

From the Amsterdam Clinic of Allergic Diseases. Chief: P. J. van der Werff.

FUNGI IN FACTORIES AND WORKSHOPS

By

P. J. VAN DER WERFF

I. INTRODUCTION

In studying the problems relating to fungus allergy, the fungi found out of doors or in living rooms and bedrooms usually receive most attention.

Although asthma and asthma-like conditions, and even endemics of these diseases, have been reported as occurring in certain industries both in the older literature (38, 34, 26, 19) and in more recent papers (10, 20, 11, 39, 14, 16, 22, 43, 18, 41, 1, 24, 8, 30, 44), so far allergologists have paid relatively little attention to these cases.

Fungi again probably are the chief cause in these cases. For time and again the striking fact was observed, that the numerous and simultaneously occurring attacks of asthma appearing in these occupations are almost always associated with the constant or occasional presence of large quantities of fungal substances in the dust of industries and the atmosphere of workshops. A striking example was provided by a number of papers by British authors (12, 6, 27) concerning an unusual illness, appearing in England in certain years. This was the massive occurrence of the so-called cotton-weaver's cough. This disease was observed in a large number of workers employed by some poorly equipped textile mills, where raw cotton was being handled, not only in 1910, 1911 and 1912, but also later, in 1924 and 1925. Collis (1912) attributed the appearance of the symptoms to the inhalation of fungi.

The moulds mainly involved in these cases were: *Penicillium* species, *Aspergillus flavus* Link, *Aspergillus niger* v. Tieghem, *Mucor* species and an unidentifiable fungus (13, 27).

Cotton-weaver's cough was detected in workers only during the years in which the cotton fibres were affected by these fungi.

Middleton (28) found a large number of spores and hyphae of fungi in dust, especially in carding-machines used to treat waste cotton. He believed that the cotton hairs themselves ultimately could only cause chronic bronchitis; on the other hand, the cotton-weaver's cough already described led him to assume that fungi played an important part in the pathogenesis of pulmonary diseases of an asthmatoïd nature: the so-called cardroom and the stripper's and grinder's asthma (17, 40, 33).

Symptoms of rhinitis, conjunctivitis, bronchitis, a sense of oppression in the chest, eczematous eruptions on the skin and fever are seen to appear in cornthreshers and flax workers. Similar symptoms occasionally occur in osier workers, reed cutters, peelers and plaiters engaged in the rush-mat industries, as well as in plasterers plastering on reed (26, 31).

Both retting—especially water-retting—and swingling give rise to the appearance of violent symptoms in various workers, such as symptoms involving the mucosa of the respiratory tract, which bear a marked resemblance to hay fever and hay asthma, but which may sometimes persist for weeks or months after the work has been completed!

From dew-retting dust I was able to isolate the following fungi:

Mucor mucedo Bref.

Rhizopus nigricans Ehrenberg

Trichoderma viride Pers.ex Fr.

Penicillium species (esp.: *brevi-compactum* Dierckx, *expansum* (Link) Thom, et *spinulosum* Thom)

Botrytis cinerea Pers.

Stachybotrys alternans Bon.

Cladosporium herbarum Link

Pullularia pullulans (de Bary et Löw) Berkh.
Alternaria tenuis Nees
and many yeasts.

Water-retting dust contained approximately the same species, as well as:

Penicillium rugulosum Thom and many
Fusarium species.

A personal communication by Professor James W. Sinden (1951) deserves to be recorded here. Together with Dr. E. Hauser, he carried out investigations in the field of mushroom-growing. The compost employed in certain farms for cultivating the *Psalliota campestris* (L.) Fr. had been infected by and fully overgrown with two unusual fungi.

In the farms infected only with a species of *Sepedonium*, none of the workers showed any symptoms, whereas symptoms did appear when the other species, apparently a new fungus of a rather strange type and tentatively placed in the genus *Spicaria*, was present as well. The symptoms in these subjects were confined to the respiratory tract, viz. congestion of the mucosa of the larynx and bronchi, extremely sharp pain in the upper part of the chest, markedly laboured breathing of the type seen in severe asthma, expectoration of bloody sputum and complete hoarseness.

None of the workers was entirely free of symptoms, although the onset and duration of the disturbances varied individually; they possibly varied with the personal degree of susceptibility or with the quantity of material inhaled. So far this problem has not been studied more closely from the medical point of view.

Very likely "*Spicaria*" was the pathogenic agent in these cases; for the time being, the mechanism—by which it did so—can only be surmised. These preliminary examples will suffice.

Obviously it is reasonable to assume that a sensitization to the inhaled fungi and subsequent allergic reactions may be induced in workers engaged in these and various other fac-

tories and workshops, in which the presence of fungi is frequently observed. It may be that in several cases this sensitization is preceded and/or accompanied and promoted by mechanical or chemico-toxic lesions or a mycosis or thrush of the respiratory tract.

In this field there are many doubtful factors, and frequently the question arises, whether the asthmatic and asthmatoïd manifestations are due to allergic influences or toxic conditions or infections exclusively. Apart from these problems, in treating allergic diseases it is frequently noted that a very large number of patients with asthma is engaged in particular occupations. Usually industries where organic substances are handled, where fungi find a fertile soil and where the optimal temperature and degree of moisture in the air also provide conditions stimulating their growth.

2. FINDINGS REPORTED BY OTHER AUTHORS AND RESULTS OF PERSONAL STUDIES¹

Various data on mycological findings regarding decomposing organic substances and concerning occupations and trades, are scattered throughout the literature.

Thus authors such as Galloway, Burgess and Mason (9, 25) have reported the finding of a large number of fungi in industries handling raw cotton, kapok, hemp, etc., the following species having been observed:

- Rhizopus arrhizus Fischer
- Chaetomium species
- Aspergillus fumigatus Fres.
- A. flavus Link
- A. niger v. Tieghem

¹ I gladly avail myself of this opportunity to thank Jhr. F. H. van Beyma thoe Kingma for the trouble he has taken in teaching me the first principles of the science and study of fungi. I also wish to thank Professor Joh. a Westerdijk, Miss Atie van Beverwijk and associates of the Centraal Bureau v. Schimmelcultures (C.B.S.) Baarn, Holland, for the helpful and cordial manner in which they have constantly lent me their expert assistance in dealing with problems in the field of mycology.

Penicillium species
Cladosporium herbarum Link
Stemphylium species
Fusarium species
Rhizoctonia solani Kühn.

Investigations of Burgess and Yendo (9) revealed that wool and natural silk from which the glue has been removed may also be a source of fungi. Especially a list of *Aspergillus* species and *Penicillium* species may be drawn up.

Joh. a Westerdijk and her associates have been carrying out investigations in this field for a period of many years (46, 4). She discovered that—as is the case in the more highly organized plants containing chlorophyll—there also are *associations of fungi: specific combinations, each of which have a particular character and a very constant composition in regard to a particular substrate* (45).

On sisal, jute, cocoanut etc., she found a fungus association consisting of

Mucor racemosus Fres.
M. spinosus v. Tieghem
Penicillium species.

The brownish black blotches appearing on cotton and linen are caused by a number of dark-coloured fungi, viz.:

Cladosporium herbarum Link
Epicoccum species
Alternaria tenuis Nees
Pullularia pullulans (de Bary et Löw) Berkh.
Stemphylium species
Stysanus species.

I observed similar, fairly constant, sociological relations myself, both out of doors and in dry and damp houses. For instance the following were about the only species I was able to isolate from the dust in linen, cotton and flannel spinning- and weaving-mills:

Rhizopus arrhizus Fischer
Rh. *nigricans* Ehrenberg

and occasionally *Aspergillus niger* v. Tieghem.

These *Rhizopus* species were also found in several samples of size (used in stiffening textiles) which contained potato flour among other things. In addition, other *Mucorales* were constantly seen in these samples, viz.:

Mucor racemosus Fres.
M. spinosus v. Tieghem
Thamnidium elegans Link

and finally:

Penicillium chrysogenum Thom
Cladosporium herbarum Link.

Another striking feature was the prevalence of *Mucorales* in the industries handling wheat-flour, rye-meal, etc. Musty rye-flour mostly appeared to be attacked by *Rhizopus* species and *Aspergillus* species (C. B. S. Baarn).

I found the following species in bakeries:

Mucor racemosus Fres.
M. spinosus v. Tieghem
Rhizopus arrhizus Fischer
Rh. nigricans Ehrenberg
Thamnidium elegans Link.

In mills a fungus association comprising nearly all the above *Mucorales* was cultivated from the grass, cocoanut and linseed meal, as well as

Trichoderma viride Pers. ex Fr.
Aspergillus Amstelodami (Mang.) Thom et Church
Penicillium species (viz.: *expansum* (Link) Thom, *chrysogenum* Thom, et *viridicatum* Westl.)
Cladosporium herbarum Link.

From the dust floating in the air in mills and from the fine dust on the beams I was able to isolate:

Rhizopus arrhizus Fischer
Rh. nigricans Ehrenberg
Chaetocladium Jonesii (Berkh. et Br.) Fres. on *Mucor racemosus* Fres.

and in grass-meal mills I found large quantities of:

Trichoderma viride Pers. ex Fr.

In breadstores others (35, 3) constantly found:

Neurospora sitophila Shear et B. O. Dodge

Penicillium glaucum Link (collective species),

as also was observed by myself.

Once, years ago, a pure culture of *Aspergillus Amstelodami* (Mang.) Thom et Church was observed in a Dutch gingerbread factory, not only on the walls and in the dust throughout the building, but also, and particularly, on the gingerbreads (C. B. S. Baarn).

In rooms where flour and corn-chandler's wares were stored and in groceries others found *Aspergillus*, *Penicillium* and *Rhizopus* species on the raw materials and in the dust (C. B. S. Baarn). From dust-samples of these storing rooms I was able to isolate:

Mucor mucedo Bref.

M. racemosus Fres.

Rhizopus arrhizus Fischer

Rh. nigricans Ehrenberg

Trichoderma viride Pers. ex Fr.

Aspergillus ochraceus Wilhelm

Penicillium brevi-compactum Dierckx

P. citreo-nigrum Dierckx

P. expansum (Link) Thom

P. meleagrinum Biourge and occasionally some other *P. glaucum*

species

Aleurisma carnis (Brooks et Hansford) Bisby

Botrytis cinerea Pers.

Cladosporium herbarum Link

Alternaria tenuis Nees

Fusarium species.

A striking feature was that *Sarcoptidae* were constantly found in the dust of flour-using industries, etc., whereas these species were hardly ever isolated from house-dust samples or dust from other industries.

Initially, I examined only one butcher's shop. Besides large numbers of *Penicillia* found on the living premises, the following species were observed in the butcher's shop itself:

Aspergillus niger v. Tieghem
Aleurisma carnis (Brooks et Hansford) Bisby.

As indicated by the name, the latter is a very common species on meat. Subsequent investigations, carried out in various butcher's shops, revealed the presence of the two above fungi as well as *Cladosporium herbarum* Link, the latter growing on the walls and even on meat in the refrigerators.

Apart from the technically useful *Penicillium roqueforti* Thom and *Penicillium camemberti* Thom, other species of fungi frequently are present on cheese; in particular, I found a wide variety of *Penicillium* species as well as *Aspergillus niger* v. Tieghem. Investigations, such as those carried out by the C. B. S. in Baarn have shown that spoiled butter and margarine contain certain fungi staining black, e.g. *Margarinomyces Bubáki* Laxa and *Margarinomyces atrovirens* v. Beyma.

A complaint constantly heard in vegetable stores as well as in greengrocery and fruitshops is, that a black, greyish green or green "mildew" appears on the vegetables and fruits. The examination I made revealed the presence of:

Mucor species
Rhizopus nigricans Ehrenberg
Penicillium species
Botrytis cinerea Pers.
Cladosporium herbarum Link
Alternaria tenuis Nees
Rhodotorula species and other yeasts.

Apples in cellars tend to a type of rot by one single fungus only, i.e. *Penicillium expansum* (Link) Thom (C.B.S.Baarn.).

Rotting citrus fruits are always found to contain either *Penicillium italicum* Wehmer or *Penicillium digitatum* Sacc., often associated with other *Penicillia*, as was found by C. B. S. Baarn and by myself. They also contain *Aspergillus* species.

The presence of a wide variety of *Monilia* species is frequently observed on raw tobacco (C. B. S. Baarn). Occasionally *Candida* and *Aspergillus* species were also found on tobacco-leaves during and after the various treatments.

From the dust of cigar-factories I was able to cultivate several fungi, viz.:

Mucor racemosus Fres.
M. spinosus v. Tieghem
Penicillium species (esp.: *expansum* (Link) Thom, et *chrysogenum* Thom)
Cladosporium herbarum Link
Stemphylium botryosum Wallr.
Alternaria tenuis Nees
Fusarium species
 Many yeasts.

Mac-Laughlin (9) and others were able to isolate fungus species from leather, viz.:

Mucor mucedo Bref.
Aspergillus glaucus Link
Oospora lactis (Fres.) Sacc.
Penicillium rugulosum Thom.

In addition, the following species were constantly isolated from moist leather (C. B. S. Baarn):

Penicillium corylophilum Dierckx
P. solitum Westl.

while large numbers of *Mucor* species may be present on the finer grades of leather, in addition to *Penicillium* species.

An excellent culture medium for *Penicillia*, which were found to be a common and frequently occurring species on hides, is provided by tanning materials, especially those used in tanning the finer grades of leather, as they are composed of substances such as wheat-meal, yolk of egg and alum.

From the dust of leather storehouses and shoemaker's workshops I was able to isolate the following species:

Mucor hiemalis Wehmer
M. racemosus Fres.
M. Ramannianus Möller

Rhizopus nigricans Ehrenberg
Aspergillus versicolor (Vuill.) Tiraboschi
Penicillium brevi-compactum Dierckx
 P. *chrysogenum* Thom
 P. *expansum* (Link) Thom
 P. *phoeniceum* v. Beyma
 P. *roqueforti* Thom
 P. *solitum* Westl.
Cladosporium herbarum Link
Pullularia pullulans (de Bary et Löw) Berkh.

On wood-pulp an association, comprising of *Phialophora* and *Hyalodendron* species, occurs (C. B. S. Baarn). Moist saw-dust in carpenter's workshops and saw-mills almost always contains very large quantities of *Penicillium*. A wide variety of genera of fungi are found on undressed wood in timber-yards and especially on the finer kinds of wood, which are shipped from the tropics to Europe in the undried state. Thus all the wood in a furniture factory, and especially the valuable lots from abroad used in veneering, was affected by a fungus to such a degree, that large quantities were rendered valueless. An investigation showed that the entire factory was covered with *Penicillium roqueforti* Thom (C. B. S. Baarn).

Workers in the timber industry affected with asthma have learnt from experience to guard against work involving the sawing of wet wood or removing the bark from tree-trunks.

From a number of samples of moist saw-dust, obtained from several workshops, I was able to isolate:

Mucor racemosus Fres.
 M. *spinosus* v. Tieghem
Rhizopus nigricans Ehrenberg
Aspergillus Amstelodami (Mang.) Thom et Church
Penicillium species (*expansum* (Link) Thom, *corymbiferum* Westl., *brevi-compactum* Dierckx, *roqueforti* Thom, et *spinulosum* Thom)
Trichoderma viride Pers. ex Fr.
Cladosporium herbarum Link
Alternaria tenuis Nees
Fusarium species, and one
Graphium spec., (a Stilbacea).

When wood is in the first stage of decay, *Trichoderma*, containing the enzymes lignase and cytase, invariably prevails, whereas it is not until a later stage that *Penicillia* and other fungi find a suitable medium on which to grow (45).

Time and again I have been able to isolate the following species in archives and records:

Chaetomium species
Trichoderma viride Pers. ex Fr.
Penicillium spinulosum Thom
Sepedonium chrysospermum (Bull.) Fr.
Alternaria tenuis Nees
Cladosporium herbarum Link
Torula chartarum (Link) Lindau
Stachybotrys alternans Bon.
Pullularia pullulans (de Bary et Löw) Berkh.
Stysanus species

an additional number of fungi, varying with the degree of dryness or moisture of the paper and cardboard storage places, being found as well, so that the following list, which also applies to offices, may be added:

Mucor hiemalis Wehmer
M. *mucedo* Bref.
M. *racemosus* Fres.
M. *spinosus* v. Tieghem
Rhizopus nigricans Ehrenberg
Aspergillus ochraceus Wilhelm
A. *versicolor* (Vuill.) Tiraboschi
Penicillium brevi-compactum Dierckx
P. *chrysogenum* Thom
P. *expansum* (Link) Thom
Botrytis cinerea Pers.
Trichothecium roseum Link
Rhodotorula mucilaginosa (Jörg) Harrison.

Every now and again large numbers of the growing crops in bulb-districts are in danger of decay due to fungi, especially *Botrytis* species.

In heating sheds and storage rooms for bulbs one constantly has to guard against the development of fungi, such

as *Botrytis*, *Fusarium*, *Sclerotinia* and *Sclerotium*. *Penicillium corymbiferum* Westl. was found to be one of the most frequent causes of decay in bulbs.

A number of bulbs, examined during my investigation, were found to be affected with the following fungi:

- in gladioli: *Mucor racemosus* Fres.
Penicillium corymbiferum Westl.
P. *expansum* (Link) Thom
P. *luteum* Zukal
Botrytis cinerea Pers.
Trichoderma viride Pers. ex Fr.
- in narcissi: *Trichoderma viride* Pers. ex Fr.
- in tulips: *Penicillium corymbiferum* Westl.
P. *chrysogenum* Thom
P. *expansum* (Link) Thom
P. *spinulosum* Thom.

A wide variety of fungi are found in flower-nurseries. To give an impression, I shall merely report the results obtained in the examination of a large number of samples which I obtained at various times from the hothouses of one of my patients, viz.:

- Mucor griseo-cyanus* Hagem
- M. *hiemalis* Wehmer
- M. *spinosus* v. Tieghem
- Rhizopus nigricans* Ehrenberg
- Penicillium brevi-compactum* Dierckx
- P. *chrysogenum* Thom
- P. *corymbiferum* Westl.
- P. *expansum* (Link) Thom
- P. *spinulosum* Thom
- Botrytis cinerea* Pers.
- Trichoderma viride* Pers. ex Fr.
- Botryosporium longibrachiatum* Oud.
- Cladosporium elatum* (Harz) Nannf.
- C. *herbarum* Link
- Fusarium culmorum* (W.Sm.) Sacc. and other
- Fusarium* species.

The following species were found in the palm-hothouse: *Gloeosporium* spec. and a fine specimen of *Polyporus* spec.

Cladosporium fulvum Cke. has been found regularly on the leaves of tomatoplants in hothouses (23, 8).

Various species of *Botrytis* and *Verticillium* were found on lettuce and other vegetables, *Phytophthora* being one of the species found on potato-leaves. All kinds of *Dematiaceae*, esp. *Cladosporium*, *Alternaria* and *Stemphylium* were observed in cornfields, both before and after harvesting. In wet summers fungi causing rust and smut also are often found on the leaves and stalks of the various grains and other *Gramineae*, as well as on clover. All these fungi and also especially *Chaetomium* and *Sordaria* may be found constantly and in large numbers in corn-straw, dried clover, bean-straw and hay—particularly when they have not been dried to a sufficient degree. In addition, I have observed *Aspergillus*, *Penicillium*, *Trichoderma*, *Fusarium* and various *Mucorales*.

The following species could be cultivated constantly from threshing dust:

- Mucor spinosus* v. Tieghem
- M. *varians* Povah
- Syncephalastrum racemosum* (Cohn) Schroet.
- Aspergillus Amstelodami* (Mang.) Thom et Church
- A. *clavatus* Desm.
- A. *flavus* Link
- A. *luteo-niger* (Lutz) Thom et Church
- A. *ochraceus* Wilhelm
- Penicillium corymbiferum* Westl.
- P. *expansum* (Link) Thom
- P. *rugulosum* Thom
- Cladosporium elatum* (Harz) Nannf.
- C. *herbarum* Link
- Alternaria tenuis* Nees
- Stemphylium botryosum* Wallr.
- Fusarium* species.

In the manure and fine dust of cow-houses I chiefly observed:

Mucor species (esp.: *piriformis* Fischer, *spinosus* v. Tieghem, *racemosus* Fres., *varians* Povah, et *sphaerosporus* Hagem)

Sordaria species
 Chaetomium species
 Botryotrichum piluliferum Marchal
 Many yeasts.

On examining the dust from a fruit-preserving works, I constantly observed a predominant growth of *Paecilomyces varioti* Bain. In addition to this unusual species of fungus, the following fungi were also isolated from the dust and from scrapings obtained from the barrels and the walls and ceilings of the workshops in this factory:

Aspergillus flavus Link
 A. *oryzae* (Ahlb.) Cohn
 A. *versicolor* (Vuill.) Tiraboschi
 A. *nidulans* (Eidam) Wint.
Penicillium glabrum (Wehmer) Westl.
 P. *italicum* Wehmer
 P. *spinulosum* Thom
Botrytis cinerea Pers.
Cladosporium elatum (Harz) Nannf.
 C. *herbarum* Link
Pullularia pullulans (de Bary et Löw) Berkh.
Alternaria tenuis Nees
Fusarium species.

Although it is almost unnecessary, in closing I cannot refrain from drawing attention to the danger of sensitization in individuals employed in factories where fungi are used for industrial purposes, e.g. in the manufacture of bakery-yeast, in breweries, in cheese-rooms (not only as agents of decay, but also in making special kinds of cheese), in the various processes essential to obtaining citric acid, vitamins and antibiotics.

Annotation: Molds must have a not too nutritive, not too dry, and slightly acid "natural"-biological substrate for optimal development (29).

The following culture media were mainly employed: May-cherry agar, pH 3.8-4.6; tomato agar, pH 4-5; sweet-wort or commercial malt-extract agar, pH 4.6-5.3; potato agar, pH 6.6. These media were used both in collecting fungus substan-

ces from the air and in cultivating fungi from dust obtained from industries. In addition they are to be preferred in growing pure cultures of the majority of fungus species, as the chief culture medium and as variations of the "propagation diet"; these variations are essential to preserving the characteristic properties of the fungi. Czapek and other synthetic media should be used in taxonomic work and in preparation of extracts exclusively.

COMMENT

It will frequently be very difficult to identify the origin of the syndromes observed in "occupational asthma". It may be due to the action of allergens or to chemico-toxic effects of the organic dust, containing proteins and histamine-like substances, possibly with the addition of numerous spores of fungi, to a bronchomycosis, whether or not accompanied by sensitization to the endogenous fungi¹, or to mechanical factors, viz. irritation or obstruction by organic and inorganic dust particles, possibly accompanied by bronchobacterial infections, and finally to any possible combination of these causative factors (24, 44).

The extent to which a hereditary predisposition of the patient, the personal degree of susceptibility, as well as the species and number of fungus substances inhaled, and possibly growing in the respiratory tract, may play a part in the pathogenesis, continues to be problematical in a large number of cases.

The majority of investigators engaged in the study of fungus-allergy assume, that when a patient shows hypersensitivity to fungi, this is almost invariably due to the repeated inhalation of air-borne mould spores (16). It has been established with certainty, that the ingestion of fungous substances can do the same (37, 7, 15, 5).

¹ Even in cases in which there is no hereditary predisposition, a sensitization of the organism may be caused by foci of fungus infection in the respiratory tract (36, 21, 2, 24, 44); it may even be induced by a fungus infection of the skin (32, 42).

Regardless of the course of events in each individual case, it seemed to me to be essential:

a) to examine from the mycological point of view whether Westerdijk's concept of "fungus association" could be confirmed by detailed investigations in a variety of factories and workshops;

b) if the former opinion could be proved, to obtain an indication from the medical point of view regarding the fungi—in the various occupations and trades known to cause asthma and asthma-like conditions—to be taken into account in studying the rôle of allergens, chemico-toxic factors and/or fungus infections.

When my investigations, extending over a period of 4 years, during which samples from a total number of 176 factories and workshops were studied, had been carried out:

the question sub a) could be answered in the affirmative, and

sub b) the above data could be made available for medical use.

SUMMARY

It was found advisable to adopt the concept "association" in mycology, as suggested by Westerdijk to define a specific combination of micro-organisms, characteristic of each decaying biological substrate. A number of examples, which may be of medical importance in general and of allergic importance in particular, are given of fungus associations, occurring in workshops and factories where a considerable number of individuals with asthmatic and asthmalike symptoms were found to be employed.

REFERENCES

1. *Alderson, V. G. & Mason, L. R.*: Californ. & West. Med. 5, 241, 1941.
2. *Barnard, J. H.*: Med. (J. &) Record 139, 534, 1943.
3. *Bernton, H. S. & Thom, C.*: with discussion Sulzberger, Rackemann, Schonwald, Vaughan, Feinberg, J. Allergy 8, 363, 1937.

4. *Beyma thoe Kingma, F. H. van.*: Mededelingen van het Phytopathologisch Laboratorium "Willie Commelin Scholten" Baarn, No. XI, 1927, No. XII, 1928, Verhand. Koninkl. Akad. Wetensch. Afd. Natuurk., 1929, XXVI, 2 & 4; 1931, XXIX, 2. Phytopathol. Zeitschr. 3, 453, 1929; S 535, 1931. Zentr. bl. f. Bakter. II. Abt.: Bd. 88, 1933; Bd. 89, 1933; Bd. 91, 1935; Bd. 95, 1936; Bd. 96, 1937; Bd. 99, 1939.
5. *Biederman, J. B.*: J. A. M. A. 106, 31, 1936.
6. *Bridge, J. C.*: Factories and Workshops, Ann. Report for 1924.
7. *Brown, G. T.*: Ann. Int. Med. 6, 655, 1932.
8. *Bruun, E. & Schwartz, M.*: Nord. Med. 26, 1219, 1945.
9. *Burgess, P., Galloway, L. D., Mac-Laughlin, G. B. and Yendo, Y.*: in: Morrow M. B. & Lowe E. P.: Mycologia 35, 638, 1943; in: Prince H. C. & Morrow M. B.: Tri-State Med. J. 11, 2277, 1939, May.
10. *Cadham, F. T.*: J. A. M. A. 83, 27, 1924.
11. *Cobe, H. M.*: J. Allergy 3, 389, 1932.
12. *Collis, E. L.*: Factories and Workshops, Ann. Report for 1912; Ann. Report for 1913.
13. *Crossley*: Factories and Workshops, Ann. Report for 1924.
14. *Detweiler, H. K.*: in *Brown, G. T.*: J. Allergy 7, 458, 1936.
15. *Feinberg, S. M. & Little, H. T.*: J. Allergy 6, 564, 1935.
16. *Feinberg, S. M.*: Allergy in Practice, Chicago, 1946.; (a.o. p. 222: Guba; and Guba: in Rackemann et al.: J. Allergy 9, 447, 1938.
17. *Fletcher* in Report-Departm. Committee, Dust-Card Rooms Industry Home Office (1932) His Majesty's Stationery Office. London.
18. *Harris, L. H.*: J. Allergy 10, 327 and 433, 1939.
19. *Hirt, L.*: Krankh. der Arbeiter. Tl I. Breslau, 1871.
20. *Hopkins, J. G. et al.*: J. A. M. A. 94, 6, 1930.
21. *Kotkis, A. J. et al.*: Arch. Int. Med. 38, 217, 1926.
22. *Leopold, S. S.*: J. Allergy 7, 594, 1936.
23. *Lind van Wijngaarden, C. de*: Commun. to Rijkstuinbouwconsul. 1944.
24. *Lohman, A. J. M.*: Ned. Tijdschr. v. Gen. 85, 3240, 1941; 88, 661, 1944.
25. *Mason, E. W.*: Annot. account fungi Imper. Mycolog. Inst. Kew, List I & II; 1925; 1928, 1933, 1937, 1941.
26. *Michel, M.*: J. Chim. méd., Pharm. et Toxicolog. 4 Sér., 9, 308, 1863.
27. *Middleton, E. L.*: Factories and Workshops, Ann. Report for 1925, p. 78; J. Ind. Hyg. 8, 428, 1926.
28. *Middleton, E. L.*: Factories and Workshops, Ann. Report for 1925, p. 76; J. Ind. Hyg. 8, 436, 1926.
29. *Mossel, D. A. A. & Westerdijk, Joh. a.*: Antonie van Leeuwenhoek 15, 190, 1949.
30. *Orie, N. G. M.*: Ned. Tijdschr. v. Gen.: 91, 3535, 1947; 91, 3576, 1947. Thesis, Utrecht, 1946.
31. *Peyser, A.*: Handb. der sozial. Hygiene u. Gesundh. fürsorge, II: 482, Berlin, 1926.

32. *Ramirez, M. A.*: Med. (J. &) Record 132, 382, 1930.
33. *Royle, H.*: Proceed. First Int. Congr. Allergy, Basel & New York, 1952.
34. *Salisbury*: Am. J. Med. Sci., July 1862.
35. *Shear, C. L. & Dodge, B. O.*: J. Agric. Res. 34, 1019, 1927.
36. *Steinfeld, E.*: J. A. M. A. 82, 83, 1924.
37. *Taub, S. J.*: J. Allergy 3, 586, 1932.
38. *Tersánky, J.*: Oesterr. med. Wochenschr. 9, 259, 1848.
39. *Towey, J. W. et al.*: J. A. M. A. 99, 453, 1932.
40. *Vismans, J. B. M.*: Ned. Tijdschr. v. Gen. 96, 800, 1952.
41. *Waldbott, G. L. & Ascher M. S.*: Ann. Int. Med. 14, 215, 1940.
42. *Wise, F. & Sulzberger, M. B.*: J. A. M. A. 95, 1504, 1930.
43. *Wittich, F. W. (et al.)*: J. Allergy 8, 189, 1937; J. Lancet 59, 382, 1939; 60, 148, 1940.
44. *Werff, P. J. van der*: Ann. Allergy 11, 567, 1933; Proceed. Allerg. Meeting, May 1955, Utrecht, in print.
45. *Westerdijk, Joh. a.*: Antonie van Leeuwenhoek 15, 187, 1949.
46. *Westerdijk, Joh. a & coworkers*: C. B. S. Baarn Mededelingen v. h. Phytopathologisch Laboratorium "Willie Commelin", Baarn; et. etc.

P. J. van der Werff, Emmastraat 28, Amsterdam, Holland

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.