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H-5 ON THE FLUCTUATION OF AIRBORNE MICROBIOLOGICAL PARTICLE CONCENTRATION

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1. INTRODUCTION

It is clear that airborne microbiological particles are moving with certain variability by the influence of such parmeters as location, seasons, weather, species of microbes and activities of people. Though there are many reports on yearly or seasonal changes of airborne microbiological particles concentration, we have very few that worked on the timely variations of relatively short period.

If the sampling time is not long enough in determination of airborne concentration, the measured values would lead to wrong estimate of contamination of the space.

The authors have been working on the behavior of airborne bacterial and fungal particles in various in-door and out-door spaces.[1)~3)] Some results on variabilities of airborne microbiological particles and their characteristics which have been obtained using long-time slit samplers in several intra-mural spaces and some discussions are introduced.

2. OUTLINE OF MEASUREMENTS

The airborne bacterial and fungal particles concentration are measured every two minutes using long time slit samplers (M/G 200J). The indoor measurements were done in an office building with air conditioning systems. From the structual characterisity, very little effect from outdoor was expected. Furthermore, a subway station was used as a field of rather high concentration. This station is built by shield-construction method and approximately 24 meters from the ground surface with mechanical ventilation in operation.

With airborne bacterial and fungal particles, settled microbes, particulate matter concentration, occupants density and other parameters were measured.

The outdoor measurements were done on the roof of the Institute of Public Health.

3. MECHANISM OF VARIATION

The concentration of airborne microbiological particles shows various types of variation due to many elements such as ventilation rates, air conditioning, number of occupants and their activities. The particles are brought in from outdoor by ventilation or accompanying people or become airborne within buildings by the activities of occupants.

In cases of indoor concentration source strength, their time variation, space distribution and kind of sources have definitly strong influences beside the characterisities of air conditioning. The results obtained were of those offices in which sources were distributed rather uniformly throughout the

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space and its strength depending on the general activities of occupants which are relatively uniform during office hours.

In case of subway stations, the main sources were considered to passengers' movements and the arrival and departure of trains. In measurements at the passages the former was dominant and the latter at the platforms, although the frequency of train departure and number of passengers had strong correlation.

In cases of outdoor measurements, beside seasonal variation of biological quantities, the weather or climatic conditions are known to have strong influences on the concentration of airborne microbiological particles. Especially the wind is sometimes a major element which decide the contamination. We used the data in this report on relatively settled, calm days with 2 - 3 m/s wind.

4. RESULTS AND DISCUSSION

1) Time Variation of Concentration.

Time variation of concentration in offices have very distinct features of low values around lunch time with sporadic high values throughout the working hours (Fig. 1).

The concentration in subway station have features of high average values and some effect from passengers and movement of trains. With the operation of mechanical ventilation, we cannot observe morning and evening peaks.

In outdoor concentration there were no distinct changes of climate during the day and the concentration had very constant fluctuation all day long.

2) Standard Deviation and Coefficient of Variation.

The average concentration, standard deviation and coefficient of variation for three cases are shown in Table 1. The length of measurements were for one whole day and sampling time length was one minute except for subway station where two minutes sampling was used.

From these data we cannot see very distinct tendency for these three values.

3) Standard Deviation, Coefficient of Variation and Concentration.

The relation of S.D. or C.V. and concentration for bacteria and fungi are shown in Figs. 2 and 3. The concentration of fungi is usually lower than of bacteria.

With bacterial particles there are two groups of cases with less than 0.15 p/l and between 0.44 - 1.43 p/l. With low value group, the lower the concentration, the larger becomes the C.V. and, with higher group, the C.V.s converge to certain level.

With fungal particles the C.V.s are very high when the concentration is 0.035 p/l, then the C.V.s become lower as the concentration becomes higher.

4) The Effect of Sampling Time.

Within certain range, we can, from their characterisity, expect the following relation between the concentration and standard deviation,

$$S = a + b \cdot C$$

where S: standard deviation

C: concentration of the space

a,b: constants

We can reform this equation into the next one which gives the relatinn of coefficient of variation and the concentration.

$$S/C = a/C + b$$

Using the linear regression method we determined the constants a and b respectively and then determined the values of coefficients of variation at various sampling length of time which are shown in Figs. 4 and 5.

It is clearly shown that the lower concentration or shorter sampling time give the larger coefficient of variation.

Especially at concentration as low as 0.03 p/l the coefficients become of very large values and this is almost same for both bacterial and fungal particles.

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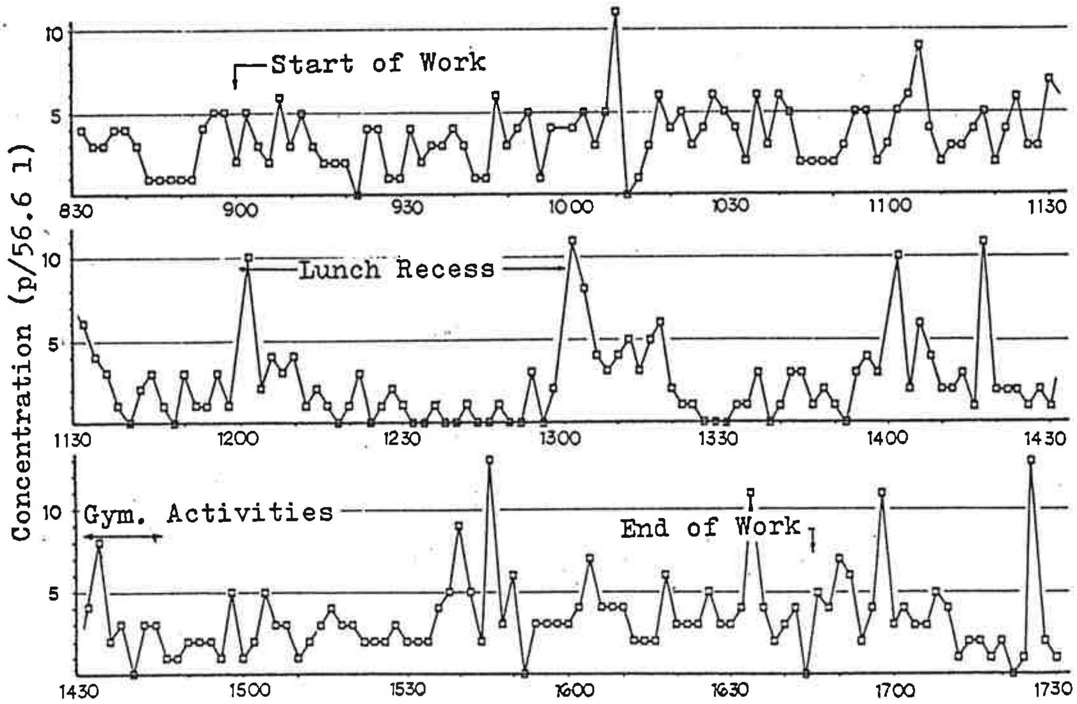

Fig. 1. Example of Bacterial Particle Concentration

Table 1. Average values and Variation

FACILITY			AVERAGE (p/l)	STANDARD DEVIATION (p/l)	COEFFICIENT OF VARIATION
OFFICE BUILDING	bacteria	Dec. 19	0.068	0.048	0.708
	fungi	Dec. 18	0.035	0.047	1.340
SUBWAY STATION	bacteria	Oct. 27	0.430	0.503	1.170
	fungi	Oct. 27	0.560	0.260	1.460
OUTDOOR	bacteria	Apr. 18	0.030	0.027	0.890
	fungi	Apr. 16	0.128	0.047	0.390

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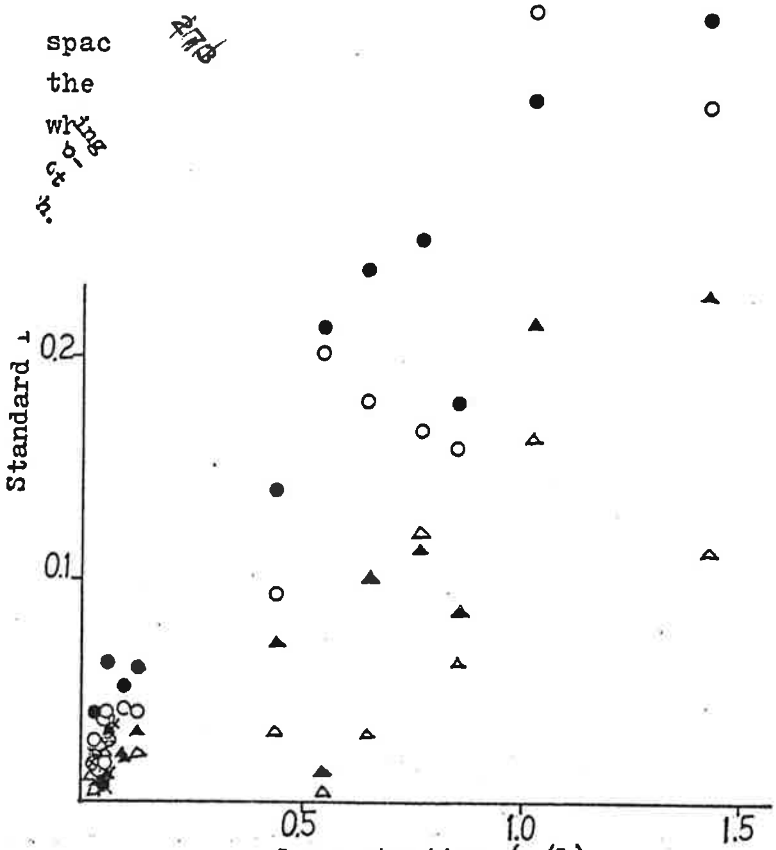

Fig. 2. Standard Deviation and Concentration (Bacterial Particles)

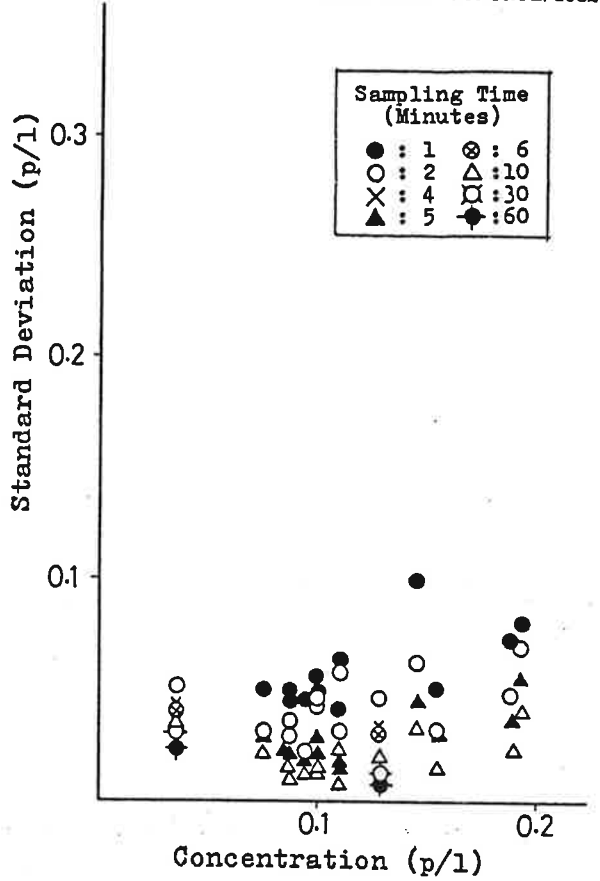

Fig. 3. Standard Deviation and Concentration (Fungal Particles)

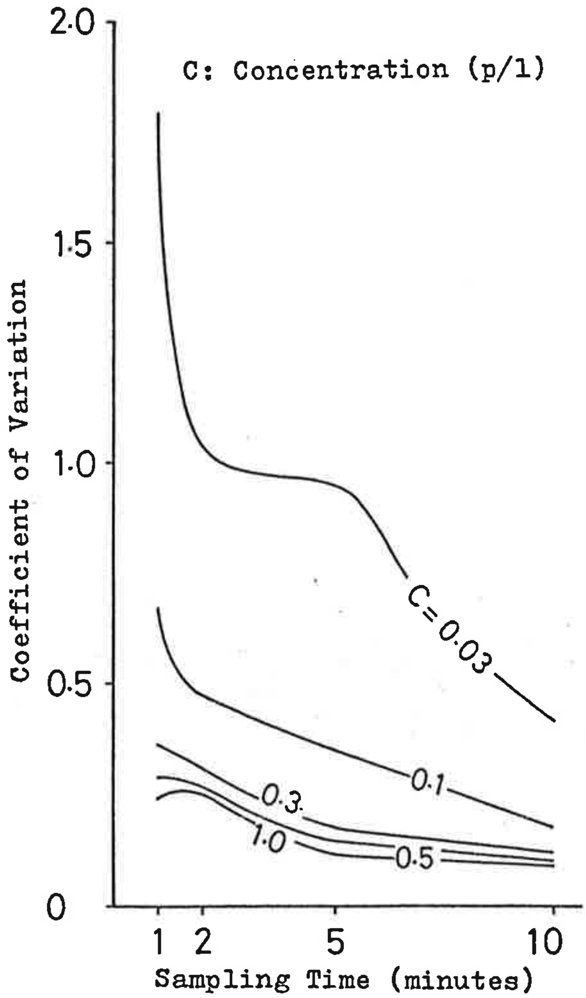

Fig. 4. Sampling Time and C.V.s (Bacterial Particles)

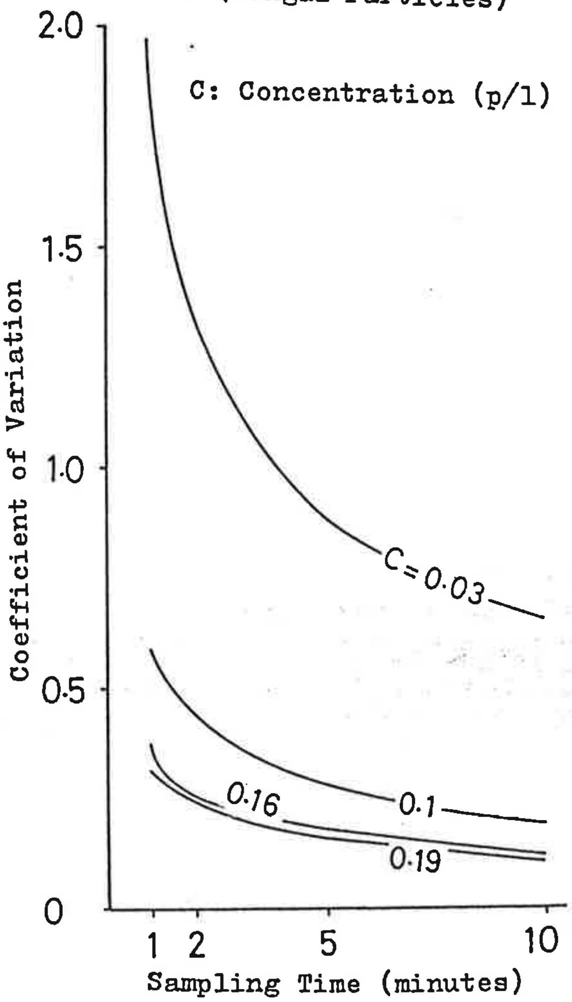

Fig. 5. Sampling Time and C.V.s (Fungal Particles)