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SOME APPROACHES AND PITFALLS

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ACCIDENT RESEARCH is highly heterogeneous in content and emphasis. It ranges from intensive studies of the role of specific variables to broad-scale investigations of accident incidence. There are many types of accidents, and many factors, often interrelated, that may be significant. This complexity is soon apparent to those approaching the subject for the first time, and it remains a source of concern to established investigators. In view of this, it is our purpose in this chapter to introduce some of the general concepts which have proved useful. We shall consider also the use of incidence rates derived from large populations—for example, that of the United States—and note the limited usefulness of such compilations in the determination of causation. Finally, we shall emphasize that, unless he uses appropriate methods and bears in mind the complexity of the field, the research worker is likely to overemphasize the importance of the variables with which he is particularly concerned.

THE NEED FOR A BALANCED APPROACH

Despite their frequent biases and lack of specificity, data summarizing the incidence of accidents in large populations can be used profitably, especially in identifying the general types, numbers, and trends of accidents. They are also used to support statements to the effect that accidents constitute a major *practical* problem and that as such they justify the application of those same concepts and methods that have proved fruitful in the understanding and control of related problems.

This emphasis on the practical has proved very useful to those seeking encouragement and support for accident research and control programs; it has, in fact, facilitated many of the investigations cited in this volume. It tends, however, to divert attention from theoretical and interdisciplinary problems not recognized as directly relevant to the solution of specific, practical problems. This emphasis on what is thought to be the obviously practical has been coupled with and has engendered a narrowness of subject matter, concept, and methodology which has unquestionably impeded progress in the field. The literature is largely parochial, fragmented, and divergent, and even where this is not the case it is difficult to find contributions which are constructively synthetic rather than merely eclectic.

These deficiencies are well illustrated by a number of the selections in this volume, even those chosen as the best available examples of their types. With the exception of the paper by Gordon, however, which follows below, and of the many papers that are to various extents in its lineage, there have been few even partially successful attempts to provide conceptual frameworks within which the *entire* subject of accidents, regardless of type, might be approached systematically.

Such an over-all synthesis must provide a framework within which it is possible to consider not only accidents in large populations but also those occurring to individuals. It must be equally adaptable to accidents in which the physical characteristics of the environment are of primary importance and those in which medical, physiological, behavioral, and other more "human" factors are dominant. For example, it must be equally useful in the analysis of accidents as diverse as those involving explosions, falling cornices, and equipment failures, at the one extreme,

and those involving ruptured aneurisms and psychological upsets, at the other. It must serve also as a device for the recognition and categorizing of factors and their interactions, to be considered in the systematic analysis of any accident or group of accidents.

Ideally, the approach must be intentionally multifactorial and must avoid *unsupported* presuppositions as to the primary causes either of accidents in general or of those in the specific group under study. Unsupported presuppositions, as we shall note in subsequent chapters, have proved a stumbling block to many who, in discerning the unique contributions of their own disciplines, have attempted to explain essentially all accident phenomena in terms of the concepts and groups of variables with which they are customarily concerned. Nonetheless, it must be recognized that much good work can be, and has been, done with the use of approaches which are not generally satisfactory.

Attempts to explain phenomena in narrow terms are characteristic of the development of a new area of scientific concern. This has been seen repeatedly in medicine and biology, as indicated, for example, by the formerly common phrase "the germ theory of disease." This early phase is followed by a second, in which more sophisticated research is accompanied by increasing emphasis on the apparent complexity of the field and, concomitantly, by despair as to the possibility that a relatively simple, unifying conceptual framework might be developed. Accident research in general has reached this second phase,¹ and we could cite many dogmatic statements that it is impossible for it to progress further. This view, however, is not supported by the evidence and is challenged in the first reading—a discussion of an open-ended but nonetheless structured approach to accident phenomena.

THE EPIDEMIOLOGY OF ACCIDENTS

—John E. Gordon, M.D.

According to Westbrook² the importance of a scientific paper can be measured in part by the frequency with which it is referred to in others' work. Judged by this criterion, Gordon's work ranks high, since it has been referred to, discussed, and productively applied by many of the authors represented in this volume. This is not to say that the use of its framework poses no problems, a point to be discussed below; but it represents that great rarity in accident literature, a practically useful device for at least approaching the entire field.

EPIDEMIOLOGIC METHODS IN ACCIDENT RESEARCH

To understand the importance of Gordon's paper, it is necessary to recall that it was written in 1948. That decade, despite the world conflict which dominated its first half, witnessed dramatic progress in the control of important infectious diseases. The sulfa drugs, the first of the antibiotics, DDT, and greater understanding and use of immunization and related measures had all contributed to sharp declines

in the incidence and prevalence of such diseases. As a consequence, those concerned with public health slowly began to realize that the substantial increases in the relative importance of accidents could no longer be ignored. This realization is reflected in many of the papers that follow. Many public health workers, however, then, as now, appeared to have had little understanding of or feeling for this area and for its close relationship to the concepts, subject matter, and methods which had classically been the concern of the profession. Gordon's paper contributes toward the resolution of this continuing problem.

In this context, it stands as a carefully organized and well-documented statement of the appropriateness and potential utility of applying to accidents an approach long applied to more traditional problems. Gordon points out that epidemiology has been successfully "extended from its original restriction to the communicable diseases to a broad application to mass disease of man; to cancer, diabetes, congenital anomalies, and many others." He adds, however, "It is not so generally appreciated that injuries, as distinguished from disease, are equally susceptible to this approach, that accidents as a health problem of populations conform to the same biologic laws as do disease processes and regularly evidence comparable behavior." This introduction is strongly supported by a series of examples drawn in parallel from the infectious disease and accident literature.

Gordon makes quite clear that by "the epidemiology of accidents" he means those aspects of human ecology that are especially pertinent to the occurrence of accidents in human populations. Since these unplanned events relate to virtually all of the interminably complex aspects of the human situation, he explicitly extends to this area the conceptual framework found useful in handling the same types of variables in the study of the gross incidence of infectious and noninfectious diseases. Within this framework he demonstrates that it is possible to delineate patterns in the distribution of these otherwise seemingly chance events which may lead (and in many instances have led) to an understanding of their causation and to the possibilities for their control. The approach is used both to describe the frequency and distribution of accidents, especially in large populations, and to organize the search, particularly in more homogeneous groups, for factors etiologically associated with increased incidence, facets of the epidemiologic method which MacMahon *et al.*³ have defined as "descriptive" and "analytic."

Applied to any medical problem, this approach involves essentially sorting out the mixture of factors associated with increased incidence. It is an ordering process analogous to that used in approaching any other similarly mixed bag of events whether, for example, "fevers" or meteorological phenomena. It is the first step in focusing down from the gross to the specific.

The readings in this chapter, in contrast with those in Chapters 4 through 9, are concerned chiefly with the descriptive epidemiology of accidents as they occur in large, heterogeneous groups. Such patterns are usually so general that their description contributes but little to the understanding of causation in any immediate sense, a fact well understood by many of those working at this level of analysis. Work of this type represents, however, a necessary step without which it is often impossible, in practical situations, to identify the general areas from which an accident problem is originating and to determine their relative importance.

THE CONCEPT OF CAUSE

Although the terms "cause" and "causation" are often used in these descriptive papers, emphasis is placed on the qualitative and quantitative definition in statistical terms of the parameters, and their relationships, associated with high rates of occurrence. This level of analysis is often far removed from those which emphasize the identification of specific "causes." Half a century ago Bertrand Russell pointed out that the "notion of cause" is foreign to what he referred to as the more established sciences, and that their concern, rather, is with the delineation in mathematical terms of the interrelationships of the variables with which they deal.⁴ Without taking sides in the attack on determinism launched by Russell and others, one may note that this emphasis is becoming increasingly widespread in accident research. A paper by Shaw and Sichel, for example, claims the successful identification, for uniform exposure, of *individual* accident rate patterns, derived without substantial attention to the activity of specific "causes."⁵ Other examples, easily identified by their complete or substantial avoidance of the terms "cause" and "causation," are to be found in the chapters that follow. Other authors use the term "cause" chiefly as a synonym for mechanisms of injury (e.g., "piercing instruments") without indicating or recognizing that this often contributes little to the understanding of the factors that led up to the accident.

Gordon's approach represents an intermediate position well illustrated by his subtitles. Progressing from a discussion of "Movements of Disease and Injury According to Time," he considers "Accidents as an Ecologic Problem" and points out the usefulness in given situations of considering "causation . . . as something more than [a function of] the agent directly involved. . . . Rather it is a combination of forces from at least three sources . . . the host, . . . the agent, . . . and the environment in which host and agent find themselves." This stress on the interaction of multiple causes is further developed by consideration of categories of characteristics of host, agent (see below), and environment which, though always somewhat important, may be especially so in specific instances. Although characteristics of many types are considered, of particular interest in connection with Chapter 8 is his statement, "Whatever the kind or nature of mass disease or injury, the part exerted by the socioeconomic environment is probably the most neglected of any epidemiologic influence. . . ."

Unfortunately, in the accident literature and elsewhere, the term "epidemiology" is given a wide and confusing variety of meanings, and Gordon's usage differs from that represented in subsequent selections.* Moreover, members of collateral disciplines have tended to regard epidemiology as primarily an extension of the concerns and methods of their particular fields. This has been especially true of workers close to the classical subject matter of public health, and the increasing representation of additional disciplines in public health research has served to confuse the matter even further.

Such views overlook the fact that, although the variables and substance with which such disciplines commonly deal are relevant to epidemiology, they do not contribute the bulk of the subject matter with which it has been and is now concerned,

* Gordon has defined epidemiology as the study of medical ecology in all of its ramifications. This definition is preferred by the present authors.

including as it does matters as diverse as incubation periods, the ecology of nonhuman vectors, the effects of ionizing radiation and air pollutants on populations, secular variations in disease incidence and prevalence, and various medical correlates of socioeconomic indices. Since the wellsprings of accidents are similarly diverse and involve many of the same human and environmental variables, we have not in this volume approached accident research from only one disciplinary viewpoint but rather we have, in the manner of the epidemiologist, attempted to emphasize the manifold ways in which the particular concerns, viewpoints, and tools of various disciplines may be brought productively to bear on the subject. For this reason, Gordon's paper, with its emphasis on multiple causation, ecologically considered, is an appropriate introduction to this broad sampling of accident research.

EXISTING RATES for deaths from accidents and violence remain numerically at almost the identical level of 1900, 88 per 100,000 population in 1900 and 88 in 1946. The relative position among public health problems is at a higher level, since these conditions have advanced as a cause of death in the United States from sixth place in 1900 to third in 1946.

Industry and various governmental agencies have given much attention to the accidents that occur in the places where men work, in public areas, and in relation to motor cars. Accidents in homes outdistance any other class in the losses they cause, whether judged by deaths, by the permanent defects that follow, or by temporary disability. Like all programs for the prevention of mass disease and injury, that directed toward accidents is necessarily a team effort involving a number of agencies and a variety of disciplines. Although health departments have an obligation in all accident prevention, a better record for home accidents is believed to depend largely upon what health departments do in that field. If home accidents are primarily a public health problem, then that problem is reasonably to be approached in the manner and through the technics that have proved useful for other mass disease problems. This includes first an epidemiologic analysis of the particular situation, an establishment of causes, the

development of specific preventive measures directed toward those causes, and finally a periodic evaluation of accomplishment from the program instituted.

No need exists in these days to trace the way in which the epidemiologic method has extended from its original restriction to the communicable diseases, to a broad application to mass disease of man; to cancer, diabetes, congenital anomalies, and many others. It is not so generally appreciated that injuries, as distinguished from disease, are equally susceptible to this approach, that accidents as a health problem of populations conform to the same biologic laws as do disease processes and regularly evidence a comparable behavior. This is readily indicated by an initial comparison of representative diseases and injuries according to frequency distributions in time, an epidemiologic characteristic of established value in separating one mass disease from another, and in distinguishing kinds of behavior.

MOVEMENTS OF DISEASE AND INJURY ACCORDING TO TIME

The point epidemic is perhaps the most arresting of all distributions in time, that circumstance where a sharp aggregation of cases occurs within a brief interval as the result of a single agent acting during a prescribed and limited time (Figure 1). A circus train backed up to a standpipe in the

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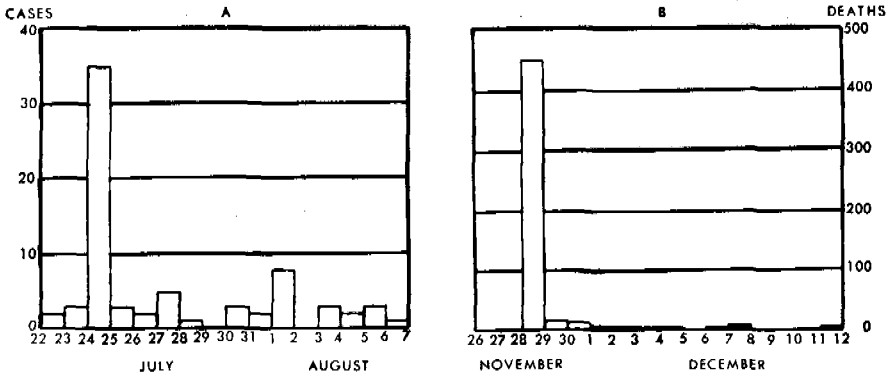


FIG. 1. Point epidemic: (A) Typhoid fever in a circus, July 22 to August 6, 1934; (B) Cocoanut Grove nightclub fire, Boston, November 28, 1942.

Pittsburg railroad yards, filled its tanks with untreated river water, and some two weeks later typhoid fever exploded sharply as the troupe played Dayton, Ohio. The deaths from accidents which occurred in the 1942 Cocoanut Grove night club fire in Boston were of the same order, the result of a single causative agent striking once and leading to an explosive outbreak with subsequent scattered deaths due to a more resistant host or a lesser activity of the agent. The result of a Florida hurricane would serve equally well in illustration.

The classical outbreak of amebic dysentery in 1933 in a Chicago hotel was characterized by three successive peaks in incidence, a cyclic distribution caused by periodic contamination of the water supply. A similar cyclic distribution of injuries occurred among soldiers of an infantry division in France in 1944, when three successive and distinctive outbreaks of cold injury and trench foot followed major military activities and increased exposure to cold, with the central and major event readily identified as a consequence of the Battle of the Bulge.

Other diseases are characterized by a non-fluctuating endemic prevalence of which tuberculosis furnishes a good example, case rates for the United States during the years 1943-1947 adhering closely to a level of about 90 per 100,000 population.

Certain classes of accidents conform to the same pattern, notably home accidents, where year after year the death rates show little variation, sometimes a few more than 25 per 100,000 persons, and uncommonly a few less.

A well defined annual seasonal variation in frequency distribution is also a common characteristic of many communicable diseases. Scarlet fever in Massachusetts regularly attains a maximum frequency in the winter months of January and February (Figure 2). An equally regular annual periodicity is shown by motor vehicle accidents for the same state and for the same years illustrated, again a winter prevalence except that the peak develops somewhat earlier, in November and December.

The long-term trend in frequency distributions by time is another common method of evaluating the movements of disease, and a method that often serves importantly in determining the effectiveness of preventive measures that have been introduced. Injuries show typical trends (Figure 3), as definite as those of diseases, sometimes with frequency distributions maintained at a more or less fixed level, sometimes with a well defined tendency to move upward or downward. The downward trend in deaths from tuberculosis in the United States during the present century is universally known, from close to 200

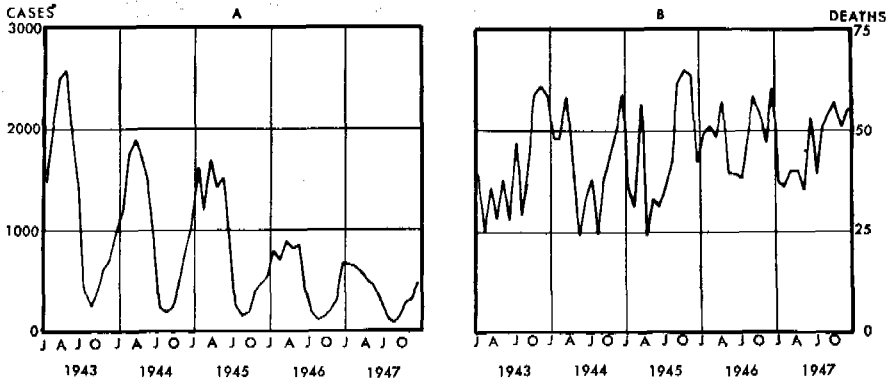


FIG. 2. Annual seasonal incidence: (A) Scarlet fever, Massachusetts, by months, 1943-1947; (B) Motor vehicle accidents, Massachusetts, by months, 1943-1947.

deaths per 100,000 population for the registration area of 1900 to a level consistently below 50 for the same region in the years since 1937. The frequency curve for deaths from accidents other than motor vehicle accidents during the same period and for the same area was at a more or less constant level of about 85 per 100,000 during the first 10 years of the century; thereafter with a significant downward movement, with the past 15 years showing little variation although the level is now at about 50. Accidents as representative of the class of injuries evidently follow as distinctive movements in time as do diseases. It remains to determine whether the same biologic laws that govern occurrence and causation also act in respect to injuries.

ACCIDENTS AS AN ECOLOGIC PROBLEM

Irrespective of whether disease and injury be looked upon as affecting the individual, or as the mass effect exerted upon a community, causation is to be interpreted as something more than the agent directly involved, a germ in infectious disease or the loose board in a home accident. Rather it is a combination of forces from at least three sources, which are the host—and man is the host of principal interest—the agent itself, and the environment in which host and agent find themselves. Neither one nor the other invariably exerts the principal effect,

which provides the assumption that similar disease phenomena can arise from dissimilar causes.

An established and satisfactory equilibrium or adjustment between man and his environment leads to the situation called health. A significant disturbance of that equilibrium is the basis for disease or injury. The disturbance may occur either through principal action of the agent, because of a characteristic of the host, or as a function of environment, but most often through some combination of the three. These are the fundamental factors in causation. The mechanisms involved—how they interact to the eventual production of a pathologic condition, in pathogenesis of individual disease, or in the genesis of epidemics—is also a practical consideration, but the essential question is what are the basic causes of the disease or injury. This is true because remedy must be suited to the whole of cause, as it lies in host, agent, and environment. Can these broad biologic principles be fitted to an interpretation of injuries, as they have been to disease, whether communicable or non-communicable?

HOST FACTORS IN ACCIDENTS

Because the object or agent which directly gives rise to an accident is so evident—the faulty pavement, the scalding water, the unguarded poison—the common ten-

dency to consider only that factor in a causative relation is readily understandable. An enveloping darkness, or rainy weather, or a crowded tortuous thoroughfare are also not so difficult to interpret as contributing to accidents. But the people who get hurt, they are only the poor victims; and yet when the question is examined, probably more causes of accidents lie within what we choose to call host factors, within people themselves, than in any other of the three parts of the triad which explain disease and injury. The host patterns of persons who suffer from accidents are of the same general order as those long recognized in many disease processes.

Age—Deaths from home accidents in the United States in 1945 were most frequent among the very old, past 65 years, and among the very young, aged 0 to 5 years, with the loss of life far less during the active periods of life, 5 to 65 years, when conceivably the opportunity for accidents is greater and the risk much enhanced. The distribution of deaths by age is so like that for deaths from pneumonia and influenza of the same region and for the same year, in the United States in 1945, that the two are almost interchangeable. However, the whole significance of age as a host factor is not revealed by the absolute weight of accidents at various ages, for the situation is altered when the interpretation is in terms of relative importance. While the

death rates for accidents are greatest at the extremes of life, the problem centers among children and young adults when considered according to rank among causes of death (Figure 4).

Sex—Difference in attack rate by sex is another characteristic useful in distinguishing community diseases, from the outstanding predominance of males over females provided by tularemia and undulant fever, where other features than sex evidently enter, to the regular although less marked excess of males that characterizes mumps and other diseases of childhood. The spread between death rates for males and females for accidents of all forms is noteworthy, and particularly so when selected types of accidents are compared. Fatal accidental injury through falls is more than twofold greater for females than males at age 65 years or more, a reversal of the experience during childhood and for young adults.

* * *

AGENT

The agents concerned with injuries and with accidents, like those of disease, are variously of physical, chemical, and biologic nature. The importance of the several classes is greater in some types of accident than in others and the kind of agent within a class is potentially great. Information about the agents concerned in accidents is none too

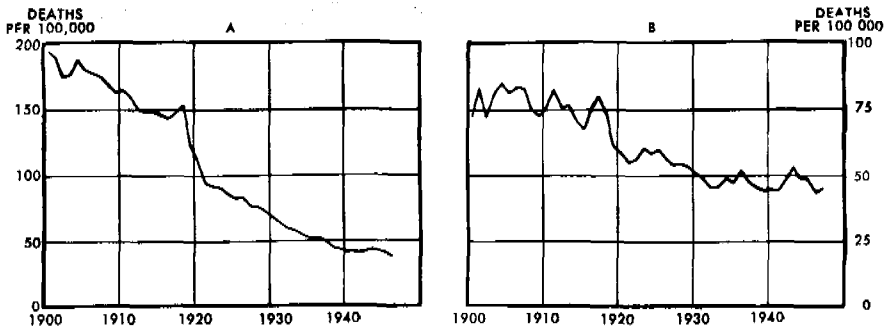


FIG. 3. Long-term trend: (A) Deaths from tuberculosis, U.S. Registration Area of 1900, 1900-1946; (B) Deaths from accidents, excluding motor vehicle, U.S. Registration Area of 1900, 1900-1947.

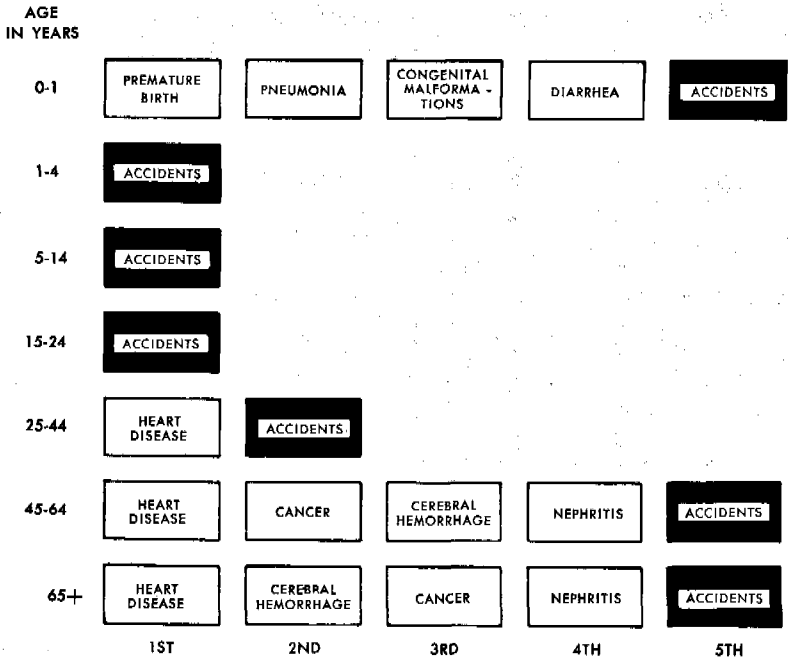


FIG. 4. Principal causes of death, by age, United States, 1945.

satisfying because of the common failure to distinguish mechanism from actual agent.

The causative factors in accidents have been seen to reside in agent, in the host, and in the environment. The mechanism of accident production is the process by which the three components interact to produce a result, the accident; it is not the cause of the accident. Kinds of mechanism serve to advantage in classifying accidents by type, with a particular event ascribed to cutting or piercing, to collision, or to crushing, and yet the agent in all three instances is a glass panelled door. Conversely, a fall may be related to such dissimilar agents as a faulty ladder, a playful pup, or a misplaced handbag.

The significance of agents in the problems of causation becomes more apparent when the kind and concentration are related to the same fundamental features of time-place-person relationship that is the basis of the epidemiologic method. This may be illustrated (Figure 6) by the geographical distribution of cases of typhoid fever and

of deaths from lightning, with the dominant "reservoirs of infection" and factor of community dosage as evident for the one condition as for the other.

ENVIRONMENT

The limited perspective with which environment is commonly viewed is open to improvement by considering it as composed of three major elements, the physical, the biologic and the socioeconomic, a concept elsewhere discussed in detail. The physical environment has to do with matters of climate and weather, of season and topographical affairs, with soil and terrain, and the other physical features of the world where man lives. The biologic component of the environment can be taken to include the universe of living things that surrounds man, all else than man himself; while the socio-economic part of environment is that which comes into play through association of man with his fellow man. Environment so considered exerts an influence on disease sometimes through direct action on host or

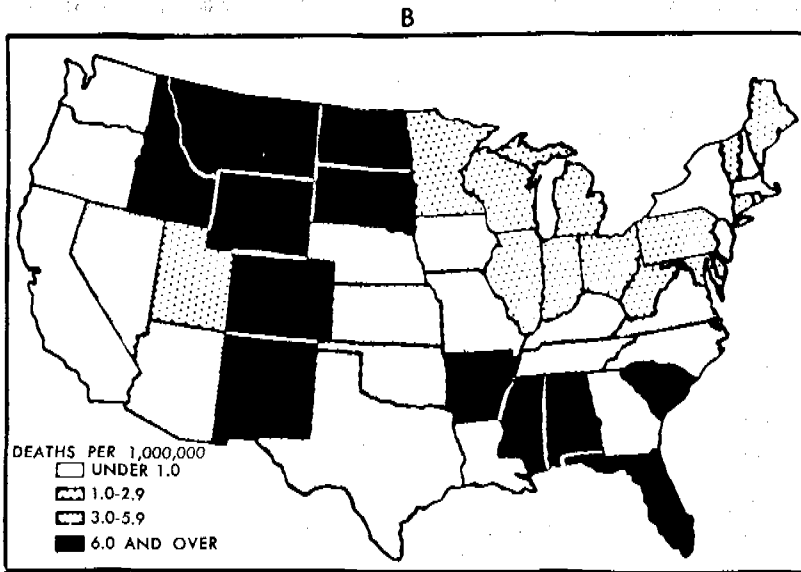
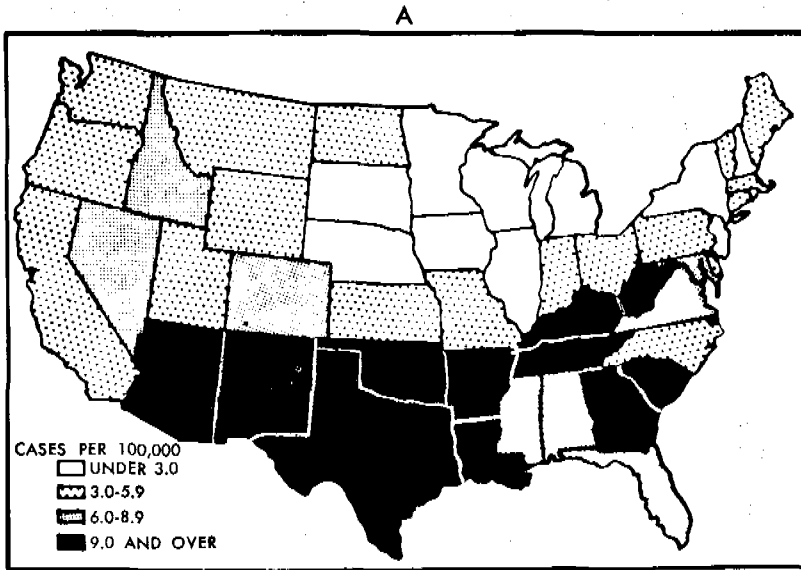


FIG. 6. Geographical distribution: (A) Cases of typhoid and paratyphoid fever, United States, 1940-1944; (B) Deaths from lightning, United States, 1940-1944.

on agent, and sometimes on the mechanisms which bring host and agent together or determine their interaction. The results of environmental influences are to be measured

by the character of the disease process that results, by the extent and nature of the frequency distributions that follow, and often by both. The three factors of environ-

ment are now considered as they act in determining distributions of accidents.

PHYSICAL ENVIRONMENT

The geographic differences in frequency of deaths from accidents of all forms are well recorded in the United States over many years; the highest rates are in the far West and in Florida, the lowest in the Middle Atlantic and New England areas. The general pattern by no means holds for the various classes of accidents, notably home accidents, nor does the gross differentiation by states permit the individual community to judge its particular problem logically. This has been recognized to the extent that some cities determine the frequency of accidents by political subdivisions such as wards or census tracts, and states like Tennessee and Kansas have effected divisions by counties. Further division can be made according to classes of accidents, for example, those that occur in the home or in association with motor vehicles.

The contrasting frequency of diphtheria and scarlet fever in the cities of Sao Paulo and Santos in Brazil is a striking example of the effect of climate on disease. The average annual mortality rates per 100,000 in Sao Paulo were for diphtheria 10.8, for scarlet fever 7.6; in Santos, diphtheria 3.1 and scarlet fever 0.3. The two cities only 49 miles apart are climatically wholly distinct since Sao Paulo high in the mountains has a temperate climate, while Santos is on the tropical sea coast. An equally striking effect of temperature is seen in the frequency of cold injury among American troops in France in World War II. As temperatures dropped from November through January, the number of soldiers developing trench foot progressively increased.

A seasonal effect on injury and accident as striking as any that characterizes a communicable disease can be had by comparison of the distribution curves for cases of poliomyelitis and accidental deaths from drowning in the United States in 1945,

the two curves being almost identical. This random choice illustrating a summer prevalence is easily duplicated, for instance by deaths associated with falls at all ages and suffocation of infants aged less than one year, which are typically winter diseases. The examples are sufficient to establish the principle that types of accidents have seasonal variations which can be as regularly recurring and as well marked as those for infectious or other disease processes.

The frequency of ascariasis in a rural area of West Virginia and in rural China is presented as an influence of soil and terrain on the frequency of infestation with an intestinal parasite. The rates for children under 10 years were respectively 58 per cent and 82 per cent. The introduction in West Virginia of the socio-economic factor of shoes being worn as age advances leads to comparative rates of 20 per cent and 63 per cent for those aged 40 years or more. Terrain can likewise act on motor accidents, as seen in a comparison of death rates in Rhode Island and in Arizona, where the regularly maintained ratio is 1 : 4 although assuredly analysis would show strong effects for socio-economic environment and from host factors, in addition to the character of the countryside.

BIOLOGIC ENVIRONMENT

The biologic factor of environment has a lesser significance in the causation of accidents, compared with the outstanding part it plays in such mass diseases as malaria and rabies. That the principle holds, that environment in relation to accidents is also to be interpreted in terms of the three components already differentiated, is substantiated by a consideration of such events as the home accidents associated with pets, with poisoning through action of snakes and arthropods, and similar incidents related to the animate things that live with man.

SOCIO-ECONOMIC ENVIRONMENT

Whatever the kind or nature of mass disease or injury, the part exerted by the

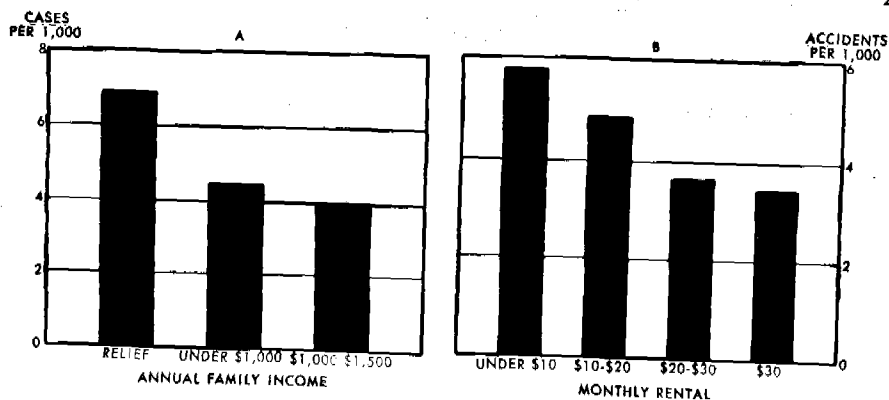


FIG. 7. Influence of socioeconomic environment: (A) Pneumonia, cases per 100,000, by annual family income, National Health Survey, 1935-1936; (B) Home accidents, cases per 100,000, by monthly rental, National Health Survey, 1935-1936.

socio-economic environment is probably the most neglected of any epidemiologic influence, and accidents are not different in this respect from any other causes of damage. Only scattered information can be put together, that arising from the National Health Survey of 1935 being most instructive. The quality of housing (Figure 7) as judged by the amount of income or rental paid has been repeatedly demonstrated as an influence on the frequency of both communicable and non-communicable disease. It is not surprising that the same causative factors which act so strongly on the frequency distributions of pneumonia are also a determining influence with accidents.

The demonstrated correlation between disease and occupation, as in tularemia where hunters and housewives are the groups most affected, is in complete agreement with the differences noted for accident rates according to occupation. Deaths per 100,000 for persons engaged in mining, quarrying, oil and gas wells were in 1947 about 170; for construction work and those in agriculture about 50.

The changing frequency in the incidence of the common communicable diseases among rural and urban populations is commonly advanced as a feature of modern disease behavior related to social and

economic conditions. It is no more definite than the transition noted for motor accidents. Deaths from this cause were dominantly a feature of urban populations 25 years ago, but the recent shift is of such extent that rural death rates now exceed those of urban areas.

THE EPIDEMIOLOGIC APPROACH TO ACCIDENTS

The idea that injuries as they affect groups of people could be profitably approached through epidemiologic methods grew out of a real and pressing experience in World War II. A type of cold injury, trench foot, involved thousands of men, and was a major cause of disability and lost man power. The initial inclination was to look upon the cause as cold, which could neither be eliminated nor adequately controlled in an army operating under field conditions. If not cold, then the cause was deficiencies in clothing and equipment. It soon became apparent that other factors were of greater relative moment, the kind of military operations, the terrain through which troops operated, the management of troops, and an intangible host factor called foot discipline. Occupational components of a division were not uniformly affected, for commonly some 94 per cent of cases were among the 27 per cent of riflemen.

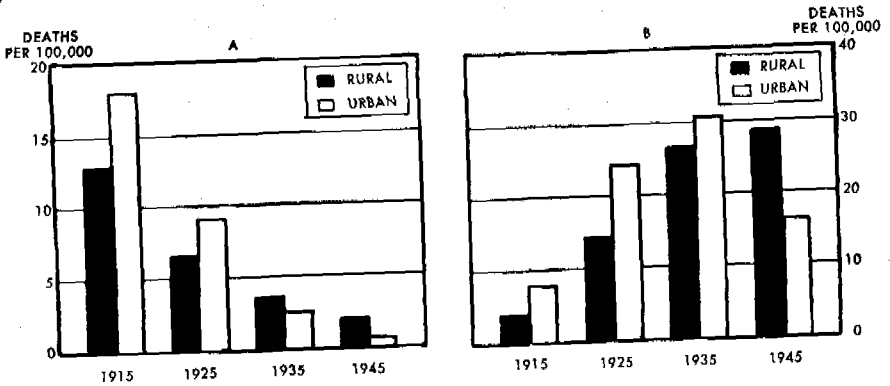


FIG. 8. Urban and rural distributions: (A) Deaths from diphtheria, per 100,000 population; (B) Deaths from motor vehicle accidents, per 100,000 population; United States, 1915-1945.

Two units operating under similar conditions were disproportionately affected, and the explanation was sometimes related to host, sometimes to the agent, and sometimes was found within the environment. The problem of prevention resolved into a determination of the specific factors contributing to cold injury of a particular unit. From knowledge of those factors a specifically directed program of correction was evolved.

With a return to civilian interests, it seemed reasonable to suppose that accidents as a type of civilian injury could be approached in similar fashion and a study was made of home accidents. The broader presentation given here is advanced in the belief that the method is usefully applicable to accidents generally.

That accidents and disease, as they affect groups of people, so frequently show similar distributions is no reason to assume identical causes; indeed, the expectation is that they are different. The illustrations presented here were purposely drawn from a wide variety of accidents and diseases, to the end of demonstrating that both great classes of morbid conditions of man are governed by broad biologic laws; that in their action on groups of people they are the resultant of the total forces within a universe, of an ecologic entity. An observed behavior is no more a function of all kinds

of accident than of all diseases, and conversely a single type of accident, like an individual disease, rarely manifests all the kinds of possible distributions.

Each of the three broad factors in causation has been considered individually to the end of demonstrating principle, but the illustrations themselves, and more particularly the concept of epidemiology as medical ecology, show this to be an over-simplification. All factors are intimately interwoven, each influenced by the other. For a given kind of accident the values are determined by subjecting adequate quantitative data to partial and multiple correlations in search for those conditions of actual importance in the particular situation. Too often the emphasis is on amassing facts with a failure to muster the power that lies in generalization, to develop information from principle or to collect data for a specific purpose and to meet a demonstrated need. A wide range of conditions commonly contributes to the prevalence of an injury. The success of a control program depends on sorting out from the larger volume those that are critically essential. These considerations make epidemiologic analysis a practical approach to an improved understanding of accidents and to a better prevention.

The start is through field investigation, individual case study of the patient, the