

QUANTITATIVE STUDIES OF AIR-BORNE FUNGI OF HAVANA IN EACH OF THE TWENTY-FOUR HOURS OF THE DAY

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SERIAL hourly fungus studies have for their object, the analysis of the fungus content of the air of a locality during each of the twenty-four hours of the day. These studies cannot be made daily over a great length of time, if the Petri dish method is employed, on account of the excessive and tedious labor involved in the manipulation of hundreds of plates, but can be repeated once a week or in determined months of the year in order to obtain an exact idea of the behaviour of fungi under determined meteorologic influences such as wind, rain, humidity, the degree of cloud coverage, and variations between day and night hours, etc.

In 1939, we published¹ an investigative article showing the hourly variations which the fungus content of the atmospheric air underwent with relation to meteorologic changes, and their influence in certain instances of asthma and rhinitis.

This work was carried out by exposing to the air, for a quarter of an hour, Petri dishes with appropriate culture media.

The plates were exposed every hour, day and night, arranging them so that the prevailing winds blew freely over them. The numbers of colonies per dish were then plotted in curves (Fig. 1) with comparisons, taking into consideration temperatures, barometric pressures, relative humidity, wind velocity and direction, and cloud coverage.

The strict correspondence between the colony curve and wind velocity is obvious, the colony curve descending with diminution of wind velocity and ascending when wind velocity was at its height.

If we fix our attention on the curve of the number of colonies, we see that the colonies on the plates increase during daylight hours, and diminishes during nocturnal hours. In considering this point, it brought us to the conclusion that the actual quantity of fungi in the air is greater during the day than during the night. After further voluminous air studies we have reached totally reversed conclusions when we employed methods of studying the fungi of the air which eliminate the factor of wind velocity. The cause of the initial error lay in the fact that the Petri dishes were exposed to the air attempting always to face them to the prevailing wind. In this manner the number of fungus spores was influenced by the amount of air which flowed directly over the dishes, the greater the volume of air, the larger the number of colonies deposited.

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This brought us to the conclusion that quantitative studies of fungi based on the open exposure of dishes to circulating air alone, will determine a quantity of fungus spores, depending on the velocity of the wind. But this is incorrect when it is desired to appraise the number of fungi in a given volume of air.

It is common to notice that asthmatics sensitive to fungi commence to notice symptoms of discomfort as evening comes on, at night, or around dawn. In day hours their annoyance is less. It is recognized that individuals allergic to fungi become worse when they inhale the dust from pillows and mattresses infected with causative fungi or when compelled to sleep in damp quarters with walls infected with such organisms. How then could we explain the symptom increase as evening comes on precisely when our initial studies indicated a diminution of the fungus content of the air?

At first we might consider that this nocturnal symptom increase coincident with the lowered fungus count could be due to a variation of the allergic reactivity or some other physiologic factor, a possible, but unconvincing hypothesis. From this discrepancy came the idea of working with stationary air and eliminating the factor of wind velocity.

Feinberg and Steinberg² had studied (1939) the pollen content of the air, by experimenting with a determined volume of air using a sack (or box) with a volumetric capacity of a tenth of a cubic yard, whose bottom was completely covered with microscopic slides covered with petroleum jelly. This was carried to the open air, opened and kept opened for 2 or 3 minutes to permit free air interchange, and then closed, sealed and kept all night in a quiet spot in order that all the pollen contained in that volume of air should be deposited on the slides.

The total number of pollen grains on all the slides was counted giving the pollen content of 0.1 cubic yard of air; by multiplying this by ten was obtained the number of pollen granules per cubic yard.

In applying this method to the study of mold spores, we designed a four sided wooden box or cabinet with an inside length of 60 centimeters and width and depth of 15 centimeters. This apparatus had 2 doors (Fig. 2) opening the whole length of the sides, to permit the free entry of air into the apparatus. The doors closed with automatic latches and all the joints between the boards forming the sides, and even the doors themselves were hermetically sealed to prevent air currents from disturbing the findings.

Before use, the internal surfaces of the apparatus must be cleaned with a pledget of cotton moistened with a solution of 1:1000 Merthiolate. The box is then carried to the open air, the two doors are opened wide and it is left in this manner for 2 or 3 minutes. One door is then closed and through the other is placed, deep in the apparatus, an open Petri dish with an appropriate culture medium. The second door is then closed. Meanwhile the lid of the Petri dish is kept face down on top of the apparatus.

All this manipulation must be done rapidly, but care taken not to close the doors with a violent slam which would introduce air currents in the wooden box. When an hour has passed, one door is opened, and the cover of the Petri

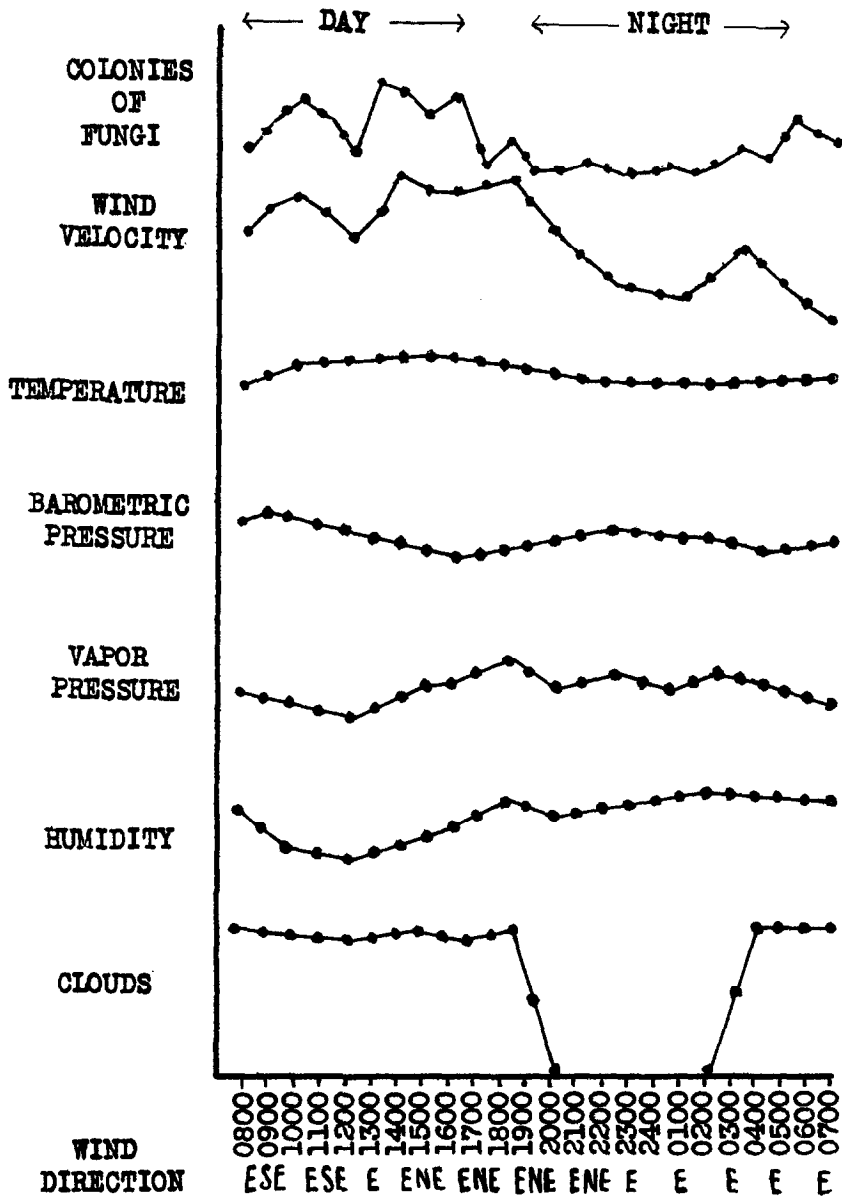


Fig. 1.—Comparative graphs of the fungus content of the air, time of day and meteorological data. Petri dish exposed to open air for 15 minutes.

dish is quickly put in place on the open dish with the culture medium. This is then incubated at the temperature of the laboratory for three or four days and then the fungus colonies appearing are counted, identified, and studied.

We leave our Petri dish in the interior of the apparatus one hour as in preliminary experiments we observed that at the end of an hour all spores have been deposited from a height of fifty centimeters.

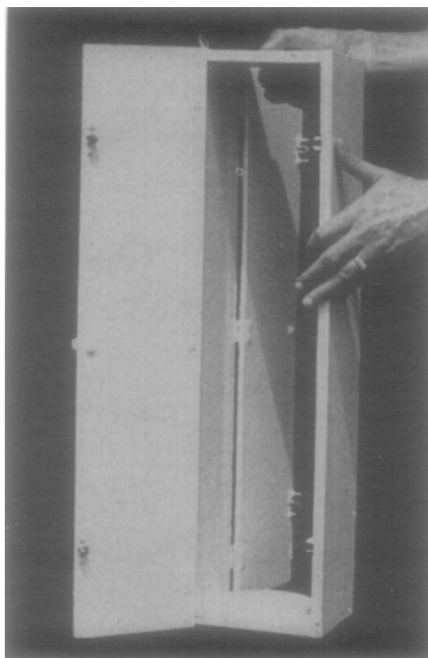


Fig. 2.—Collecting apparatus for the study of air-borne fungi.

In order to determine the volumetric content of fungi, employing Petri dishes with an internal diameter of 9 centimeters, the volume of air which is over the dish will then be $\pi R^2 A$; where R = radius of circle of the culture medium; A = interior height of the apparatus; $\pi = 3.1416$. Applying the formula gives a volume of 3816 c.c. of air.

Thus all the colonies cultivated in the Petri dish will be derived from a volume of 3.816 liters of air. To calculate the count of spores or colonies per cubic meter the following calculation applies. $n = \frac{X \times 1000}{3.816}$; n = number of spores per cubic meter; X = number of colonies on Petri dish.

In Fig. 3 is seen the graph which shows the study of the fungi in each of the twenty-four hours of the day, as determined by using this collecting apparatus. It is seen that a curve is obtained whose maximum peak is around 4 A.M. The minimal fungus count is around 6 P.M. It is thus demonstrated that the fungus content of the air of Havana is greater at night than in daylight hours as result which coincides perfectly with our clinical observations.

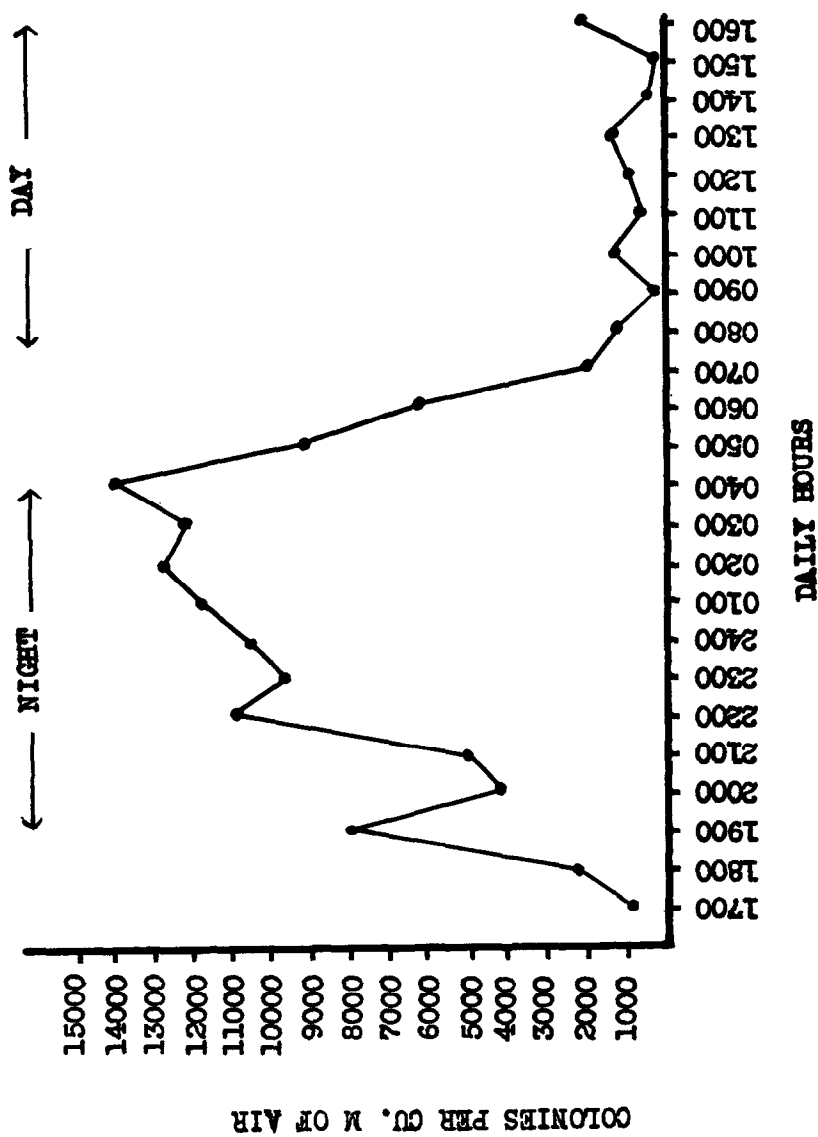


Fig. 3.—Graph of the quantity of fungi of the air every hour of the day. Petri dishes exposed in the collecting apparatus described in the text.

CONCLUSIONS

From serial studies of the fungi of the air of Havana, we conclude that the number of colonies or spores deposited on Petri dishes exposed openly and freely to the air increases on days of increased wind velocity, but this does not mean that the actual number of fungi in a fixed volume of air is greater. The air is the vector of the spread of spores, but nothing else. Hypersensitive cases are worse the days of much wind, but they also become worse when the actual quantity of fungi in the air is high even when there is no wind as happens on many of the nights in our climate. In Havana, this quantity of fungi in stationary air is greater at night than during the day, the graph curve beginning to rise after 6 P.M.

REFERENCES

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