THE AIR-BORNE FUNGI IN JOHANNESBURG

A SECOND FIVE-YEAR SURVEY : 1955 - 1959

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In 1956 the findings were reported[1] of the first 5-year survey (1950 - 1954) of the air-borne fungi in Johannesburg, as a basis for the study of fungus allergy in South Africa. The principal fungus genera then found in the atmosphere of Johannesburg were: cladosporium 32·5%, yeasts and yeast-like fungi 12·6%, alternaria 12·3%, penicillium 10·1%, epicoccum 10·1%, and phoma 8·3%.

Rhizopus, nigrospora, stemphylium, trichoderma and

acrospeira each contributed about 1·5% to the total. Eighteen other fungus genera together with 41 unidentified varieties made up the remaining 6·4%.

This paper presents the findings in the second 5-year survey covering the period 1954 - 1959. The methods and techniques of this investigation have remained the same and are as previously described.[1]

The following outline of the procedures adopted refers both to the culture plates and the prepared glass slides exposed to the air. Four-inch diameter plates of a suitable culture medium — mainly dextrose-agar — were exposed to the air of Johannesburg at 11 o'clock each morning at the top of a 3-storey building in Hospital Hill, a northern suburb situated on one of the ridges overlooking the city. Plate exposures were, as far as possible, made each working day except during rain. Experimental trials revealed that 3 minutes was the optimum exposure time, since longer exposures resulted in the plates becoming unduly overgrown. After exposure the plates were covered and left undisturbed at room temperature in the laboratory and examined for fungus colonies after 4 or 5 days, both qualitatively and quantitatively. They were observed daily thereafter for the identification of the fungi as their characteristic spores appeared. Colonies were, if necessary, subcultured on to various media to encourage sporulation, and were re-examined at intervals.

The culture-plate exposure method is by itself not entirely satisfactory for atmospheric fungus studies. Any artificial medium used must of necessity be selective in that it permits the growth of some, but not of other, varieties of fungus. Further, not every air-borne fungus grows on artificial medium and some will thus be lost to the colony counts. Certain hazards with regard to colony counts must also be borne in mind — avoidance of including 'daughter' colonies (e.g. of penicillium); preventing the overgrowth of young not yet identified colonies by rapidly-growing and spreading fungi (e.g. rhizopus); awareness of the fact that some fungi may elude identification because sporulation cannot be induced ('sterile mycelia').

In spite of these difficulties and inadequacies plate exposures at the same place and at the same time regularly over a period of years provide a satisfactory comparison for practical purposes even if precise and absolute knowledge of the atmospheric content is not obtained.

Throughout the period of this investigation and for many years before its commencement, suitably-prepared glass slides had been systematically exposed with the object of studying the pollen content of the atmosphere. There had thus become simultaneously available a record of the fungus elements on these slides supplying information additional to that obtained by the culture-plate technique. This gravity-slide method of fungus investigation is of value in that it reveals fungi present in the atmosphere which do not grow on the usual culture media, e.g. rusts. On the other hand the method is in itself inadequate for the qualitative and quantitative estimation of the atmospheric fungi, because not all fungus spores are identifiable by direct microscopic examination and, in any event, the nature of certain fungus elements seen in the non-sporing phase cannot of course be determined.

Up to the end of 1956 monilia, torula and other yeast-like organisms were recorded separately. Since 1957, however, these organisms have been classified together as 'yeast and yeast-like' organisms, with pullularia in a separate grouping.

As in the previous survey, the quantitative estimation of the atmospheric fungi was recorded in two ways: (1) *Abundance* — the total number of fungus colonies *per annum* of each variety appearing on the culture plates

TABLE I. ANNUAL ABUNDANCE OF AIR-BORNE FUNGI IN JOHANNESBURG IN THE 5-YEAR PERIOD, 1955–1959*

Fungus	*Number*	*Percent of total*	
Cladosporium	828	22·8 (32·5)‡	86·7 (85·9)
Yeast and yeast-like†	678	18·7 (12·6)	
Epicoccum	576	15·9 (10·1)	
Penicillium	398	11·0 (10·1)	
Alternaria	312	8·6 (12·3)	
Pullularia†	233	6·4	
Phoma	120	3·3 (8·3)	
Aspergillus	106	2·9 (0·7)	13·3 (14·1)
Nigrospora	62	1·7 (1·6)	
Helminthosporium	46	1·3 (0·7)	
Fusarium	41	1·1 (0·8)	
Rhizopus	24	0·7 (1·7)	
Trichoderma	22	0·6 (1·5)	
Acrospeira	—	— (1·4)	
Pleospora	10	0·3 (1·1)	
Other fungi	136	3·7 (3·1)	
Unidentified	39	1·0 (1·5)	

* Average annual exposure days = 256.
† Average for 3-year period (1957 - 1959).
‡ The figures in brackets represent, for comparison, the corresponding Abundance percentages in the previous 5-year period (1950 - 1954).

during the days of exposure; (2) *Frequency* — the number of days *per annum* each fungus variety appeared irrespective of quantity during the days of plate exposure.

In Table I the annual Abundance of air-borne fungi in Johannesburg is shown for the 5-year period 1955 - 1959.

TABLE II. ANNUAL FREQUENCY OF AIR-BORNE FUNGI IN JOHANNESBURG IN THE 5-YEAR PERIOD, 1955–1959

Fungus	*Average number of days per year on which the fungus appeared*	
	Number of days	*Percentage of exposure days (256)*
Cladosporium	237	92·6 (83·3) †
Yeast and yeast-like*	234	91·4 (not classified thus)
Epicoccum	222	86·7 (37·2)
Alternaria	186	72·6 (66·6)
Pullularia*	173	67·6 (not classified thus)
Penicillium	160	62·5 (59·3)
Phoma	106	41·4 (49·3)
Nigrospora	62	24·2 (17·7)
Aspergillus	47	18·4 (7·1)
Helminthosporium	46	18·0 (7·8)
Fusarium	41	16·0 (8·1)
Rhizopus	24	9·4 (19·0)
Trichoderma	22	8·6 (11·4)
Mucor	20	7·8 (4·2)
Curvuluaria	17	6·6 (—)
Stemphylium	13	5·1 (15·3)
Acrospeira	—	— (13·2)
Other fungi	56	Each less than 5·0% frequency.

* Average for 3-year period (1957 - 1959).
† The figures in brackets represent, for comparison, the corresponding Frequency percentages in the previous 5-year period (1950 - 1954).

In Table II the annual Frequency is similarly shown. The corresponding Abundance and Frequency percentages for the period 1950 - 1954 are also given (in brackets) for purposes of comparison. A graphical representation of the Abundance and Frequency data year by year is given in Fig. 1.

SEASONAL INCIDENCE OF ATMOSPHERIC FUNGI IN JOHANNESBURG

In the previous atmospheric fungus survey of the period 1950 - 1954, no significant seasonal incidence was noted in

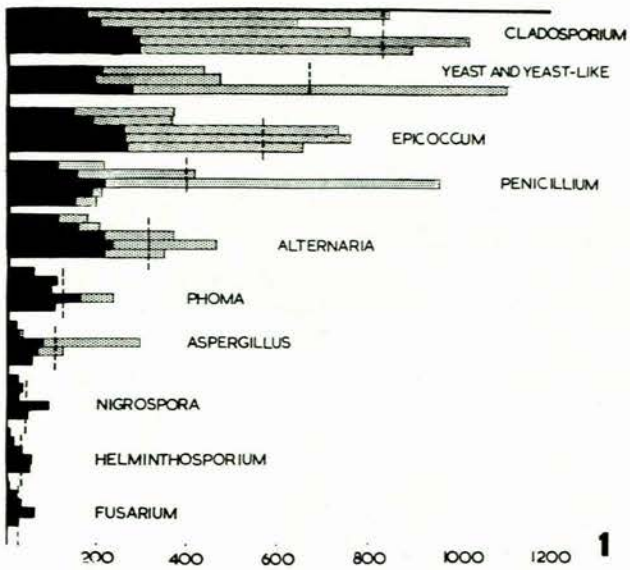

Fig. 1. The commoner air-borne fungi in Johannesburg, 1955 - 1959.
Whole column = *Abundance:* The total number of colonies of the specific fungus recovered in the exposure days of each year. The annual average for the 5 years is shown by a dotted line.
Black column = *Frequency:* The number of days on which the specific fungus was recovered in the exposure days each year. The relation of the whole column to the black column each year indicates the average number of colonies of the specific fungus recovered per exposure day.

the Abundance of any of the commoner air-borne fungi — alternaria, cladosporium, penicillium and epicoccum. In Fig. 2 the monthly Abundance of these fungi in the present 5-year period has been charted. Peaks of incidence are seen in certain months of this period, but these do not appear consistently in the different years. The absence of a significant seasonal incidence of these fungi is thus confirmed.

Yeast and yeast-like organisms constituted 18·7% of the total atmospheric fungi in the 3-year period, 1957 - 1959 (Table I). It will be observed from Fig. 3 that these appear to have a higher incidence in the winter-spring period, since there is a consistent rise in their numbers from May to October.

Fig. 4 shows the monthly incidence data obtained by the *slide-exposure method*. The chart indicates the findings in the microscopic examination of the exposed slides per sq. cm. in the 5-year period 1956 - 1960 for the commoner fungi — cladosporium, alternaria, helminthosporium and

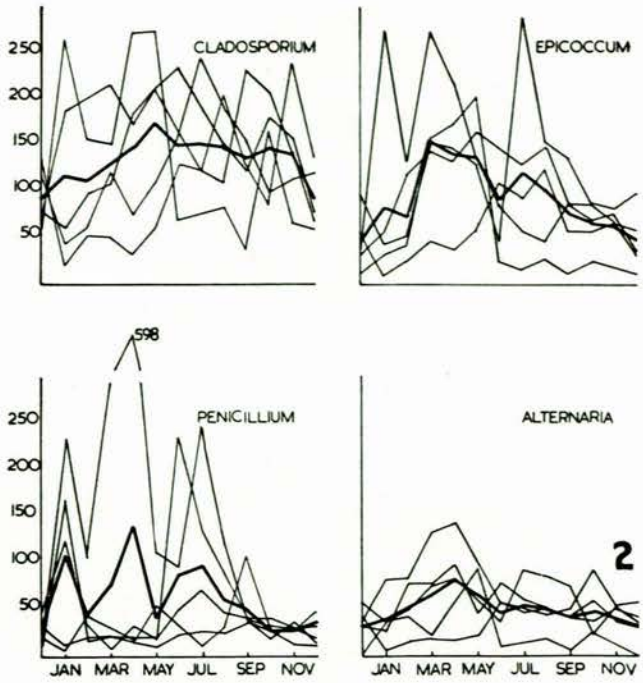

Fig. 2. The seasonal incidence of the commoner air-borne fungi of Johannesburg, 1955 - 1959, showing the number of colonies *(Abundance)* of the specific fungus recovered monthly during each of the successive years. The average for the 5-year period is shown by a heavy black line.

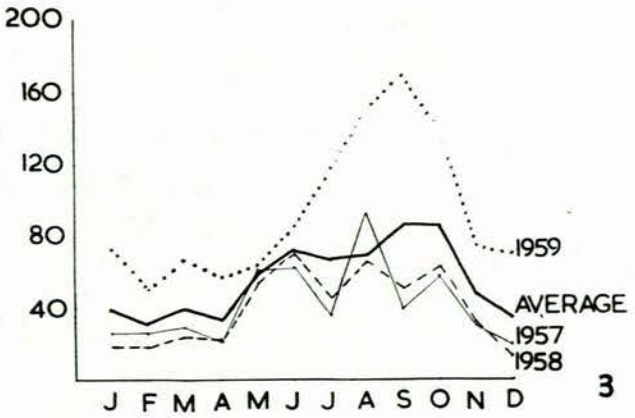

Fig. 3. The seasonal incidence of the air-borne 'yeast and yeast-like' organisms of Johannesburg, 1957 - 1959 showing the number of colonies *(Abundance)* recovered monthly during each of the successive years. The average for the 3-year period is shown by a heavy black line.

nigrospora — as well as for smuts and rusts. Cladosporium spores were found in relatively large numbers with high peaks of incidence in certain months of the year, but without seasonal regularity in the successive years. Alternaria, helminthosporium and nigrospora spores, as well as rusts, were found in small numbers and also without evidence of seasonal incidence. Smuts, on the other hand, were found in considerable quantity on the exposed slides, with a reasonably consistent increased incidence

in winter (May and June) and again in mid-summer (December and January).

SUMMARY

A second 5-year survey of the air-borne fungi in Johannesburg is reported, covering the period 1955 - 1959.

The principal genera of fungi found in the atmosphere of Johannesburg were: Cladosporium 22·8%, yeast and yeast-like organisms 18·7%, epicoccum 15·9%, penicillium 11·0%, alternaria 8·6%, pullularia 6·4% and phoma 3·3%.

The remaining 13·3% was made up by other fungus genera and unidentified varieties.

No significant seasonal incidence was noted in any of the above commoner atmospheric fungi, except in the case of the yeast and yeast-like organisms (yeasts, monilia, torula, etc.) where a consistent increase occurred each year in the winter-spring period (May - October).

Slide-exposure studies in the period 1956 - 1960 confirmed the absence of seasonal incidence in the case of cladosporium, alternaria, helminthosporium and nigrospora. Considerable quantities of smuts, however, were recorded by this method, with a definite seasonal increase in early summer — October - December.

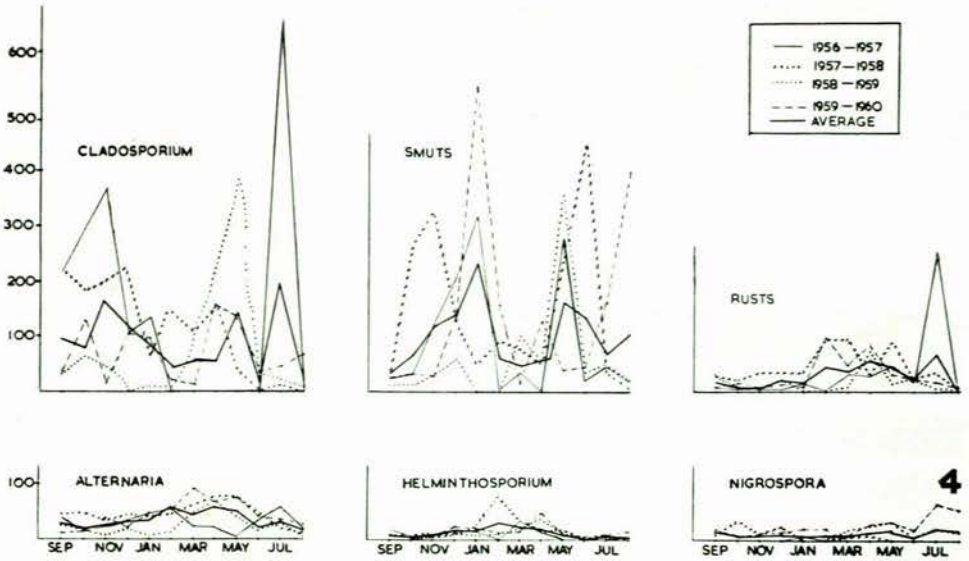

Fig. 4. The air-borne fungi of Johannesburg, 1956 - 1960, as determined by the *slide-exposure* method. The total number of fungi per sq. cm. is shown for each month of the successive years. The average for the 5-year period is indicated by a heavy black line.

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REFERENCE

1. Ordman, D. and Etter, K. G. (1956): S.Afr. Med. J., **30**, 1054.