The report was printed in the *A. M. A. Journal*, July 23, 1949.

Dr. Ernest W. Brown, executive officer, Committee on Scientific Development and Education of the Council on Industrial Health, and Dr. Walton Van Winkle, Jr., secretary, Therapeutic Trials Committee, Council on Pharmacy and Chemistry, summarize their report as follows:

1. Studies on the therapy of silicosis thus far have been inadequately controlled. The majority of subjects have reported subjective improvement, apparently of psychic origin. No convincing evidence of objective improvement either of pulmonary function or by roentgen ray has been forthcoming. Certain cases have shown eventual progression by roentgen ray subsequent to aluminum therapy under present conditions of dosage.

2. It is too early to expect evidence of the effectiveness of aluminum prophylaxis in men who do not have a history of exposure to silica dust prior to the beginning of the treatment. It is a fact that certain Canadian miners with a history of previous exposure have shown roentgenologic progression despite treatment with aluminum, although statistical data are not as yet available.

3. Aluminum is apparently not harmful to the normal or silicotic human lung in the dosages given for the therapy and prophylaxis of silicosis. Whether or not it increases susceptibility to tuberculosis is unproved. As far as we can ascertain the mass administration of aluminum in the United States and Canada over the past 5 to 6 years has not had an unfavorable effect in this respect, although again statistical data are not yet provided. However, great care should be taken to exclude the tuberculous in selecting persons to receive aluminum therapy.

4. It is not believed that a scientifically controlled experiment in industry is feasible for the evaluation of aluminum for the prophylaxis of silicosis. This follows from the uncontrollable variables inherent in the industrial situation and other factors which have been discussed. For these reasons, it appears improbable that any research agency would consider it advisable to undertake such a project except under special conditions already discussed, and which may not be attainable.

5. The McIntyre Research Foundation, as presently organized, is not equipped to solve the aluminum prophylaxis problem in relation to silicosis. The steps considered necessary to accomplish this objective are outlined.

6. Research should be continued with laboratory animals with the object of finding a more adequate basis for application to man. Such study is now included in the program of the Saranac Laboratory of the Trudeau Foundation.

*Reprints may be secured from Dr. Ernest W. Brown, 535 North Dearborn Street, Chicago 10, Ill.