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ENVIRONMENTAL CANCER HAZARDS CAUSED BY INDUSTRIAL AIR POLLUTION

Introductory Comment to the Discussion

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AN APPRECIABLE number of recognized or suspected occupational cancers are probably caused by inhalation of certain cancerigenic chemicals in dust, fumes, vapors, mists or gases (figs. 1 and 2). Many of these industrial agents are also introduced into the air while they are being used or released as waste products. Because the minimal effective cancerigenic dose of almost every one of these agents is yet to be established, the possible, even the probable, existence of cancer hazards resulting from pollution of the environmental air by chemicals represents an appropriate subject for those taking part in this conference to consider.

With the exception of soot as a possible cause of cancer of the lung and cancer of the scrotum, cancer-producing factors polluting the environmental air have only rarely been considered or investigated in connection with cancer in man. Studies of this problem which render valid evidence are difficult, complex and time-consuming. There is small wonder, therefore, that at present all available data on this matter have suggestive value at best, and most are mere speculation.

Some years ago Green alleged that the sulfur dioxide released during the burning of coal and the smelting of ores is the cause of an excessive incidence of cancer among population groups exposed to the fumes. On the other hand, Stephens blamed carbon monoxide, which was introduced into the atmosphere from domestic and industrial sources, for causing cancer in certain workers and the general population. These claims have little, if any, basis in fact.

Much more substantial, however, is the evidence in regard to other industrial products (table). There can be no doubt that products of the combustion and fractionation of coal, such as soot containing cancerigenic tar, tar fumes, pitch and tar dust are polluting the environmental air from various sources and at many places. Similarly, combustion products and processed fractions of mineral oils, shale oils and natural gas are released into the air as domestic or commercial soots and fumes,

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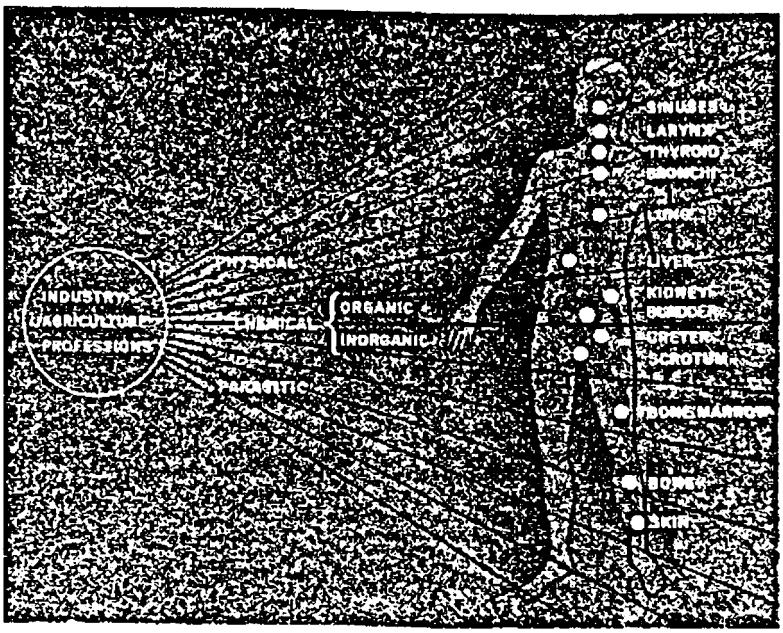


Fig. 1.—The environmental cancer spectrum.

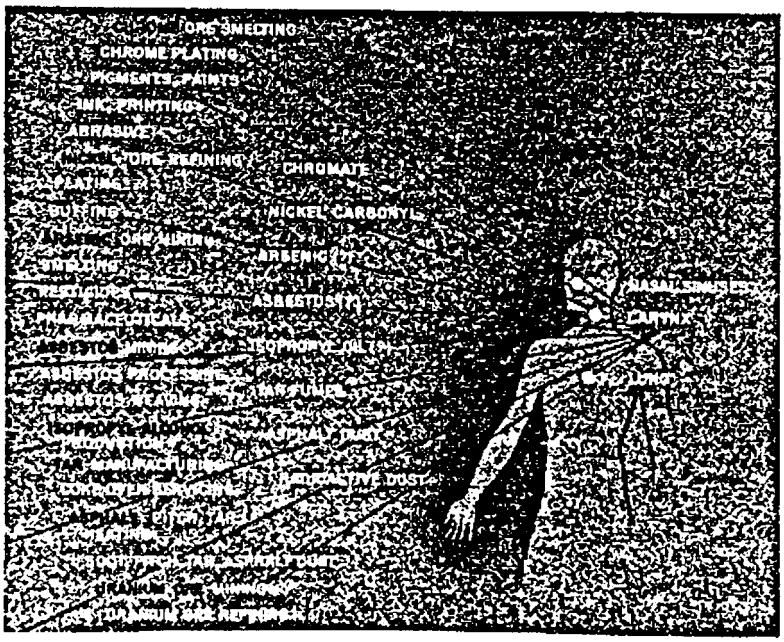


Fig. 2.—Established and potential sources of environmental respiratory cancer.

Environmental Cancerigenic Agents and Sites of Cancer

Cancerigenic Agent	Type of Contact	Site of Cancer
	Aromatic Organic Chemicals	
Benzene	Cutaneous	Leukemia
	Respiratory	Lymphosarcoma?
		Myeloma?
Aromatic amines	Cutaneous	Carcinoma of bladder,
Beta naphthylamine	Respiratory	ureter, renal pelvis
Benzidine		
Coal tar, pitch,	Cutaneous	Carcinoma of skin
asphalt, soot,		
bitumen, creosote	Respiratory	Carcinoma of lung
oil, anthracene	(fumes)	
oil (3,4-benzpyrene)		
Shale oil		
Lubricating oils		
Crude paraffin oils	Cutaneous	Carcinoma of skin
Lignite oils		
Lubricating oils		
Crude paraffin oils		
Tar oils	Cutaneous	Carcinoma of skin
Petroleum and		
petroleum products		
Lubricating oils	Cutaneous	Carcinoma of skin
Crude paraffin oils		
Fuel oils	Respiratory	Carcinoma of lung?
Commercial soots	(Mist-Dust)	
	Aliphatic Organic Chemicals	
Isopropyl oil?	Respiratory	Carcinoma of nasal sinuses
		and lung?
	Inorganic Chemicals	
Arsenicals	Cutaneous	Carcinoma of skin
Inorganic and organic?	Alimentary	
	Respiratory	Carcinoma of lung?
		Carcinoma of alimentary
		tract?
		Carcinoma of bladder?
Chromates	Respiratory	Carcinoma of lung
Nickel carbonyl?	Respiratory	Carcinoma of nasal sinuses
		and lung
Asbestos	Respiratory	Carcinoma of lung
	Physical Agents	
Ionizing radiation	Cutaneous	Carcinoma and sarcoma
of electromagnetic		of skin
(gamma) and corpus-	Respiratory	Carcinoma of lung
cular types (alpha, beta)		Carcinoma of nasal sinuses
from radioactive	Alimentary	Sarcoma of bones
chemicals	General body	Leukemia, lymphosarcoma
	Parenteral	Carcinoma of liver?
Ionizing radiation		
from x-ray tubes	Cutaneous	Carcinoma of skin
		Sarcoma of connective
		tissues and bones
	General body	Leukemia, lymphosarcoma
Ultraviolet radiation		
solar radiation	Cutaneous	Carcinoma of skin

Cancerigenic Agent	Site of Cancer	Species
Potential Environmental Cancerigenic Agents and Cancer Sites		
Aromatic amino compounds		
o-aminoazotoluene	Liver	Rat
n-aminoazobenzene	Bladder	Mouse
2,3-azotoluene		
n,n1-diethyl-p-amino-azobenzene		
4-dimethyl-amino-benzene-1-azonapth-thalene		
4-oxy-2:3-dimethyl-azobenzene		
2-acetylaminofluorene		
2-aminofluorene		
Dibenzocarbazole		
4-dimethyl-amino-azobenzene		
Estrogenic compounds	Breast	Mouse
Stilbestrol		Rat
	Uterus	Guinea pig
	Hemopoietic tissue	Mouse
Aliphatic compounds		
Chlorinated hydrocarbons	Liver	Mouse
Chloroform		
Carbon tetrachloride		
Diethylene glycol	Bladder	Rat
Carbamate derivatives	Lung	Mouse
		Rat
Thiourea derivatives	Thyroid gland?	Mouse
Beryllium	Bone	Rabbit
Selenium	Liver	Rat

or may cover mineral particles escaping from cracking towers, thereby becoming a part of the constituents of smogs. Whenever production and waste disposal methods in aromatic amine operations are inadequate, dust, fumes and vapors of beta or alpha naphthylamine and benzidine may enter the air of the factory fume zone. The large scale use of arsenical dusts as pesticides and the long-continued and formerly uncontrolled release of arsenicals with the waste fumes of metal ore smelters may have created potential cancer hazards in many regions. It may be wise to consider the possible existence of similar conditions for the population living near chromate factories, beryllium operations and asbestos mills. In recent years the potentiality of cancerigenic air pollution hazards in connection with many establishments in which radioactive material is produced, used or handled has become an important factor in their operations.

Cancerigenic agents polluting the air may enter the human body by inhalation, cutaneous contact or ingestion. Exposure of the population to cancerigenic air pollutants, especially those of stable nature, may result from their subsequent incorporation into and contamination of drinking water, foodstuffs and soil. Cancers caused by cancerigenic air pollutants may affect not only parts of the respiratory tract, such as the lung or the nasal sinuses, but, depending on the nature of the agent and the type of exposure, may affect other organs, such as skin, bones, bone marrow and bladder.

The future control of these potential hazards depends, first, on the reliable qualitative and quantitative demonstration of cancerigenic agents in the air around establishments producing or handling recognized or suspected cancerigenic agents; second, on thorough epidemiologic studies of cancer incidence in the population living in the fume or waste disposal zone of such plants; and third, on the subsequent institution of effective measures preventing further release of cancerigenic agents into the environmental air.

To cope properly and speedily with this new health hazard from air pollution in the modern industrial environment, it is essential that industrial management, public health agencies and the medical profession be alerted to the problem and that they work together harmoniously in trying to solve it.