concentration, produced the condition in Donora. The U. S. Public Health team, in their investigation, found that this same city had experienced several previous incidences of lesser severity during the preceding 30 years. This was shown by much higher mortality rates during certain periods. A high percentage of the population of this city suffered to some extent during the recent *smog*. Older individuals were more seriously affected with cardio-respiratory symptoms.

Study of such a situation is rather difficult, as explained in the aforementioned report. The medical profession has much to learn about the effects of these substances on human beings, and until more precise knowledge is obtained, it is difficult to know when precise controls are really needed. Further research is urgently needed.[3]

SANITARY VENTILATION

During the last 15 years great popular interest has been aroused in the spread of respiratory infection indoors, and control by ventilation or its sanitary equivalent by air disinfection. In Europe three important documents have appeared recently in English, Swedish, and French literature.[4,5,6] In the United States where the study began, the vast literature has been consolidated, and definitions, formulations, and factors of sanitary ventilation codified in a volume now being edited for publication.

The Council of Physical Medicine of the *American Medical Association* approved the radiant disinfection of air in 1943, and two sub-committees of the Committee on Research and Standards of the *American Public Health Association* have reported favorably upon the control of airborne infection by sanitary ventilation and on air sanitation respectively.[7,8,9,10] The work of a Technical Advisory Committee on Air Sterilization of the A.S.H.V.E. has from time to time since 1944 reported progress in THE JOURNAL, and has recommended a set of definitions, formulations and factors for joint adoption by the *American Public Health Association* and the Society.

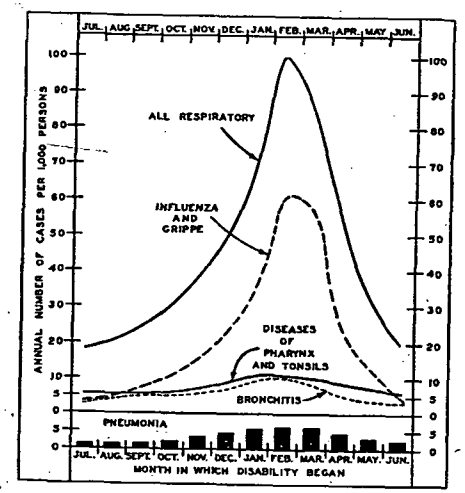
But this important new field of sanitary ventilation is just emerging from the research to the development stage. When consolidation and codification of present data have been completed, a more comprehensive treatment in THE GUIDE may be possible. The following section on Control of Airborne Infection gives some idea of the scope of the subject.

CONTROL OF AIRBORNE INFECTION

The majority of airborne diseases are spread indoors where people gather. Any program of air sanitation is influenced by a number of factors. In the winter months, the closing of doors, windows and other means of access to the outside air to conserve warmth, as well as the crowding of persons indoors, provides conditions conducive to a high incidence of contagion. This seasonal phenomenon, illustrated in Fig. 1 which represents a study made by the *U. S. Public Health Service*, will concern the ventilating engineer insofar as air quality (determined by temperature, humidity, air replenishment and type of air movement and by freedom from contamination) is a major intrinsic factor. Apart from the seasonal picture of airborne contagion, are such extrinsic factors as rate of turnover of personnel, and the marked susceptibility of the recruit in comparison with permanent personnel[11] as shown in Fig. 2 by studies of military personnel housed in barracks. These extraneous variables and the factor of contact infection (direct spray) tend to complicate any evaluation of the effectiveness of air sanitation for elimination of micro-organisms in droplet-nuclei and droplet-dust. Thus, control measures may eliminate consistently 90 percent

of airborne organisms in laboratory tests, but cannot effect a decrease in actual incidence of infection exceeding 30 percent. Thirty percent may be the maximal reduction in infection possible by air treatment methods. The distinction should be clearly drawn, therefore, between the effectiveness of a procedure in laboratory tests and its effectiveness and applicability in actually reducing the incidence of airborne disease. On the other hand, recent studies suggest that inhalation of dust-borne bacteria is more important than direct inhalation of infectious droplets or droplet nuclei in the spread of respiratory tract infections.[12]

The following sequence of events has been postulated as occurring in a large proportion of intra-ward infections: (*a*) ejection of relatively large protected infective particles from patients; (*b*) rapid venting or settling of these particles so that those remaining airborne are in low con-



Occurrence of diseases causing disability for 8 consecutive days or longer in a group of 100,000 wage earners (10 percent women) in different industries.
[a] Graph obtained from Dean K. Brundage, *U. S. Public Health Service*.

FIG. 1. STUDY OF AVERAGE MONTHLY FREQUENCY (1921–1926 INCLUSIVE) OF SPECIFIED RESPIRATORY DISEASES[a]

centration; (*c*) survival of infective particles to permit the accumulation of high concentrations on surfaces; (*d*) repeated reintroduction of infective particles into the air under the stimulus of ward activities or by air currents of the order of 50 fpm over the floor; and (*e*) extension of infective areas by air turbulence throughout the ward or hospital. The most important link in this probable infection chain has been demonstrated to be the reintroduction of particles into the air.[13]

Intensive studies on air disinfection have indicated two distinct control measures: (*a*) suppression of dust and lint, and (*b*) disinfection of droplet-nuclei. A third measure, control of relative humidity, is important. It has been shown that the viability of certain organisms sprayed into the atmosphere from a liquid suspension is dependent on relative humidity. The mortality rate of the organisms is very high at a relative humidity of 50 percent,[14] and decreases at humidities above and below this figure. It