The Influence of Environment on the Survival of Airborne Virus Particles in the Laboratory

By

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With 4 Figures

When considering the possible role of airborne particles in the transmission of a virus disease, it is useful to know if the virus can survive for any length of time in the airborne state, and if so, how much effect environment has on its survival.

Ideally, such information should come from field studies carried out in communities in which the disease is prevalent. However, the most we can expect from this sort of investigation is to establish, either directly in qualitative way, or by inference, that the disease can be spread by the airborne route. Attempts to measure time of survival of airborne viruses and the influence of environment are not very practicable in these conditions. Variations in survival due to environmental factors could easily be swamped by the nature of the measurements it is possible to make.

The ability of a virus to survive long enough to transmit infection by the airborne route and how large are the effects of environment are best investigated in the first place in the laboratory. This enables us to obtain the information relatively quickly and in properly controlled conditions, but does impose certain limitations on the use we can make of the results. I will be dealing with this aspect at some length later on.

A number of workers have studied the survival of airborne viruses in the laboratory. In 1936, Wells and Brown reported that influenza virus was infective for ferrets for at least 1 hour after spraying and since that time, other workers have shown that airborne influenza virus can remain viable for considerable times. Recently, Hemmes and his co-workers (1960) have published the results of studies in which the survival of influenza and poliomyelitis viruses was compared. They showed that in these conditions influenza survived best in dry air (relative humidities below 50%), poliomyelitis survived best in wet air (relative humidities above 50%).

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However, the quantitative aspects of some of the earlier work leave much to be desired and comparison between different workers’ results is difficult due to the widely differing techniques used. Some of the variations in technique which could have marked influence on the results are:

a) The way in which aerosols were generated, stored, and sampled,
b) The virus assay methods used,
c) Failure to differentiate between physical and viable decay,
d) Presence or absence of light,
e) Degree of control over relative humidity and temperature.

A further difficulty lies in the variety of ways used to present the results of such studies.

Recently I have carried out tests with four unrelated viruses: poliomyelitis, influenza, vaccinia, and Venezuelan equine encephalomyelitis (VEE). By the use of a carefully controlled aerosol generation and holding technique, improved virus assay methods, and a cloud tracer method to differentiate between physical and viable decay, readily repeatable experiments have been carried out. The results have been used to compare the behaviour of the four viruses tested in closely similar conditions. I should make it clear at this point that I am not an epidemiologist or virologist and these tests were not carried out to try to answer some of the problems of epidemiology to be discussed during this seminar. However, as two of the viruses I have examined, influenza and poliomyelitis will be under discussion the results may be of some interest to you. The technical details of these studies have recently been published in J. Hyg. (1961) so I will not deal further with them here.

Three aspects of environment have been looked at: relative humidity, temperature, and the influence of the virus suspending fluid.

**Results**

The influence of relative humidity is best looked at in two parts. First, what happens immediately after spraying when the wet droplets leaving the atomiser are undergoing rapid changes during the process of coming into equilibrium with the test atmosphere, a process similar to that occuring to droplets expelled by sneezing, coughing or talking.

<table>
<thead>
<tr>
<th>Relative Humidity %</th>
<th>Vaccinia</th>
<th>Influenza</th>
<th>Poliomyelitis</th>
<th>VEE</th>
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Table 1. % Initial viability at 22°C