WORLD HEALTH ORGANIZATION
REGIONAL OFFICE
FOR THE EASTERN MEDITERRANEAN

ORGANISATION MONDIALE DE LA SANTÉ
BUREAU RÉGIONAL
POUR LA MÉDITERRANÉE ORIENTALE

SEMINAR ON AIR POLLUTION

Teheran, 21-29 April 1969

EM/SEM.AIR.POL./11
10 April 1969
ENGLISH ONLY

SOME EPIDEMIOLOGICAL THOUGHTS ON AIR POLLUTION

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Introduction.

Among the many research projects which are presently under investigation, the field of biomedical research has gained the strongest impetus in recent years. Efforts are directed toward conquering the diseases which alter man's normal course of existence. Although diseases have been with man since his existence it was not until the past century that he developed the tools and techniques to discover the etiology and thus control many of these diseases. There are still, however, many diseases whose origin cannot be readily determined and hence it is difficult to find the proper means for the study of these diseases. Many of these diseases are, unquestionably, the result of the vast advancement of scientific technology.

While the epidemiological aspects of most communicable diseases have been studied with varying degrees of success for many years, the epidemiology of the non-contagious diseases have focused the greatest attention to the public in the last two decades. Many investigators believe that the air pollution problem is responsible, to a great extent, for the increase of non-contagious epidemics that have occured in many areas of the world. Unfortunately the search for adequate proof of the correlation of disease to air pollution has been greatly hindered because (1) no single source could be demonstrated as the only cause of the adverse effect, immediate or delayed, (2) in most cases air pollution epidemics were recognized some time after

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they had occured, and (3) no exact disease pattern could be demonstrated in any of the previous episodes. Hence, the study of air pollution epidemics includes a number of variables, in addition to human factors, that may result in a completely different conception of the term epidemiology. Perhaps only one certainty exists at the present, and that is much work and effort needs to be accomplished for the demonstration of this complex "cause - effect" relationship.

The Problem.

In the "classical" approach of studying epidemics, it has been customary to accept the causative role of the mechanisms of bacterial infection. Even if a patient shows symptons having little resemblance to the "classical" reaction, the diagnosis may be defended with the understanding that the pathologic conditions produced by any infective process are, among other things, a function of the host tissue, as well as the activities of the agent and thus an induced risk of error is recognized.

There are no ready made recipes to be followed in the study of air pollution, nor is there general agreement among scientists upon the application of "Koch's postulates" to this problem. But to clearly establish the fact that an air pollution epidemic is or has been present the following conditions must be met:

1. There is, or has been, recognized a number of cases of respiratory illness clearly in excess of normal expectation
2. The number of excess cases demonstrate symptoms of a toxic effect
3. A pollutant capable of causing this respiratory toxic effect is, or has been, present

4. All of the cases admitted are, or have been, exposed to this pollutant, and

5. There are no other sources which cause, or could have caused, this epidemic

In addition the "toxic effect" must be characterized by the manifestation of symptoms that can be diagnosed by the clinician. The occurrence of a toxic pollutant then must be demonstrated by the quantitative and qualitative examination of the air. The interpretation that can be drawn from this study, wether or not a toxic pollutant exists, will also depend upon the association of time and place. Furthermore, the absence of any other causative agent must be clearly ascertained and the effect of the pollutant must be clearly demonstrated. In many cases, air pollution has been accused of being the cause merely because of the increased prevalence of nonspecific illnesses reported which may be entirely due to the variation in severity occuring all the time. Therefore, the most important factors that must be determined are (1) there must be a "population at risk", and (2) there must be an "excessive exposure". But in order to define "excessive exposure" there must be a sufficient concentration of a toxicant prevailing for a certain time period in a certain area and an unquestionable toxic effect must occur within this certain time period. If this condition can be, or is, met then the validity of evidence for the clarification of this problem is clearly established.

The Present Status of the Epidemiological Aspects.

Unfortunately, the above statement in its present form may too rigid to generally be acceptable by the scientist because the above conditions are not exactly met nor are they applicable to the normal urban environment.

In all known air pollution disasters no single pollutant ever could be demonstrated as the causative agent. The cause-effect relationship has been demonstrated mainly in the older age groups and in those persons already suffering from respiratory or cardiovascular disease. Furthermore, in some episodes a "quick" as well as a "slow" consequence was observed; and hence would aid to the puzzle of this complex problem. In addition, the various types of pollution and the variables existing from one region to another region greatly hinder any recognition of an epidemiologic pattern.

The existence of an air pollution epidemic was recognized but too late in most of the known episodes. A review of the "London Epidemic" showed clearly a sudden increase in the mortality rate in excess of normal expectation; even so these rates are recognized, albeit belatedly, it is difficult to tetrospectively analyse the situation and, hence to find a conclusive cause-effect relationship. The other difficulty with retrospective studies arises in the determination of wether there was a specific or a non-specific chronic disease present and to what extent personal atmospheric "pollution" i.e. "cigarette smoking" contributed to the disease. In spite of these disadvantages, it is evident that the retrospective study plays a vital role in epidemic investigations because (1) they provide data that may be useful for future studies, (2) the mode of occurrence may be determined more readily, (3) some responsible factors may be detected that have not been detected previously, and (4) some logical patterns are existing and their recognition will enable the prevention of some future epidemics.

Toxicological studies have played an important part in the determination of the effects of pollutants upon laboratory animals. Of the many studies that are presently under investigation, studies of the toxic effect of pesticides, radionuclides in the air, and the exhaust from moving vehicles

have gained the strongest impetus in recent years. The threat of these pollutants to the environment has been recognized and, thus, may be the possible reason for this intensified research. There are, however, limitations in the evaluation of the results obtained from these laboratory studies. These limitations are (1) the experiments are performed in a "controlled environment", and (2) the very same toxicants may not produce the same symptoms in animals as in man. The differences in anatomical structures and in metabolism of the various species used in investigations play an important role in the determination of the toxic effect of some pollutants. The use of primates in the study of tl possible effects of pollutants has gained much attention in recent years. The cloe evolutionary relationship of these animals to man, and the fact that these animals adapt well to the outdoors, may result in studies that simulate more closely the conditions to which the population is at risk.

Possible Future Trends in Epidemiologic Studies.

The need for further intensified field and laboratory studies of the many problems brought about by air pollution is apparent. These studies are not only justified by reason of human health, but also by the economic loss that is associated with this problem and for pure ethstetic reasons. In many instances unusually strict control measures are imposed upon the sources of pollution, even though the limitations of the atmosphere in coping with the ordinary emissions are not well recognized for lack of knowledge. These control measures forced the industries and the communities to accept an additional financial burden without really demonstrating a reduction in the harmful effect to man and his environment. This may be a

reasonable approach to the problem but, needless to say, it also causes a great deal of frustration and, usually, leads to fruitless discussions. The latter being mainly due to the inability of trapping all wastes from all sources or because the process is uneconomical. This may lead to the assumption that this type of "non-specific" control does not satisfy the requirement and hence the "calculated risk" can be demonstrated again.

The epidemiologists studying the patterns of infectious diseases have recognized some fundamental approaches for some time. Some of these approaches are the intensive clinical study of the disease process, the demonstration of the agent and its culture, the study of the population at risk under different degrees of exposure, and to support their findings with laboratory experiments. The study of environmental pollution epidemics has not, unfortunately, developed this classical approach. The reason for this slow development may be found in the relatively young problem and also in the complexity of this type of study. The methods usually employed in this type of epidemiological study were confined to the determination of simple incidence and point prevalence of some diseases and to the calculation of specific mortality and morbidity rates. These methods are basic, to say the least, for little is known about the person, the place, and the time. Furthermore, little information can be retrieved about the environmental factors that may be, in part, responsible for the clinical symptoms or for the possible reason of Exitus. It is evident that the approach to this type of study must be executed on a broad scale in order to effectively determine the magnitude of the problem; needless to say this is not an easy venture.

The primary problem may be the inability of recognizing the disease entity and thus the possible cause-effect relationship. This indicates that, regardless of the diagnostic procedures used, any inference drawn will automatically be received ressessive, depending upon the motives of the individual. Consequently, the investigator should rely for his indices on those diseases that are suspected to bear a relationship to the prevailing atmospheric conditions. To do this the atmospheric conditions must be analyzed with respect to the type and magnitude of air pollution, and to metereological patterns. This analysis may prove to be difficult for there are many variables that must be taken into consideration. But if and when these two conditions are met, then the causal relationship of agent - disease may be established, provided that the responsible "reservoir" of the agent can be found. This might be very difficult to prove for there are many different materials found in air. Unless the mode of transmission can be clearly demonstrated. which is peculiar to one agent, it is unlikely that the presence of air contaminants can be shown as the primary cause and not merely as being a possible contributing factor.

To better understand some of the aspects of the epidemiology of air - borne outbreaks, it appears necessary to refine and to expand the data on incidence and point prevalence. This does not, necessarly, require a sophisticated method for a statistical analysis of the data, but should be directed more toward comparing different sample populations which are exposed to different levels of the environmental conditions. The degree of sucseptibility of an individual to air pollution should also be established with particular emphasis to the specific age groups, the socio-economic level, the geographic location, and his habitats. Another factor that must be included into this data is the type of work the individual performs,

This may lead to a better understanding of the clinical findings.

As mentioned previously, in most known episodes the most effected people were the elderly or those persons with chronic respiratory or with cardiovascular symptoms. Consequently, the determination of the age - specific attack rate will result in the best index of the problem, particularly when compared to other population samples. The socio - economic level of the sample may be of greatest interest to the study because it may reveal several important factors. These factors may include the type of housing, the degree of susceptibility within one group, the nutritional level of the sample or of the population, and the living pattern of the individual in the sample. The geographic location of the sample is important because (1) unusual topographic features will determine the greatest possible variation in the amount of exposure, and (2) the meteorological conditions vary greatly from one place to another place.

Carefully planned and executed laboratory studies will greatly enhance the success of any field study. The present status of laboratory investigations is not overwhelmingly optimistic; the problem though is not an easy one. More investigations must be performed with animals that resemble more the patho - physiological patterns of humans, and more studies must be conducted under more natural environmental conditions. With a gain in scientific knowledge from these laboratory investigations a better understanding of the epidemiological aspects in air pollution will be achieved and new and better tests will be developed for a more precise diagnosis of the disease.

Conclusion.

It is appreciated that the study of the epidemiological aspects of "airborne contaminants" is not an easy venture nor is it an inexpensive one. The solution to this problem has not been answered satisfactorly even so some progress has been made in recent years. But the need for further study of this complex problem is apparent, not only by those few idealistic investigators who are dedicated to science and to this society, but every individual can and must help, if only for the sake of his own comfort. Finally, it is hoped that this statement of the problem may help in sec ing the concern and the thoughts of the individual for an emphatic support to a "reasonable" solution of this paramount problem.