

in with the breath. Such germs may be deposited on substances with which we readily come into contact, or they may fall on articles of food where they may find conditions suitable for their reproduction, which cannot occur when they are suspended in the air in consequence of the lack of moisture.

From these facts, what points of view present themselves to guide us in preventing infection through this channel? Surely something more than simply by abolishing foul odors,

There are two indications which apply especially to the prevention of the transportation of disease germs by the air. One is the necessity of guarding, as far as practicable, against the desiccation, when exposed to the air, of substances which contain infectious germs not destroyed by drying, and another is free ventilation.

For no disease is the importance of the first of these indications so evident and so well established as for tuberculosis, the most devastating of all infectious disease. Against this disease, formidable as it may seem to cope with it, the courageous crusade of preventive medicine has begun, and is destined to continue.

It is now generally recognized that the principal, although not the sole, sources of tuberculous infection are the sputum of individuals affected with pulmonary tuberculosis and the milk of tuberculous cows.....

By means of free ventilation, disease-producing micro-organisms which may be present in the air of rooms are carried away and distributed so far apart that the chance of infection from this source is removed or reduced to a minimum. It is a well established clinical observation that the distance through which the specific microbes of such diseases as small-pox or scarlatina are likely to be carried from the patient by the air, in such concentration as to cause infection, is small, usually not more than a few feet, but increases by crowding of patients and absence of free ventilation. The well-known experiences in the prophylaxis and treatment of typhus-fever are a forcible illustration of the value of free ventilation.

It is, of course, not to be understood that by ventilation we accomplish the disinfection of a house or apartment. Ventilation is only an adjunct of such disinfection which, as already mentioned, is of first importance. Time will not permit, nor is it in the plan of this address, to discuss the details of such questions as house disinfection, but I may be permitted to say that the methods for disinfecting apartments have been worked out on a satisfactory experimental basis, and should be known at least by all public health officers. Whether it be pertinent to this occasion or not, I cannot forbear to add my protest to that of others against placing reliance upon any method hitherto employed of disinfecting houses or apartments by fumigation....

THE GROUND AS A SOURCE OF INFECTION.

That the prevalence of many infectious diseases depends upon conditions pertaining to the soil cannot be questioned, but the nature and extent of this influence have been and are the subjects of lively discussion. The epidemiological school led by Pettenkofer assigns, as is well known, to the ground the chief and even a specific and indispensable influence in the spread of many epidemic diseases, particularly cholera and typhoid-fever.... The exclusive ground hypothesis has become an ingenious and carefully elaborated doctrine with those who believe that such diseases as cholera and typhoid-fever can never be transmitted by [direct] contagion....

The ground, unlike the air, is the resting or the breeding place of a vast number of species of micro-organisms, including some which are pathogenic. Instead of a few bacteria or fungi in a litre as with the air, we find in most specimens of earth thousands, and often hundreds of thousands, of micro-organisms in a cubic centimetre. Frankel found the virgin soil almost as rich in bacteria and fungi as that around human habitations.

This vast richness in micro-organisms belongs, however, only to the superficial layers of the earth. Where the ground has not been greatly disturbed by human hands there is, as a rule, about three to five feet below the surface an abrupt diminution in