PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 4, Part 1, pp. 47–68 (1965)

REMARKS ON SPECIES OF PHOMA REFERRED TO PEYRONELLAEA

G. H. BOEREMA, M. M. J. DORENBOSCH, & H. A. VAN KESTEREN
Plantenziektenkundige Dienst (PD), Wageningen

(With four Plates and four Text-figures)

The authors conclude that the separation of the form-genus *Peyronellaea* Goid. ex Togliani from *Phoma* Sacc. is both undesirable and unpracticable. A comparative study of the data in the literature, of original cultures, and of herbarium material of the fungi ascribed to *Peyronellaea*, leads to the distinction of three species: *Phoma glomerata* (Cda.) Wr. & Hochapf., *Phoma prunicola* (Opiz) Wr. & Hochapf., and *Phoma musae* (Joly) comb. nov. The synonymy and characteristics of these species are discussed and a key is given.

In 1946 Goidànich proposed a new form-genus *Peyronellaea* (Goidànich, 1946a) for *Phoma*-like fungi which *in vitro* are characterized by the production of multicellular chlamydosporal structures resembling the dictyospores found in such Dematiaceae as *Alternaria*, *Stemphylium*, and *Coniothecium*. Luedemann (1959) termed these structures d i c t y o c h l a m y d o s p o r e s. Togliani (1952) validly published the name *Peyronellaea* by furnishing a formal Latin diagnosis and designating *Coniothyrium glomeratum* Cda. sensu Wollenweber & Hochapfel (1936), the basionym of *Peyronellaea glomerata* (Cda.) Goid., as type species.

Disregarding synonymy, Goidànich (1946a) listed twenty-two species and transferred them to the genus *Peyronellaea*. Dictyochlamydospore-like structures are mentioned in the original diagnoses of only seven of these species. Various authors have ascribed similar structures to the other species on the basis of specimens so identified (e.g. Wollenweber & Hochapfel, l.c.). An extensive review of the literature of all the species mentioned by Goidànich (l.c.) is given by Luedemann (1957) in a thesis on the genus *Peyronellaea*. He concluded (see also Luedemann, 1959) that probably only two well-defined morphological species exist: *Peyr. glomerata* and *Peyr. prunicola* (Opiz) Goid. (the last name still not validly published) as defined by Wollenweber & Hochapfel (l.c.). In France (cf. Joly, 1961) a third 'old' species is differentiated, viz. *Peyr. fumaginoides* (Peyron.) Goid. ex Leduc (1958). Luedemann (1959) included this species in the synonymy of *Peyr. glomerata*.

Since the genus was established, further species have been described, such as *Peyr. stipae* Lacoste (1957), which, according to Joly (l.c.), is only a "*Peyr. glomerata* juvénile," *Peyr. nicotiae* Leduc (1958), *Peyr. musae* Joly (1961), and *Peyr. nainensis* Tandon & Bilgrami (1961).

Our own study of the pertinent literature and original cultures has led to the identification of six more species (*Phoma* and *Ascochyta* spp.) that can be considered to be *Peyronellaea*-like fungi.

The present paper gives the results of a comparative study of all these species in co-ordination with the study of Luedemann in the genus *Peyronellaea* (1957).

Names of authors mentioned in this paper are abbreviated as recommended in the 'Index of Plant Diseases in the United States' (Agric. Handb. U.S. Dep. Agric. 165. 1960).

Herbaria and culture collections are coded according to Lanjouw & Stafleu (1959) and the list of abbreviations in the catalogue of the American Type Culture Collection (Ed. 7, 1964), respectively.

The status of Peyronellaea

In the course of this study the question as to why *Peyronellaea* should be separated from *Phoma* proved to be of current interest. In this connection it should first be noted that the pycnidia of the type-species of both form-genera, respectively *Peyr. glomerata* and *Phoma herbarum* West. (see Boerema, 1964), resemble each other so much that they can be distinguished only by small differences in the size and colour of their pycnidiospores. In both cases the pycnidiospores arise through a monopolar repetitive budding process (Boerema, 1965). The only difference between both genera, therefore, is the occurrence of dictyochlamydospores in *Peyronellaea*. However, the production of dictyochlamydospores is a character of questionable value, as appears in the following.

Peyronellaea strains in culture may lose their ability to form dictyochlamydospores (Chodat, 1926, strains of *Phoma alternariaceum*, a synonym of *Peyr. glomerata*; Luedemann, 1957: 62, 65, 67, culture of *Peyr. prunicola* sensu Goidànich) and thus merge into *Phoma!*

In culture *Peyronellaea prunicola*, respectively *Peyr. nicotiae* at first produces only chains of single chlamydospores (Boerema & Dorenbosch, 1965; Leduc, 1958), such as are known in many typical *Phoma* species. In the course of time dictyochlamydospores usually develop as well, but this depends not only on the 'age' of the strain and the composition of the medium but also on strain qualities. Frequently in the cultures of some strains there are scarcely any dictyochlamydospores to be found.

There are many *Phoma*-like fungi which, besides single chlamydospores, incidentally produce complexes of chlamydospores. The difference between these complex chlamydosporal structures and dictyochlamydospores is relative. An example is *Ascochyta gossypii* Syd. Some strains of this fungus apparently produce typical dictyochlamydospores, as in *Peyr. glomerata* (Chippindale, 1929), but in the cultures of the four strains of this fungus that we studied [1] only such irregular compound chlamydosporal structures develop as can be found in many *Phoma*-like fungi that produce chlamydospores.

[1] Culture ATCC (American Type Culture Collection) No. 12786 and three cultures (A, B, C) obtained from Dr. L. S. Bird, A. & M. Coll. of Texas, College Station; see Phytopathology **53**: 621, 622. 1963.

It should also be noted that the pycnidia and the dictyochlamydospores of *Peyronellaea* occur as two different forms, adapted to the conditions of growth of these fungi. In both, the carbon-nitrogen ratio of the medium appears to be a determining factor (Chodat, 1926; Lacoste, 1955; Luedemann, 1957); at low values (6–35) there is greater production of pycnidia, at higher values (40–70) the development of dictyochlamydospores usually increases.

The chief purpose of the artificial system of Deuteromycetes is to provide a practicable method for identifying and naming the asexual forms of fungal appearance, viz. conidial fructifications and characteristic mycelial stages. From this point of view it is, in our opinion, unpractical and undesirable to use for the characterization of a form-genus an unstable criterium that cannot be sharply defined and which largely depends on the conditions of growth. As stated above, this is the case with the dictyochlamydospores of the genus *Peyronellaea*. It is also in conflict with the principle of the nomenclature of the Deuteromycetes to base a form-genus on two different asexual forms that are not indisputably related. This is even more true of *Peyronellaea*, where the relation between pycnidia and dictyochlamydospores can be established only *in vitro*, depending on the medium. In nature dictyochlamydospores are much more variable (i.e. not characteristic) in shape; consequently they cannot be identified as belonging to a pycnidial stage.

Therefore we have concluded that separation of the genus *Peyronellaea* from the genus *Phoma* is undesirable.

Of course in the complete diagnoses of the fungi in question it is always necessary to record that *in vitro*, apart from *Phoma* pycnidia, dictyochlamydospores can also develop. The same is true of single chlamydospores, sclerotia, pigment production, forming of crystals, etc. These alternative characters (*in vitro*) are even indispensable to a key to fungi that produce *Phoma* pycnidia!

The species concept

When considering the problem of the species concept our starting point was again that the system of Deuteromycetes is artificial and should be used for identification purposes only. Therefore in our opinion a form-species must be a taxon that a taxonomist can readily identify. This means that the delimitation of a form-species must be based on clear, stable characteristics. As a result, such a form-species concept is rather broad. In our opinion, however, it is the only one that is practicable. Chaos is bound to arise if form-species are based on minor differences only. This emerged, for example, in comparing the specimens of *Phoma* that produce dictyochlamydospores (*Peyronellaea*) in official (type) culture collections in the United States (ATCC), England (CMI), France (PC), the Netherlands (CBS), and Italy (PAV). The cultures labelled *P. glomerata* in these collections, including cultures originating from Goidànich (Togliani, 1952) and Wollenweber (Wollenweber & Hochapfel, 1936), show more correlative differences than exist, for example, between cultures of *P. prunicola* sensu Goidànich (Pupillo, 1952),

P. glomerata sensu Wollenweber (Wollenweber & Hochapfel, 1936), and *P. fumaginoides* sensu Leduc (1958). Here a narrow species concept would lead to a chaotic confusion of names.

The study of Chodat (1926) has shown that in this type of fungi single spore isolates and saltants from one and the same strain can produce cultures that show many small differences. In this case, therefore, a broad concept of a form-species is in agreement with the variability of the natural species. If, moreover, it is for any reason desirable, there is always the possibility of giving variants that have been detected a separate position (variety, form, etc.) within the form-species.

The pycnidia of all the species of *Phoma* studied that produce dictyochlamydospores show only few differences. This applies equally to many *Phoma* species. Therefore, as pointed out in the former chapter, the substitute characters in culture are essential for differentiating this kind of form-species. For the species discussed in this paper (i) the manner in which the dictyochlamydospores are produced and (ii) the occurrence of single chlamydospores appear to be practicable criteria for distinguishing species.

KEY TO THE SPECIES

1. Dictyochlamydospores generally in chains of 2–20 elements that resemble the conidia-chains of *Alternaria* spp. (compare Fig. 2, Pl. 1) . . . . . *Phoma glomerata*
1a. Dictyochlamydospores generally single, usually resembling the conidia of *Stemphylium* spp. 2
2. Dictyochlamydospores usually terminal on hyphal branches; abundant production of single chlamydospores in long chains (compare Fig. 3, Pl. 3) . . . . *Phoma prunicola*
2a. Dictyochlamydospores seem to be produced laterally from hyphal strands; single chlamydospores do occur but are inconspicuous (compare Fig. 4, Pl. 4) . . *Phoma musae*

The above key is based on the characters of the chlamydospores from fresh cultures on maltagar (recipe Ainsworth, 1961: 241).

For the characters of the pycnidia and pycnidiospores of the three *Phoma* species, see Figure 1 and Table I.

For comparison of the general habitus *in vitro*, see Plates 2, 3, and 4.

TABLE I

PYCNIDIA AND PYCNIDIOSPORES IN PHOMA SPECIES UNDER DISCUSSION

Species	Pycnidia	Pycnidiospores
Phoma glomerata	usually 30—180 × 60—200 μ	usually 6—7.5 × 3—3.5 μ, av. 6.6 × 3.1 μ
Phoma prunicola	usually 80—200 × 100—220 μ, often 'furcate'	usually 5—7 × 2—3 μ, av. 6.1 × 2.8 μ
Phoma musae	usually 50—180 × 60—200 μ	usually 6—7 × 3—4 μ, av. 6.6 × 3.7 μ

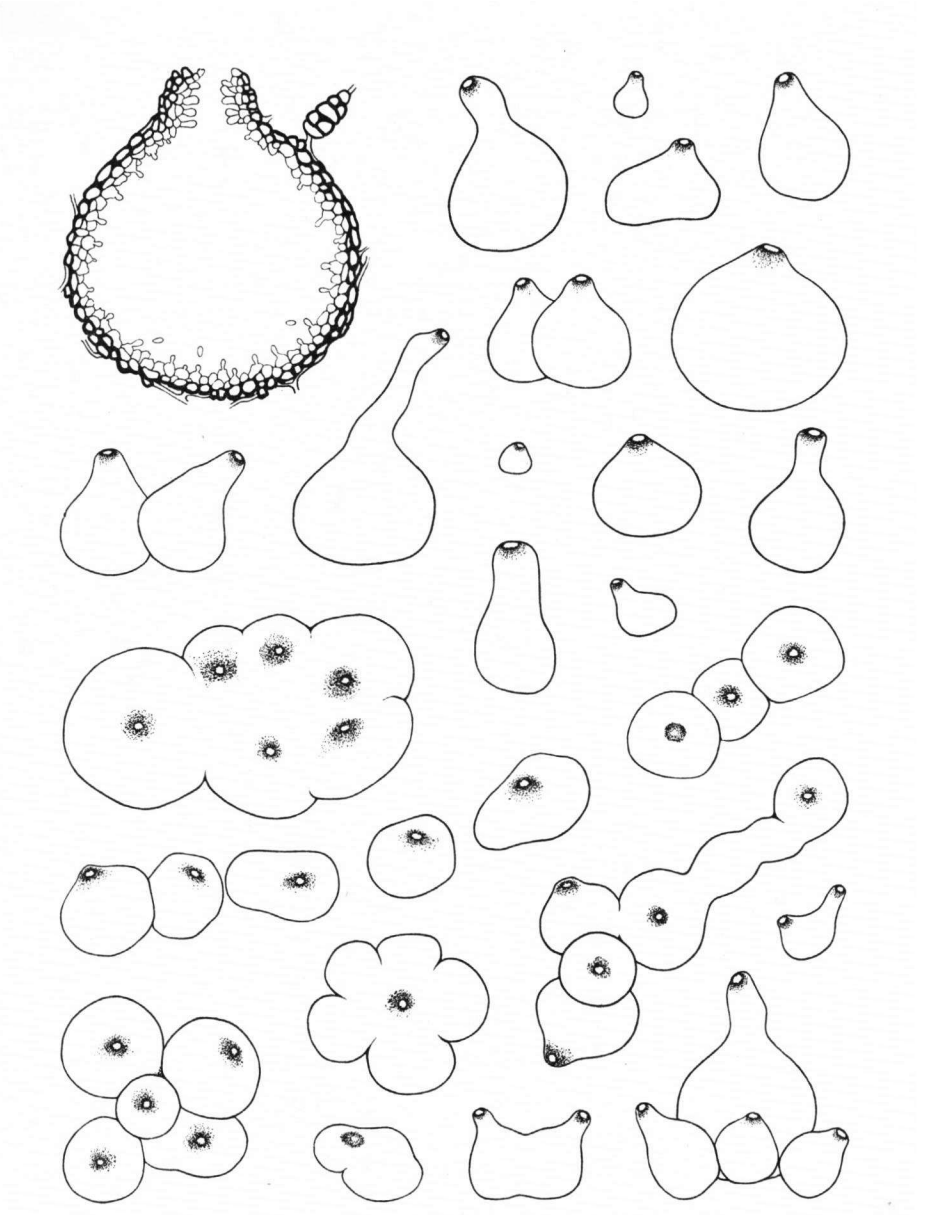


Fig. 1. Pycnidia in the three *Phoma* species under discussion; structure and variation in size and shape.

PHOMA GLOMERATA (Cda.) Wr. & Hochapf.[2] —Fig. 2, Pls. 1, 2

A

Coniothyrium glomeratum Cda., Ic. Fung. **4**: 39. 1840. — *Aposphaeria glomerata* (Cda.) Sacc., Syll. Fung. **3**: 175. 1884. — *Phoma glomerata* (Cda.) Wr. & Hochapf. *in* Z. ParasitKde **8**: 592. 1936. — *Peyronellaea glomerata* (Cda.) Goid. *in* Rc. Accad. Lincei **1**: 455, 658. 1946;[3] *ex* Togliani *in* Annali Sper. agr. **6**: 93. 1952.

Phoma fibricola Berk. *in* Hook. J. Bot. **5**: 41. 1853. — *Aposphaeria fibricola* (Berk.) Sacc., Syll. Fung. **3**: 176. 1884. — *Peyronellaea fibricola* (Berk.) Goid. *in* Rc. Accad. Lincei **1**: 455. 1946.[4]

Aposphaeria consors Schulz. & Sacc. *in* Hedwigia **23**: 109. 1884. — *Peyronellaea consors* (Schulz. & Sacc.) Goid. *in* Rc. Accad. Lincei **1**: 455. 1946.[4]

Phoma herbarum West. f. *chrysanthemi-corymbosi* Allesch. *in* KryptFl. Deutschl. **1** (6): 330. 1901. — *Peyronellaea herbarum* f. *chrysanthemi-corymbosi* (Allesch.) Goid. *in* Rc. Accad. Lincei **1**: 455. 1946.[4]

B

Alternaria polymorpha Planchon *in* Annls Sci. nat. (Bot.), sér. 8, **11**: 48–89. 1900. — *Peyronellaea polymorpha* (Planchon) Goid. *in* Rc. Accad. Lincei **1**: 455. 1946.[4]

Phoma radicis-andromedae Ternetz *in* Jb. wiss. Bot. **46**: 365–366. 1907.

Phoma radicis-vaccinii Ternetz *in* Jb. wiss. Bot. **46**: 366–367. 1907.

Ascochyta trachelospermi Fabricatore *in* Annali Sper. agr., ser. 2, **5**: 1445. 1951.

C

Phoma richardiae Mercer *in* Mykol. Zentbl. **2**: 244, 297, 326. 1913. — *Peyronellaea richardiae* (Mercer) Goid. *in* Rc. Accad. Lincei **1**: 454–455. 1964.[3] — *Coniothecium richardiae* (Mercer) Jauch. *in* An. Soc. cient. argent. **144**: 456. 1947.

Phoma conidiogena Schnegg *in* Zentbl. Bakt. ParasitKde (Abt. 2) **43**: 326–364. 1915. — *Peyronellaea conidiogena* (Schnegg) Goid. *in* Rc. Accad. Lincei **1**: 455. 1946.[4]

Phoma alternariaceum Brooks & Searle *in* Trans. Brit. mycol. Soc. **7**: 193. 1921. — *Peyronellaea alternariaceum* (Brooks & Searle) Goid. *in* Rc. Accad. Lincei **1**: 455. 1946.[4]

Phoma fumaginoides Peyron. = *Alternaria fumaginoides* Peyron., *apud* Filippopulos *in* Boll. Staz. Patol. veg. Roma, ser. 2, **7**: 332–336. 1927. — *Peyronellaea fumaginoides* (Peyron.) Goid. *in* Rc. Accad. Lincei **1**: 452, 455. 1946;[3] *ex* Leduc *in* Revue gén. Bot. **65**: 542, 543. 1958.

Phoma hominis Agostini & Tredici *apud* Pollacci *in* Atti Ist. bot. Univ. Lab. crittog. Pavia, ser. 4, **6**: 154. 1935;[5] *ex* Agostini & Tredici *in* Atti Ist. bot. Univ. Lab. crittog. Pavia, ser. 4a, **9**: 187. 1937 = *Alternaria hominis* Agostini & Tredici *in* Atti Ist. bot. Univ. Lab. crittog. Pavia, ser. 4a, **9**: 187–188. 1937. — *Peyronellaea hominis* (Agostini & Tredici) Goid. *in* Rc. Accad. Lincei **1**: 455. 1946.[4]

Peyronellaea stipae Lacoste *in* C. r. hebd. Séanc. Acad. Sci., Paris **241**: 818–819. 1955;[5] *ex* Lacoste *in* Rev. Mycol. **22** (suppl. colon. 1): 14. 1957.

Phoma saprophytica Eveleigh *in* Trans. Brit. mycol. Soc. **44**: 582–583. 1961.

Peyronellaea veronensis Goid. *in* Rc. Accad. Lincei **1**: 451, 455, 658. 1946.[6]

[2] The synonyms are divided into three groups, A, B, and C, which will be discussed separately.

[3] Not validly published according to Art. 43 of the International Code of Botanical Nomenclature (Utrecht, 1961).

[4] Not validly published according to Arts. 32 and 43 of the International Code of Botanical Nomenclature (Utrecht, 1961).

[5] Not validly published according to Art. 36 of the International Code of Botanical Nomenclature (Utrecht, 1961).

[6] Not validly published according to Arts. 36 and 43 of the International Code of Botanical Nomenclature (Utrecht, 1961).

MISAPPLICATIONS.—*Phoma cincta* Berk. & Curt., *Phyllosticta destructiva* Desm., *Phyllosticta asteris* Bres., and *Sphaeronaema glomerata* Berk. & Br. *sensu* Wr. & Hochapf. *in* Z. ParasitKde **8**: 592. 1936, pro syn. and *Phoma cincta* Berk. & Curt. and *Phyllosticta destructiva* Desm. *sensu* Togliani *in* Annali Sper. agr., ser. 2, **6**: 93. 1952, pro syn. [see the discussion; all names transferred to *Peyronellaea* by Goidànich (*in* Rc. Accad. Lincei **1**: 455. 1946), but not validly published].

Togliani (*in* Annali Sper. agr., ser. 2, **6**: 93. 1952) mentions further as a synonym of *Peyronellaea glomerata*: *Phyllosticta glomerata* Berk. & Br. This name, however, does not exist. See the discussion.

A cultural variant of *Peyronellaea glomerata*, described by Pupillo (*in* Annali Sper. agr., ser. 2, **6**: 60–65. 1952), has been misidentified by Goidanich as *Peyronellaea prunicola* (Opiz) Goid. The latter, *Phoma prunicola* (Opiz) Wr. & Hochapf., will be discussed hereafter.

DESCRIPTIONS & ILLUSTRATIONS.—Planchon *in* Annls Sci. nat. (Bot.), sér. 8, **11**: 48–92, figs. 7–9, pl. 1, figs. 1–15. 1900 (*Alternaria polymorpha*); Mercer *in* Mykol. Zentbl. **2**: 245–253, figs. 1, 2; 297–305, figs. 3–5; 326–331, fig. 6. 1913 (*Phoma richardiae*); Schnegg *in* Zentbl. Bakt. ParasitKde (Abt. 2) **43**: 326–363, figs. 1–7. 1915 (*Phoma conidiogena*); Brooks & Searle *in* Trans. Brit. mycol. Soc. **7**: 173–197. 1921 (*Phoma alternariaceum*); Chodat *in* Bull. Soc. bot. Genève, sér. 2, **18**: 66–144, figs. 9–18. 1926 [*Phoma alternariaceum* ("*alternariacearum*")]; Filippopulos *in* Boll. Staz. Patol. veg. Roma, ser. 2, **7**: 332–336, figs. 1–4. 1927 (*Alternaria fumaginoides*); Benham *in* Bull. Torrey bot. Club **58**: 203–214, figs. 12–19, pls. 14–16. 1931 (*Phoma conidiogena*); Wollenweber & Hochapfel *in* Z. ParasitKde **8**: 592–594, fig. 15a, b. 1936 (*Phoma glomerata*); Agostini & Tredici *in* Atti Ist. bot. Univ. Lab. crittog. Pavia, ser. 4a, **9**: 180–186, figs. 3–5. 1937 (*Phoma hominis*); Dennis *in* Trans. Brit. mycol. Soc. **29**: 38–39. 1946 [*Phoma alternariaceum* ("*alternariacearum*")]; Pupillo *in* Annali Sper. agr., ser. 2, **6**: 60–65, figs. 9–11. 1952 (as *Peyronellaea prunicola*, misapplied); Togliani *in* Annali Sper. agr., ser. 2, **6**: 82–93, figs. 3–7. 1952 (*Peyronellaea glomerata*); Lacoste *in* C. r. hebd. Séanc. Acad. Sci., Paris **241**: 818–819. 1955 and *in* Rev. Mycol. **22** (suppl. colon. 1): 14, fig. 7. 1957 (*Peyronellaea stipae*); Luedemann *in* Doct. Diss. Ser., Publ. 21, 920, Univ. Michigan: 36–41, pls. 1–6. 1957; Leduc *in* Revue gén. Bot. **65**: 543, figs. 1, 2. 1958 (*Peyronellaea fumaginoides*); Joly *in* Rev. Mycol., **26**: 94–96, figs. 2e, f. 1961 (*Peyronellaea glomerata*).

DIAGNOSTIC CHARACTERISTICS IN VITRO.—Pycnidia superficial on and immersed in agar (small ones occasionally also in aerial mycelium), sometimes developing from an element in a dictyochlamydospore chain, light-coloured to black and carbonaceous, mostly globose-ampulliform to obpyriform, sometimes irregularly ovoid-ellipsoid to oblong, usually with one ostiole, occasionally 2–3 ostioles; 20–300 × 40–600 μ, mostly 30–180 × 60–200 μ. Often pycnidia coalesce to form irregular large fructifications with many ostioles.

Pycnidiospores hyaline to dark-coloured, with 2 or more guttules; mostly ovoid to ellipsoid, sometimes globose or irregular in shape, usually continuous, occasionally 1-septate, 3–16 × 1.5–6 μ, mostly 6–7.5 × 3–3.5 (av. 6.6 × 3.1) μ.

Dictyochlamydospores (Fig. 2, Pl. 1) dark brown to black, arising in unbranched or branched chains of 2–20 or more elements from older pycnidia, in clumps from the medium and in aerial mycelium, sometimes connected by dark-celled mycelial

elements or else with single chlamydospores and intermediate stages alternating between chlamydospores and dictyochlamydospores, generally obclavate-ovoid to obpyriform, sometimes fusiform-ellipsoid to ovoid or oblong, with 3–9 transverse walls and usually some longitudinal or oblique walls, 18–80 × 12–30 μ.

HABITAT.—This ubiquitous fungus commonly occurs in all kinds of plant material (Wollenweber & Hochapfel, 1936; Togliani, 1952; and personal observations). It occurs with special frequency on dead seed coats, glumes and dead leaf sheaths (Crosier & Weimer, 1940; Reeder & Vanterpool, 1953; Lacoste, 1955, 1957; Leduc, 1958; and personal observations). As a soil fungus (Warcup, 1951) it occurs on the living underground parts of plants (Ternetz, 1907; Wollenwever & Hochapfel, 1936; and personal observations), sometimes having a stimulating effect on the growth of the plants (nitrogen fixation?; Ternetz, 1907; ten Houten, 1939).

The fungus as a secondary invader is often associated with distinct disease symptoms of plants. It occurs on diseased and prematurely fallen leaves of all kinds of plants (Mercer, 1913; Swift, 1932; Andrus, 1933; Wollenweber & Hochapfel, 1936; Togliani, 1952; and personal observations). It is also found on dying shoots and in association with diebacks, cankers, papery bark, tuber lenticel-rot and galls caused by insects (Petri, 1934; Togliani, 1952; Porreye, 1961; Boerema & van Kesteren, 1962; Luedemann, 1957). Inoculation experiments are always negative (Mercer, 1913, on leaf spots of calla lily; Foschi, 1956, on papery bark of apple; Boerema & van Kesteren, 1962, on lenticel-rot of potato tubers). In these cases the role of the fungus is generally considered to be that of a secondary, rather than a primary, invader.

The fungus attacks different fruits; it is known as the cause of rot in tomatoes (Brooks & Searle, 1921; and personal observations), pitting in apples (Wollenweber & Hochapfel, 1936; Goidànich, 1946b; Ghillini, 1952; Ghillini & Mezzini, 1954; Mezzetti, 1956) and pulprot in lemon fruits (Pupillo, 1952). On the vine the fungus has been reported as the cause of a blight of shoots, leaves, and young grapes during the flowering period (Šarić-Sabadoš, Milatović, & Masten, 1960; Milatović, Masten & Kadić, 1960; Picco, 1962). It has been described from a tip blight (silver gray tip) of boxwood (Swift, 1932; Andrus, 1933). Further it is known as a harmful sooty mold on the leaves and branches of olive trees (Filippopulos, 1927).

This fungus has several times been recorded in association with special disease symptoms in man, namely granuloma of the foot, dermatomycosis of the hand (Pollacci, 1935; Agostini & Tredici, 1937), otomycosis, subacute and vasomotor rhinitis and ozaena (Motta, 1929), and mycosis of the genital tract of a woman (Perazzi, 1925). Further it has been reported as inciting asthma attacks in a man (Benham, 1931; Hopkins, Benham & Kesten, 1930). Apparently the fungus is also able to cause tooth-caries (Goidànich, 1946b). In none of these cases could the symptoms be reproduced in animals by artificial infection. With human mycosis the fungus seems to be not a causal but an aggravating factor (Pollacci, 1935).

The fungus can also grow on several purely chemical products (Planchon, 1900; Schnegg, 1915). Further it is known from paint (Eveleigh, 1961; and personal

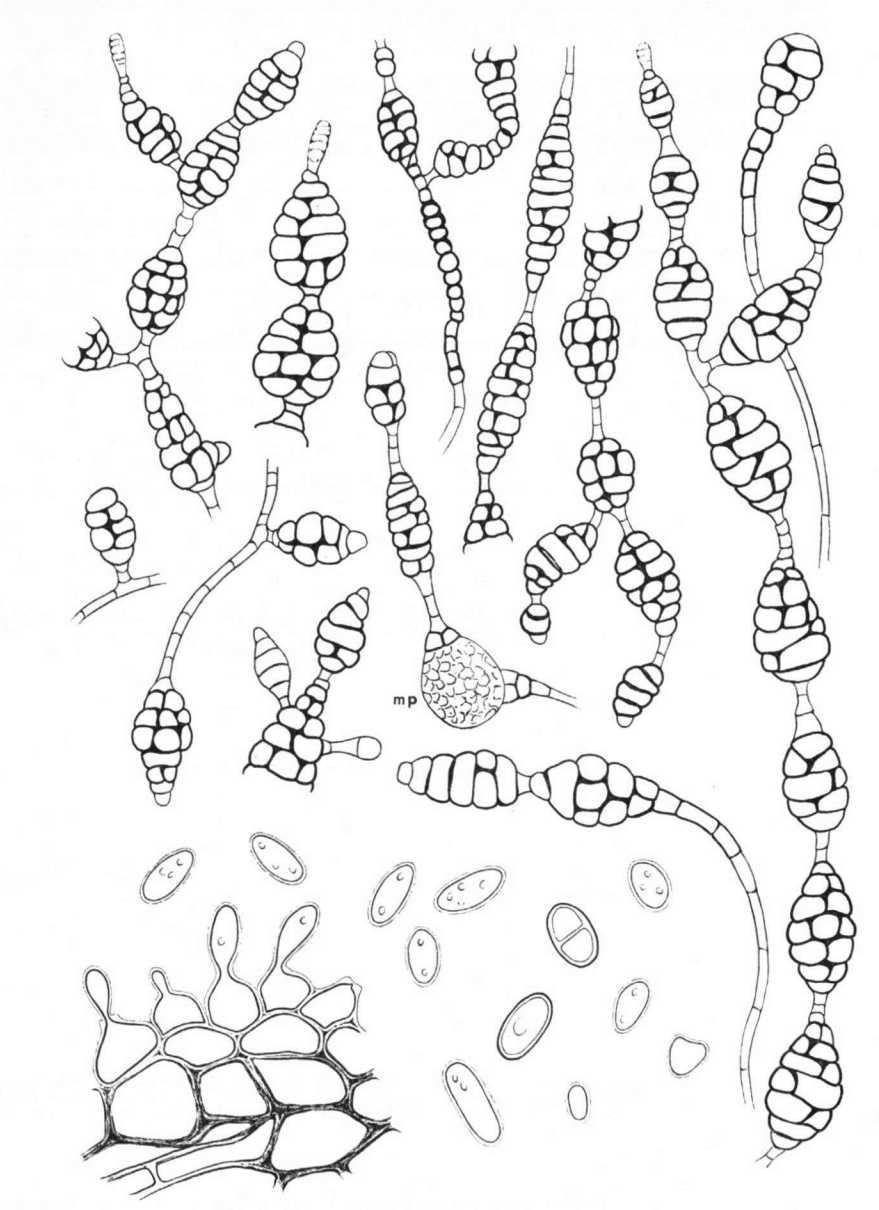


Fig. 2. *Phoma glomerata*; pycnidiospores and dictyochlamydospores. Note the variable shape and size of the latter, depending on the C/N ratio of the medium, age of the culture, and race qualities.
mp = micropycnidium developing from a dictyochlamydospore.

observations), wool fibers (Mulcock, 1959), wood (Vernon, 1935; Harris, 1932) and butter (Vernon, 1935).

SPECIMENS EXAMINED.—

Cultures: *Peyronellaea stipae*, culture of type (PC-1567); "*Peyronellaea prunicola*" (misapplied), isolate from lemon, see Pupillo, 1952, identification Goidànich (CBS, PAV-803); *Phoma alternariaceum*, culture of type, see Brooks & Searle, 1921 (CMI-17.361, under *Peyronellaea glomerata*, catalogue 1960); *Phoma conidiogena*, isolation and identification Benham, 1931 (CBS, under *Peyronellaea*, catalogue 1961); *Phoma* (*Alternaria*) *fumaginoides*, culture Prof. Sibilia, Rome, type culture? (CBS, under *Peyronellaea*, catalogue 1961), isolate made by Mrs. M. Moreau from diseased carnations, France, 1954, identification Mrs. J. Nicot (PC-1521), isolate made by Mrs. J. Nicot, from desert soil in S. Oran (PC-1522); *Phoma glomerata*, isolate made by J. E. Machacek, Canada Dept. Agric., Winnipeg 1938 (ATCC-6735), isolate made by Wollenweber, see Wollenweber & Hochapfel, 1936 (CBS, under *Peyronellaea*, catalogue 1961), isolate from tomato roots (CBS, under *Peyronellaea*, catalogue 1961), isolate made by Mulcock, 1959 (CMI-74.752, under *Peyronellaea*, catalogue 1960), isolate from *Eucalyptus* in S. Africa (CMI-46.259, under *Peyronellaea*, catalogue 1960), isolate made by Goidànich from apple, see Togliani, 1952 (PAV-884, under *Peyronellaea*), isolate made by Goidànich from pear (PAV-804, under *Peyronellaea*), isolate made by Luedemann from walnut petiole galls, strain B and C, see Luedemann, 1957 (under *Peyronellaea*), isolate made by R. Taylor, Australia, from grape, via Luedemann; *Phoma* (*Alternaria*) *hominis*, culture of type, see Pollacci, 1935 (CBS, under *Peyronellaea*, catalogue 1961); *Phoma saprophytica*, culture of type and two other cultures, see Eveleigh, 1961 (CMI-85.470, 85.471, 85.472).

DISCUSSION.—The variability of this fungus *in vitro* is illustrated by the differences between the cultures of this species in various collections. Our first impression was that nearly all these cultures belonged to different species. Our own isolates of *Phoma glomerata* on different agar media, however, so frequently showed sector mutants (saltants) that we have had to accept considerable variability in this species. Aside from this, it appeared that the production of pycnidia, aerial mycelium, and dictyochlamydospores, as well as the size and pigmentation of pycnidia, pycnidiospores, and dictyochlamydospores are strongly influenced by the age of the isolates and the C/N ratio of the artificial media (compare Luedemann, 1957). There is no doubt but that it is the use of different media at the various institutes that has been principally responsible for the increase in variability noted among the old cultures [cf. Chodat (1926) on *Phoma alternariaceum* and Lacoste (1955) on *Peyronellaea stipae*].

Notwithstanding the large variability *in vitro*, *Phoma glomerata* can always be easily recognized (see the Key).

Synonyms of Group A: The synonymy of this group is based on the study of Wollenweber & Hochapfel (1936).

In the paper of Togliani (1952) on *P. glomerata* many old species names are listed as synonyms. It appears that this list was copied from the study by Wollenweber & Hochapfel (l.c.). The original descriptions of these old species were all made from observations *in vivo*, consequently dictyochlamydospores were not mentioned. Wollenweber & Hochapfel based the synonymy on the pycnidial characteristics and on the substrata mentioned as matrices in the various diagnoses. However, they gave their interpretation without studying the existing original exsiccata of the old species. Therefore we rechecked their conclusions.

No original material of the basionym *Coniothyrium glomeratum* exists. The description and figures of this fungus given by Corda agree with the characters of *Phoma glomerata in vivo*. In our opinion, therefore, there is no reason to disagree with Wollenweber & Hochapfel's interpretation of *C. glomeratum*.

The same holds good for *Phoma fibricola*, *Aposphaeria consors*, and *Phoma herbarum* f. *chrysanthemi-corymbosi*, of which, so far as is known, no original herbarium material exists.

Other old species names, however, listed as synonyms by Wollenweber & Hochapfel (l.c.) and Togliani (l.c.), appear to represent other fungi (compare "misapplications" above). Investigation of an original collection of *Phoma cincta* Berk. & Curt. ["*Peyronellaea cincta* (Berk. & Curt.) Goid.", not validly published] nr. 3791 in the herbarium of Berkeley (K, Sphaeropsidales nr. 590679) showed that the wall structure of the pycnidia of this fungus is totally different from the wall structure of *Phoma glomerata*. The shape of the spores is also different, viz. acerose, fusiform, averaging 7.6 × 1.9 μ. Examination of two original collections of *Phyllosticta destructiva* Desm. ["*Peyronellaea destructiva* (Desm.) Goid.," not validly published] occurring on *Lycium europeum* and *Malva sylvestris* (PC, Coll. Desm. 147; 1863 Nr. 8) also showed that this species does not agree with *P. glomerata* [compare the description of *Ascochyta destructiva* (Desm.) Kabat & Bubak (*in* Sber. K. böhm. Ges. Wiss. **11**: 4. 1904)]. Of *Phyllosticta asteris* Bres. and *Sphaeronaema glomerata* Berk. & Br. ["*Peyronellaea asteris* (Bres.) Goid." and "*Peyronellaea glomerata* (Berk. & Br.) Goid.," both not validly published] it was not possible to obtain the original material; from the diagnoses, however, it is obvious that these species are not identical with *Phoma glomerata*. The non-existing name "*Phyllosticta glomerata* Berk. & Br.," inserted in the synonymy by Togliani (l.c.), is apparently a telescoping of the above-mentioned *Phyllosticta asteris* and *Sphaeronaema glomerata*.

Synonyms of Group B: The synonymy of this group is based on original descriptions of the growth *in vitro*.

In the original description of *Alternaria polymorpha*, *Phoma radicis-andromedae*, *Phoma radicis-vaccinii*, and *Assochyta trachelospermi* the occurrence of dictyochlamydospores has been mentioned ("formes *Macrosporium*, *Alternaria* irréguliers etc. etc.," "mauerförmige Conidien," "strutture ipnocistische simili a conidi di Ifali Dema-

ziacee"). Comparison of the descriptions and figures with the characteristics of the three species producing dictyochlamydospores that we studied *in vitro* showed that they all agreed with *Phoma glomerata*.

The small differences in the size of pycnidia and pycnidiospores mentioned by Ternetz in her description of *Phoma radicis-andromedae* and *Phoma radicis-vaccinii* on *Rhododendron* agar are within the normal range of variability of *P. glomerata* on this medium. Ternetz supposed that both species of *Phoma* and three others described from Ericaceae are mycorrhizal fungi but this has never been proved (cf. Harley, 1959). The recorded stimulating effect of *Phoma radicis-andromedae* and *Phoma radicis-vaccinii* on the growth of the plants is in accordance with observations on *P. glomerata* (ten Houten, 1939: 87). Further it must be noted that Fabricatore (1951), in her paper on *Ascochyta trachelospermi*, emphasized the occurrence of some 1-septate pycnidiospores, a character not reported by Goidànich (1946a) for *Peyronellaea*. However, Wollenweber & Hochapfel (l.c.) had already mentioned the incidental occurrence of two-celled spores in *Phoma glomerata*.

Synonymy of Group C: The synonymy of this group is based on original descriptions of the growth *in vitro* and the study of living cultures.

The identifications of the remaining species with *P. glomerata* have been partly based on the observations by Wollenweber & Hochapfel (l.c.). They studied the type culture of *Phoma richardiae*, obtained from the CBS, and found it identical with their isolates of *Phoma glomerata*. The culture of *Phoma richardiae* is no longer present in the CBS.

We studied a culture from the CBS of *Phoma conidiogena*, isolated and determined by Benham (1931). This proved to be *P. glomerata*, mentioned earlier by Luedemann (1957) and Joly (1961). The original description of *Phoma conidiogena* is also in accordance with the characteristics of *P. glomerata*.

The type culture of *Phoma alternariaceum*, preserved in the CMI, was studied extensively by Chodat (1926). Culturally it apparently behaved like *P. glomerata*. Some of the mutants which Chodat obtained from this type culture agree with mutants derived from our own cultures of *P. glomerata*.

The identification of *Alternaria* (*Phoma*) *fumaginoides* with *P. glomerata* is based on a study of two cultures received respectively from the CBS and the Cryptogamic Laboratory in Paris (PC). The CBS culture, possibly a subculture of the type material, was at first sterile. After inoculation in tomato we obtained a culture which sporulated fairly well and which did not differ from *P. glomerata*. Luedemann (l.c.) came to the same conclusion. The culture from Paris also showed the characteristics of *P. glomerata*. Leduc (1958) stated that in *Peyronellaea fumaginoides* (from Paris) the dictyochlamydospores are always connected by mycelial elements, which would not be true of *P. glomerata* (cf. Joly, 1961). We observed both possibilities, however, in various isolates of *P. glomerata*.

The type culture of *Phoma hominis* (CBS) was characterized by chains of relatively small dictyochlamydospores. In our cultures of *P. glomerata*, however, some sections

were observed to possess the same type of dictyochlamydospores. Hence there is no reason to separate *Phoma hominis* from *P. glomerata*. Joly (l.c.), studying an original culture of *Phoma hominis* in Paris (PC), also identified it as *P. glomerata*. A *Peyronellaea* isolate from lemon fruits (Pupillo, 1952), identified by Goidànich as *Peyronellaea prunicola* and received from both Baarn (CBS) and Pavia (PAV) had the same type of dictyochlamydospores as *Phoma hominis* and is therefore also considered to be *P. glomerata* (see under "misapplications"). As can be seen from comparison of the descriptions of both fungi, the true *P. prunicola* is quite different from *P. glomerata*.

As had already been stated by Joly (l.c.), the original culture of *Peyronellaea stipae* (PC), also proved to be identical with *P. glomerata*. The observations by Lacoste (1955) about the influence of a different C/N composition of the growing media on *Peyronellaea stipae* coincide with our observations on isolates of *P. glomerata*.

The original cultures of *Phoma saprophytica*, isolated from paint by Eveleigh (1961) and obtained from the CMI, represent typical isolates of *P. glomerata*. We ourselves have also isolated *P. glomerata* from paint on several occasions. Before describing the paint-fungus as a new species, Eveleigh compared it with cultures of various *Phoma*-like fungi, among others a culture of *P. glomerata* from the CMI. He evidently failed to realize that the CMI strain of *P. glomerata* represents only one cultural type of this variable fungus.

Finally, it should be noted that Goidànich in his study of the genus *Peyronellaea* gave this fungus the provisional name *Peyronellaea veronensis*, so that this name is also mentioned in the synonymy of *P. glomerata*.

PHOMA PRUNICOLA (Opiz) Wr. & Hochapf.[7] —Fig. 3, Pl. 3

A

Depazea prunicola Opiz *in* Malá Encyclop. Nauk. Náklad. česk. Mus. **10**: 120. 1852. — *Phyllosticta prunicola* (Opiz) Sacc. *in* Michelia **1**: 157. 1878. — *Phoma prunicola* (Opiz) Wr. & Hochapf. *in* Z. ParasitKde **8**: 595. 1936. — *Peyronellaea prunicola* (Opiz) Goid. *in* Rc. Accad. Lincei **1**: 455. 1946 (misapplied).[8]

Phyllosticta pruni-avium Allesch. *in* Ber. bot. Ver. Landshut **12**: 15. 1892.

Phyllosticta pirina Sacc. *in* Michelia **1**: 134. 1878. — *Coniothyrium pirinum* (Sacc.) Sheldon *in* Torreya **7**: 142–143. 1907 (misapplied).

Phoma pomorum Thüm., Fungi pomicoli 105. 1879.

Phyllosticta cydoniicola Allesch. *in* Hedwigia **36**: 158. 1897; not *Phyllosticta cydoniicola* P. Henn. *in* Hedwigia **41**: 114. 1902.

Phoma pruni-japonicae Syd. *in* Hedwigia **38**: 136. 1899.

Phyllosticta tirolensis Bubak *apud* Bubak & Kabat *in* Öst. bot. Z. **54**: 181. 1904.

B

Phoma fictilis Del. *in* Bull. Soc. mycol. Fr. **9**: 186. 1893. — *Peyronellaea fictilis* (Del.) Goid. *in* Rc. Accad. Lincei **1**: 455. 1946.[8]

Peyronellaea nicotiae Leduc *in* Revue gén. Bot. **65**: 545. 1958.

[7] The synonyms are divided into two groups, A and B, which will be discussed separately.

[8] Not validly published according to Arts. 32 and 43 of the International Code of Botanical Nomenclature (Utrecht, 1961).

MISAPPLICATIONS.—*Peyronellaea prunicola* (Opiz) Goid. *sensu* Pupillo *in* Annali Sper. agr., ser. 2, **6**: 60–62. 1952 = cultural variant of *Phoma glomerata*, which see, also the discussion below.

Phyllosticta pirina Sacc. *sensu* Sheldon *in* Torreya **7**: 142–143. 1907 [*Coniothyrium pirinum* (Sacc.) Sheldon] = *Coniothyrium* spec.

Coniothyrium tirolense Bubak and *Coniothyrium piricola* Poteb. *sensu* Dennis & Wakefield *in* Trans. Brit. mycol. Soc. **29**: 157. 1946, pro syn. of *Phyllosticta pirina*; both names refer to a true *Coniothyrium* spec., fide Petrak & Sydow (1927) and Wollenweber & Hochapfel (1937).

DESCRIPTIONS & ILLUSTRATIONS.—Crabill *in* Rep. Va agric. Exp. Stn. **1911–1912**: 99–109, figs. 20–26. 1913 (*Phyllosticta pirina*); Bolle *in* Meded. phytopath. Lab. Willie Commelin Scholten **7**: 59, pl. 3, figs. 14–17. 1924 (*Phyllosticta pirina*); Wollenweber & Hochapfel *in* Z. ParasitKde **8**: 595–597, fig. 16. 1936 (*Phoma prunicola*); Leduc *in* Revue gén. Bot. **65**: 544–545, figs. 3–5. 1958 (*Peyronellaea nicotiae*); Boerema & Dorenbosch *in* Versl. Meded. plziektenk. Dienst Wageningen 142 (Jaarb. 1964): 144–149, figs. 7, 8. 1965.

DIAGNOSTIC CHARACTERISTICS IN VITRO.—Pycnidia superficial on and immersed in agar, small pycnidia occasionally also in aerial mycelium, sometimes developing from dictyochlamydospores; light-coloured to black and carbonaceous, globose-ampulliform to obpyriform, generally with a ridged or furrowed surface, usually with one ostiole; size variable, as a rule 80–200 × 100–220 μ. Often pycnidia coalesce to form irregular, large fructifications with many ostioles.

Pycnidiospores hyaline to dark-coloured, usually with some guttules; generally ovoid to ellipsoid; usually continuous, occasionally 1-septate, 3–13 × 1.5–6 μ, as a rule 5–7 × 2–3 (av. 6.1 × 2.8) μ.

Single chlamydospores (Fig. 3, Pl. 3) dark brown to black, produced on agar surface chains of 2–25 or more elements, 8–10 μ diam.

Dictyochlamydospores (Fig. 3, Pl. 3) dark brown to black, usually arising as single terminal spores on mycelial branches, occasionally intercalary in the mycelium in connection with single chlamydospores, and intermediate stages between chlamydospores and dictyochlamydospores; as a rule ovoid to ellipsoid, sometimes obovoid-clavate to oblong; with 3–9 transverse walls and usually some longitudinal or oblique walls, 18–60 × 12–30 μ.

HABITAT.—A ubiquitous fungus, occurring on all kinds of dead and diseased plant material. It is often associated with leaf spots on apple, pear, and species of *Prunus* among others (Crabill, 1913; Wollenweber & Hochapfel, 1936; Boerema & Dorenbosch, 1965). In these cases it seems to be a secondary invader (Crabill, 1913). As a soil fungus it has also been found many times on roots and other underground parts of plants (personal observations). Frequently it occurs on the dead seed coats of all kinds of plants (Leduc, 1958 and personal observations). Further isolations have indicated that it has a rather wide range of substrate upon which it can grow (e.g. earthenware, isolation of Saito, CBS Baarn).

SPECIMENS EXAMINED.—

Exsiccata: *Depazea* (*Phyllosticta*) *prunicola*, Opiz herb., type (PR-185704), Sydow, Mycoth. germ. 175 in Saccardo herb. (PAD, under *Phyllosticta*); *Phyllosticta*

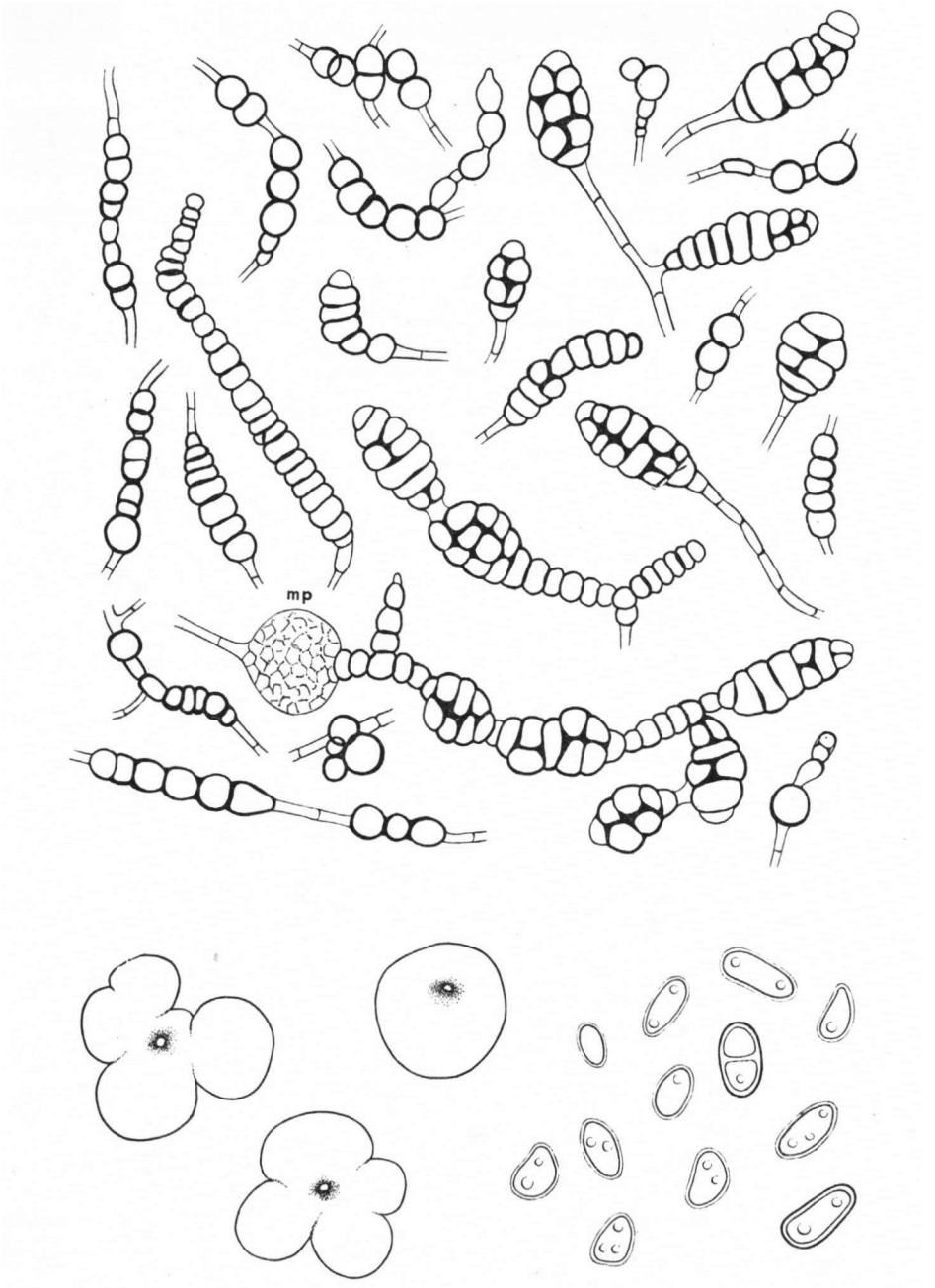


Fig. 3. *Phoma prunicola*; furcate pycnidia, pycnidiospores, chlamydospores, and dictyochlamydospores. Note the complex structures of chlamydospores and dictyochlamydospores. mp = micropycnidium developing from a dictyochlamydospore.

pirina, Saccardo herb., type and exs. coll. Ellis & Martin (PAD); *Phyllosticta tirolensis*, Bubak herb., type (BKL).

Cultures: *Phoma fictilis*, isolate made by Saito from earthen pots in Japan, 1916 (CBS, under *Peyronellaea*, catalogue 1961), *Peyronellaea nicotiae*, culture of type, see Leduc, 1958 (PC-1552).

DISCUSSION.—This fungus is fairly uniform in cultural appearance and characterized by the abundant production of chains of single chlamydospores in combination with dictyochlamydospores. However the production of dictyochlamydospores varies in accordance with the age of the culture and isolate and with the C/N ratio of the medium. The same holds good for the pigmentation and size of the pycnidia and pycnidiospores.

The fungus is fairly easy to distinguish from *Phoma glomerata*. However, Goidànich created confusion by his identification of a cultural variant of *Phoma glomerata* from lemon (Pupillo, 1952) with *Phoma prunicola* as described by Wollenweber & Hochapfel (1936). This implies that the description of *Peyronellaea prunicola* in Pupillo (l.c.) and the cultures labelled *Peyronellaea prunicola* in CBS, PAV, and PC actually relate to *Phoma glomerata*! The detailed characters of *Phoma prunicola* given above have been described from our own isolates of the fungus in comparison with the description given by Wollenweber & Hochapfel (l.c.). Besides this, we had access to data on the cultural characters of two specimens which Wollenweber & Hochapfel (l.c.) considered to be *Phoma prunicola*, viz. *Phyllosticta pirina* as described by Crabill (1913: strain 1, 2; see also Bolle, 1924: 59) and *Phoma fictilis* (sensu Saito, see below under B).

Synonyms of Group A: The synonymy of this group is based on the study of Wollenweber & Hochapfel (1936).

Most of the old species names listed as synonyms of *Phoma prunicola* were described from material in leaf spots on trees. Wollenweber & Hochapfel (l.c.), in their study of this fungus, pointed out that these species, except *Phyllosticta tirolensis*, are identical with *P. prunicola*; with this we agree. It is true that in the original diagnoses of those species dictyochlamydospores are not mentioned, but is should be kept in mind that the descriptions were based on observations *in vivo* (compare the discussion under *P. glomerata*). Because a study of the original diagnoses and an examination of the herbarium material available failed to give any concrete contra-indications, we accept the interpretation by Wollenweber & Hochapfel (l.c.).

The pycnidia in the type material of *Phyllosticta tirolensis* are similar to the pycnidia of *P. prunicola* on leaf spots, so that we have added that species described from leaf spots to the synonymy of *P. prunicola*.

Synonyms of Group B: The synonymy of this group is based on the study of living cultures.

Wollenweber & Hochapfel (l.c.) established that a CBS culture of *Phoma fictilis* isolated from earthen pots and determined by Saito in Japan in 1916 belongs to

Phoma prunicola. This culture was still present in the CBS in 1960 under the name *Peyronellaea fictilis*. It was sterile but after repeated culturing in tomatoes it produced pycnidia and dictyochlamydospores. This agrees with our isolates of *Peyronellaea prunicola*. The vague original French description of *Phoma fictilis* is not in contradistinction to this synonymy. Furthermore it is now known that *Peyronellaea prunicola* occurs on all kinds of substrata.

In France an isolation of *P. prunicola* from flax seed has been described as a new species, *Peyronellaea nicotiae*. From a comparative study of the type culture of this species and *P. prunicola* we came to the conclusion that they are identical.

Phoma musae (Joly) Boerema, Dorenb., & Kest., *comb. nov.*—Fig. 4, Pl. 4.

Peyronellaea musae Joly *in* Rev. Mycol. **26**: 97. July 1961.
Peyronellaea nainensis Tandon & Bilgrami *in* Curr. Sci. **30**: 344. Sept. 1961.

DESCRIPTIONS & ILLUSTRATIONS.—Joly *in* Rev. Mycol. **26**: 96–97, figs. 2a–d. 1961 (*Peyronellaea musae*); Tandon & Bilgrami *in* Curr. Sci. **30**: 343–344, fig. 1. 1961 (*Peyronellaea nainensis*).

DIAGNOSTIC CHARACTERISTICS IN VITRO.—Pycnidia superficial on and immersed in agar, small pycnidia often in aerial mycelium and then as a rule developing from dictyochlamydospores; globose-ampulliform to obpyriform, usually with one ostiole; size variable, generally 50–180 × 60–200 μ. Occasionally pycnidia coalesce to form irregular fructifications with several ostioles.

Pycnidiospores hyaline or yellow-coloured, usually without guttules; as a rule ovoid to ellipsoid, sometimes globose or irregular in shape; continuous; 3–10 × 1.5–6.5 μ, mostly 6–7.5 × 3–4 (av. 6.6 × 3.7) μ.

Dictyochlamydospores (Fig. 4, Pl. 4) tan to dark brown, arising terminally and through continued growth of the hyphae becoming lateral, or of intercalary origin and usually developing laterally; mostly clavate to obovoid, sometimes ovoid; with 1–8 transverse walls and usually some longitudinal or oblique walls; size variable, 13–50 × 7–25 μ. Single chlamydospores and intermediate stages between chlamydospores and dictyochlamydospores occur occasionally.

HABITAT.—This species has been observed only on plant material of tropical origin. In France it is found on stems, peduncles, and the fruit of *Musa* sp. In India it is described as the cause of a leaf spot disease on *Eriobotrya japonica*.

SPECIMENS EXAMINED.—

Exsiccatum: *Peyronellaea nainensis*, dried culture of type isolate made by Dr. Tandon (CMI).

Cultures: *Peyronellaea musae*, culture of type (PC); *Peyronellaea nainensis*, culture of type from Dr. Tandon, Allahabad University, India.

DISCUSSION.—The characters of this species are also highly influenced by the age of the cultures and isolates, and by the C/N ratio of the artificial medium.

This applies especially to the size and pigmentation of pycnidia and pycnidiospores, the size of chlamydospores and the extent of the hyphal elements and hyphal branches between these dictyochlamydospores. It is the background of the differences between the original diagnoses of *P. musae* and *P. nainensis*. Comparative study of the type cultures of both species proved that they are identical in every detail!

Excluded species

Coniothecium chomatosporum Cda., Ic. Fung. 1: 2. 1837. — *Peyronellaea chomatospora* (Cda.) Goid. *in* Rc. Accad. Lincei 1: 455. 1946 ("*cromatospora*").[9]

This species, originally described from dried pine wood, was transferred by Goidànich to the genus *Peyronellaea* apparently on account of Australian data about the fungus (Goidànich 1946: 455). However, in the original diagnosis of *Coniothecium chomatosporum* no pycnidia are mentioned, whereas the complex structures of globose, thick-walled cells described and figured cannot be related to the dictyochlamydospores of the *Phoma* species discussed in this paper.

Coniothecium scabrum McAlp., Fung. dis. Citr. Austr., Melbourne 80. 1899. — *Peyronellaea scabra* (McAlp.) Goid. *in* Rc. Accad. Lincei 1: 455. 1946.[9]

Goidànich placed this species, which was described from *Citrus*, in his genus *Peyronellaea*. For this he relied on a paper by Mason (1933), who discussed a fungus referred to *Coniothecium scabrum* by S. P. Wiltshire. The figures in Mason's paper actually prove Wiltshire's fungus to be a *Phoma* species that produces dictyochlamydospores, possibly *P. glomerata*. However, in our opinion the original data about *Coniothecium scabrum* do not justify Wiltshire's interpretation. Neither pycnidia nor characteristic dictyochlamydospores are mentioned or figured in the original diagnosis of *Coniothecium scabrum*.

ACKNOWLEDGEMENTS

The authors are greatly indebted to Dr. G. Luedemann, Schering Corporation, Bloomfield N. J., U.S.A., for his help. They are also under obligation to the Directors of the Culture collections and Herbaria at Baarn, Brooklyn, Kew, Padova, Paris, Pavia, Prague, and Washington and to Dr. N. Tandon, Allahabad University, India, for supplying living and dead specimens for study. Further they are grateful to Miss C. J. M. Posthumus and Miss M. Numans for technical assistance, to Mr. H. Wulff for preparing the photographs, to Miss E. de Weert for making the drawings, to Mrs. E. van Maanen-Helmer, Amsterdam, for kindly correcting the English text, and to Dr. R. A. Maas Geesteranus for his help in preparing the manuscript.

[9] Not validly published according to Arts. 32 and 43 of the International Code of Botanical Nomenclature (Utrecht, 1961).

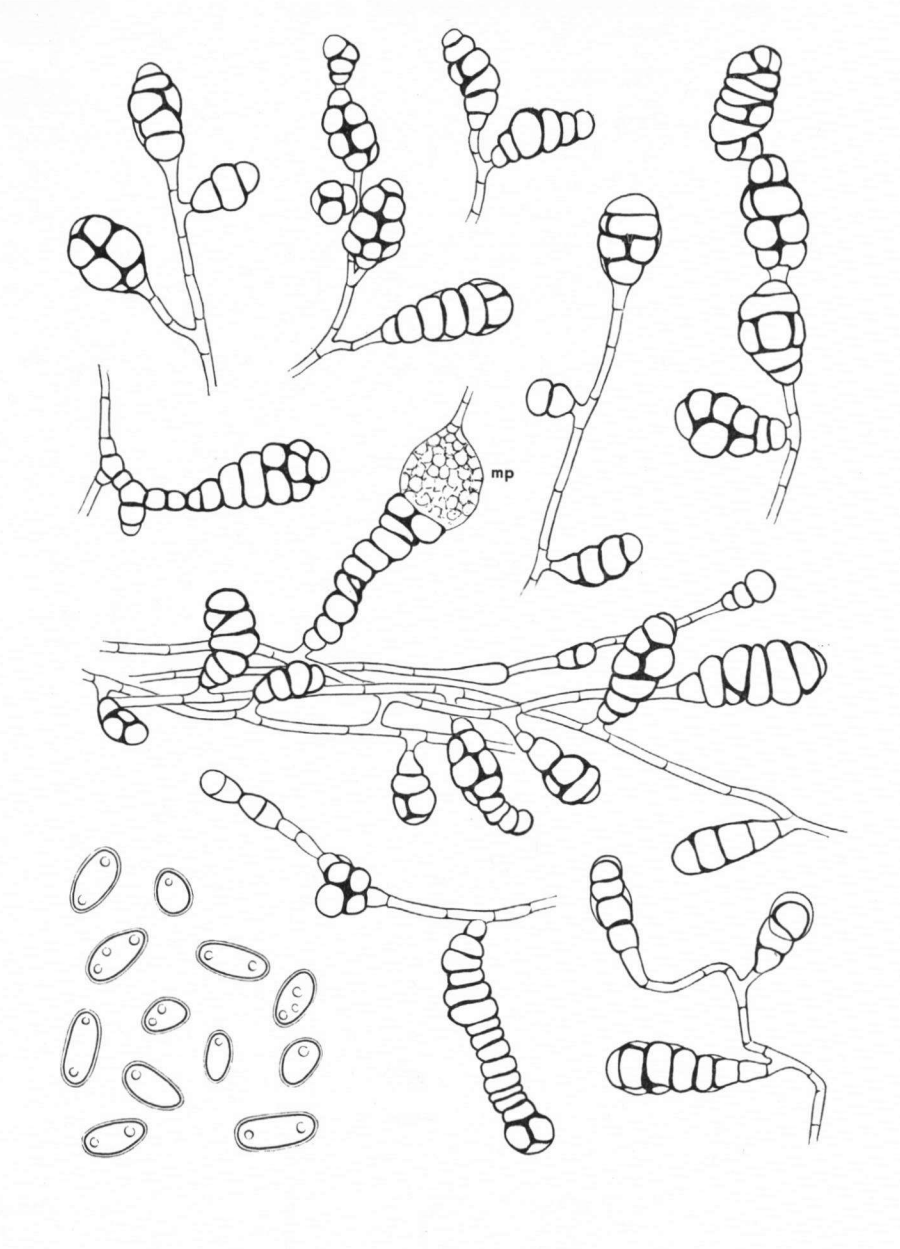


Fig. 4. *Phoma musae*; pycnidiospores and dictyochlamydospores. Note the alternating arrangement of the latter.
mp = micropycnidium developing from a dictyochlamydospore.

REFERENCES

AGOSTINI, A. & V. TREDICI (1937). Sopra una nuova specie di micete commensale (*Phoma hominis* Agostini et Tredici) isolato da forme cliniche del derma. *In* Atti Ist. bot. Univ. Lab. crittog. Pavia, ser. 4a, **9**: 179–189.

AINSWORTH, G. C. (1961). Ainsworth & Bisby's dictionary of the fungi. Kew.

ANDRUS, C. F. (1933). Fungous flora accompanying decline of Boxwood. *In* Pl. Dis. Reptr **17**: 169–170.

BENHAM, R. W. (1931). *Phoma conidiogena*, an excitant of asthma: some observations on the development and cultural characteristics. *In* Bull. Torrey bot. Club **58**: 203–214.

BOEREMA, G. H. (1964). *Phoma herbarum* Westend., the type-species of the form-genus *Phoma* Sacc. *In* Persoonia **3**: 9–16.

—— (1965). Spore development in the form-genus *Phoma*. *In* Persoonia **3**: 413–417.

—— & M. M. J. DORENBOSCH (1965). *Phoma*-achtige schimmels in associatie met appelbladvlekken. *In* Versl. Meded. plziektenk. Dienst Wageningen 142 (Jaarb. 1964): 138–154.

—— & H. A. VAN KESTEREN (1962). *Phoma*-achtige schimmels bij aardappel. *In* Versl. Meded. plziektenk. Dienst Wageningen 136 (Jaarb. 1961): 201–209.

BOLLE, P. C. (1924). Die durch Schwärzepilze (Phaeodictyae) erzeugten Pflanzenkrankheiten. *In* Meded. phytopath. Lab. Willie Commelin Scholten **7**: 1–77.

BORUT, S. Y. & T. W. JOHNSON (1962). Some biological observations on fungi in estuarine sediments. *In* Mycologia **54**: 181–193.

BROOKS, F. T. & G. O. SEARLE (1921). An investigation of some tomato diseases. *In* Trans. Brit. mycol. Soc. **7**: 173—197.

CHIPPENDALE, H. G. (1929). The development in culture of *Ascochyta gossypii* Syd. *In* Trans. Brit. mycol. Soc. **14**: 201–215.

CHODAT, F. (1926). Recherches experimentales sur la mutation chez les champignons. *In* Bull. Soc. bot. Genève, sér. 2, **18**: 41–144.

CRABILL, C. H. (1913). Studies on *Phyllosticta* and *Coniothyrium* occurring on apple foliage. *In* Rep. Va agric. Exp. Stn **1911–1912**: 95–115.

CROSIER, W. & D. WEIMER (1940). Some fungi associated with grass seed. *In* Proc. Ass. off. Seed Analysts N. Am. **1939**: 120–124.

EVELEIGH, D. E. (1961). *Phoma* spp. associated with painted surfaces. *In* Trans. Brit. mycol. Soc. **44**: 573–585.

FABRICATORE, J. A. (1951). *Ascochyta trachelospermi* n. sp. e considerazioni relative ad una possibile revisione del genere *Peyronellaea*. *In* Annali Sper. agr., ser. 2, **5**: 1433–1446

FILIPPOPULOS, G. K. (1927). Azione di alcuni composti venefici sopra la fumaggine dell'Olivo. *In* Boll. Staz. Patol. veg. Roma, ser. 2, **7**: 330–346.

FOSCHI, S. (1956). Cascola dei frutti, ipertrofia delle "borse" e "sfogliatura" dei peduncoli e dei rami di melo provocati da eccesso di umidità. *In* Annali Sper. agr., ser. 2, **10**: 427–437.

GHILLINI, C. A. (1952). Elenco dei principali casi fitopatologici osservati nel 1951. *In* Notiz. Mal. Piante **18**: 31–37.

—— & L. MEZZINI (1954). Elenco dei principali casi fitopatologici riscontrati nel 1953. *In* Notiz. Mal. Piante **28**: 58–64.

GOIDÀNICH, G. (1946a). "*Peyronellaea*", nuovo genere di deuteromiceti. *In* Rc. Accad. Lincei **1**: 449–457.

—— (1946b). Un interessante tipo di butteratura parassitaria delle mele. *In* Rc. Accad. Lincei **1**: 654–659.

HARLEY, J. L. (1959). The biology of mycorrhiza. London.

HARRIS, H. A. (1932). Initial studies of American Elm diseases in Illinois. *In* Bull. Ill. St. nat. Hist. Surv. **20** (1): 1–70.

HOPKINS, J. G., R. W. BENHAM & B. M. KESTEN (1930). Asthma due to a fungus—*Alternaria*. *In* J. Am. med. Ass. **94**: 6–10.
HOUTEN, J. G. TEN (1939). Kiemplantenziekten van coniferen. Thesis. Utrecht.
JOLY, P. (1961). Espèces nouvelles ou intéressantes de la flore des bananes. *In* Rev. Mycol. **26**: 89–99.
LACOSTE, L. (1955). De la morphologie et de la physiologie de *Peyronellaea stipae* nov. sp. *In* C. r. hebd. Séanc. Acad. Sci., Paris **241**: 818–820.
—— (1957). Champignons parasites et saprophytes de l'Alfa (*Stipa tenacissima* L.). *In* Rev. Mycol. **22** (suppl. colon. 1): 6–18.
LANJOUW, J. & F. A. STAFLEU (1959). Index Herbariorum. Part I. The herbaria of the world. Ed. 4 (Regnum vegetabile **15**). Utrecht.
LEDUC, A. (1958). Sur les micromycètes alternarioides de la flore fungique des graines des lins. *In* Revue gén. Bot. **65**: 541–580.
LUEDEMANN, G. M. (1957). A study in the genus *Peyronellaea*. Doctoral dissertation series, Publ. 21, 920. University Microfilms, Ann Arbor—London.
—— (1959). The dictyochlamydospore of *Peyronellaea glomerata* (Corda) Goidanich ex Togliani contrasted with the dictyoporospore of *Alternaria tenuis* Auct. *In* Mycologia **51**: 772–780.
MASON, E. W. (1933). In Mycol. Pap. **2** (2): 1–14.
MERCER, W. B. (1913). On the morphology and development of *Phoma Richardiae* n. sp. *In* Mykol. Zentbl. **2**: 244–253, 297–305, 326–331.
MEZZETTI, A. (1956). La "plara" delle mele. I. Osservazioni e ricerche sulla morfologia dell'alterazione. *In* Annali Sper. agr., ser. 2, **10**: 471–494.
MILATOVIĆ, I., V. MASTEN & B. KADIĆ (1960). Pokus suzbijanja sušice cvata i grozdiča vinove loze [*Peyronellaea glomerata* (Corda) G. Goid.] u istri. *In* Zašt. Bilja **61**: 57–60.
MOTTA, R. (1929). I miceti delle cavità nasali e delle gola negli ozenatosi. *In* Valsalva **1929**: 1–35.
MULCOCK, A. P. (1959). Discoloration of wool fibres by a fungus. *In* Nature, Lond. **183**: 1281–1282.
PERAZZI, P. (1925). I miceti dimoranti nella regione genitale della donna. *In* Atti Accad. Fisiocr. Siena.
PETRAK, F. & H. SYDOW (1927). Die Gattungen der Pyrenomyzeten, Sphaeropsideen und Melanconieen. I. Die phaeosporen Sphaeropsideen und die Gattung *Macrophoma*. *In* Beih. Repert. Spec. nov. Regni veg. **42**.
PETRI, L. (1934). Degenerazione e necrosi del cambio dei peri e dei meli nel Trentino e in Alto Adige. *In* Boll. Staz. Patol. veg. Roma, ser. 2, **14**: 281–326.
PICCO, D. (1962). *La Peyronellaea glomerata* su piante erbacee di vigneti con viti infette. *In* Riv. Patol. veg., Pavia, ser. 3, **2**: 311–333.
PLANCHON, L. (1900). Influence de divers milieux chimiques sur quelques champignons du groupe des Dématiées. *In* Annls Sci. nat. (Bot.), sér. 8, **11**: 1–248.
POLLACCI, G. (1935). Sopra una nuova specie di micete commensale (*Phoma hominis* Agostini et Tredici), isolato da forme cliniche del derma. *In* Atti Ist. bot. Univ. Lab. crittog. Pavia, ser. 4, **6**: 153–155.
PORREYE, W. (1961). Le chancre du pommier et du poirier. *In* Parasitica **1961**: 5–8.
PUPILLO, M. (1952). Un marciume dei frutti di limone prodotto da una associazione di micromiceti. *In* Annali Sper. agr., ser. 2, **6**: 53–67.
REEDER, E. T. & T. C. VANTERPOOL (1953). *Phoma* spp. on flax in Saskatchewan. *In* Proc. Can. phytopath. Soc. **21**: 16.
ŠARIĆ-SABADOŠ, A., I. MILATOVIĆ & V. MASTEN (1960). *Peyronellaea glomerata* als Erreger der Vertrocknung der Blüten und jungen Trauben der Weinrebe in Jugoslavija. *In* Atti Ist. bot. Univ. Lab. crittog. Pavia, ser. 5, **18**: 101–107.
SCHNEGG, H. (1915). Zur Entwicklungsgeschichte und Biologie der Pycniden, sowie der

Schlingenmycelien und Hyphenknäuel. Studien an einem häufigen Brauerei-Saprophyten. *In* Zentbl. Bakt. ParasitKde (Abt. 2) **43**: 326–364.
SWIFT, M. E. (1932). *Phoma conidiogena* on box. *In* Mycologia **24**: 199–206.
TANDON, R. N. & K. S. BILGRAMI (1961). A new species of *Peyronellaea* Goid. *In* Curr. Sci. **30**: 343–344.
TERNETZ, C. (1907). Ueber die Assimilation des atmosphärischen Stickstoffes durch Pilze. *In* Jb. wiss. Bot. **44**: 353–395.
TOGLIANI, F. (1952). Contributo alla conoscenza di uno Sferossidale del genere *Peyronellaea*. *In* Annali Sper. agr., ser. 2, **6**: 81–94.
VERNON, T. R. (1935), Studies on the mycological problems of dairying. I. The surface moulding of butter. II. The internal and subsurface discolorations of butter. *In* J. Dairy Res. **6**: 154–174.
WARCUP, J. H. (1951). The ecology of soil fungi. *In* Trans. Brit. mycol. Soc. **34**: 376–399.
WOLLENWEBER, H. W. & H. HOCHAPFEL (1936). Beiträge zur Kenntnis parasitärer und saprophytischer Pilze. I. *Phomopsis*, *Dendrophoma*, *Phoma* und *Ascochyta* and ihre Beziehung zur Fruchtfäule. *In* Z. ParasitKde **8**: 561–605.
—— & —— (1937). Beiträge zur Kenntnis parasitärer und saprophytischer Pilze. IV. *Coniothyrium* und seine Beziehung zur Fruchtfäule. *In* Z. ParasitKde **9**: 600–637.

EXPLANATION OF PLATES 1–4

PLATE 1

Figs. 1–8. *Phoma glomerata*; various types of dictyochlamydospores produced in culture. — Figs. 1. 2, 7. 8 from Luedemann (1957). — Figs. 1–6, c. × 60. — Figs. 7–8, c. × 125. mp = micropycnidia; ps = pycnidiospores.

PLATE 2

Figs. 9–12. *Phoma glomerata*; cultures of different strains. — Figs. 9 and 10, on cherry agar. — Figs. 11 and 12, on oat agar.

PLATE 3

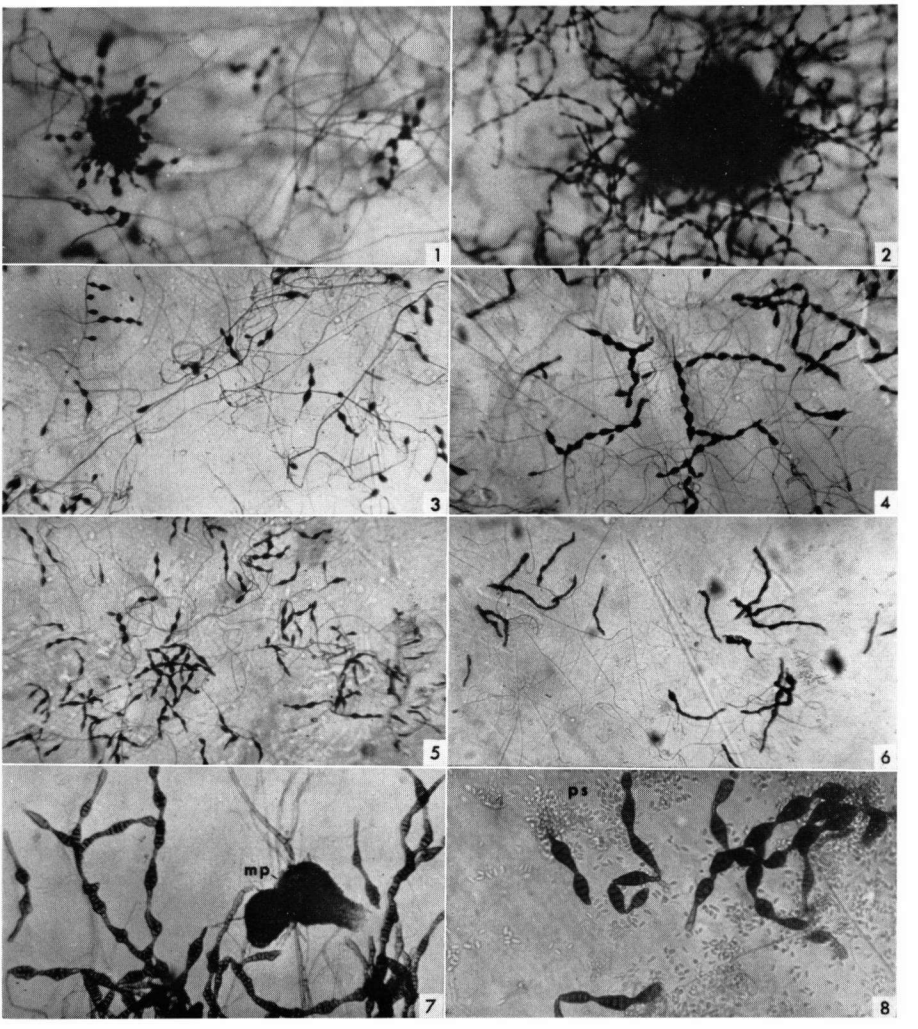
Figs. 13–19. *Phoma prunicola*; various types of chlamydospores and dictyochlamydospores in culture. — Figs. 13 and 14, c. × 60. — Figs. 15–19, c. × 125.

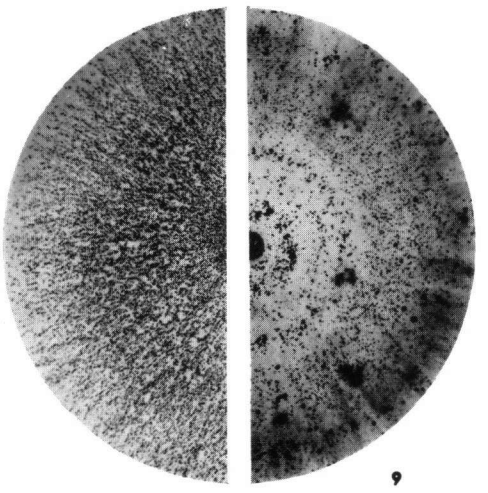
Figs. 20, 21. *Phoma prunicola*; cultures of different strains. — Fig. 20, on cherry agar. — Fig. 21, on oat agar.

PLATE 4

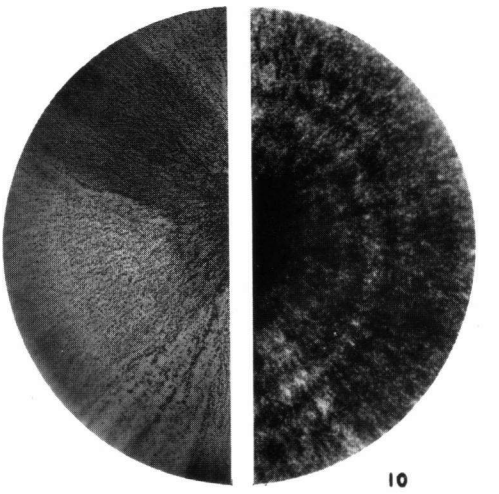
Figs. 22–25. *Phoma musae*; various types of dictyochlamydospores in culture. — Fig. 22, c. × 60. — Figs. 23–25, c. × 125.

Figs. 26, 27. *Phoma musae*; cultures of different strains. — Fig. 26, on cherry agar. — Fig. 27, on oat agar.

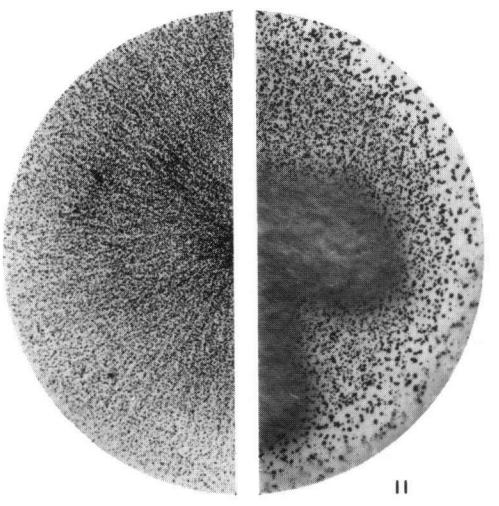

1
2
3
4
5
6
mp
7
ps
8



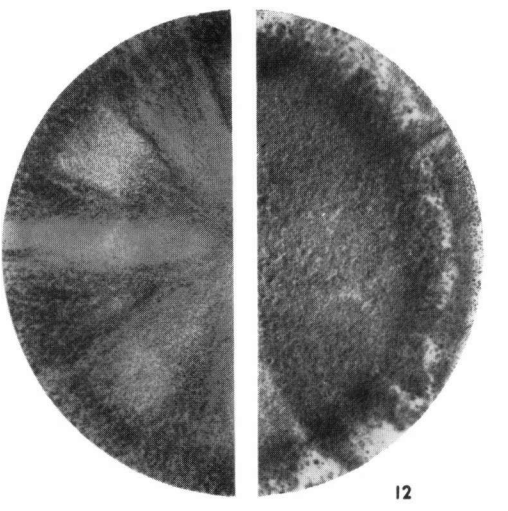
9



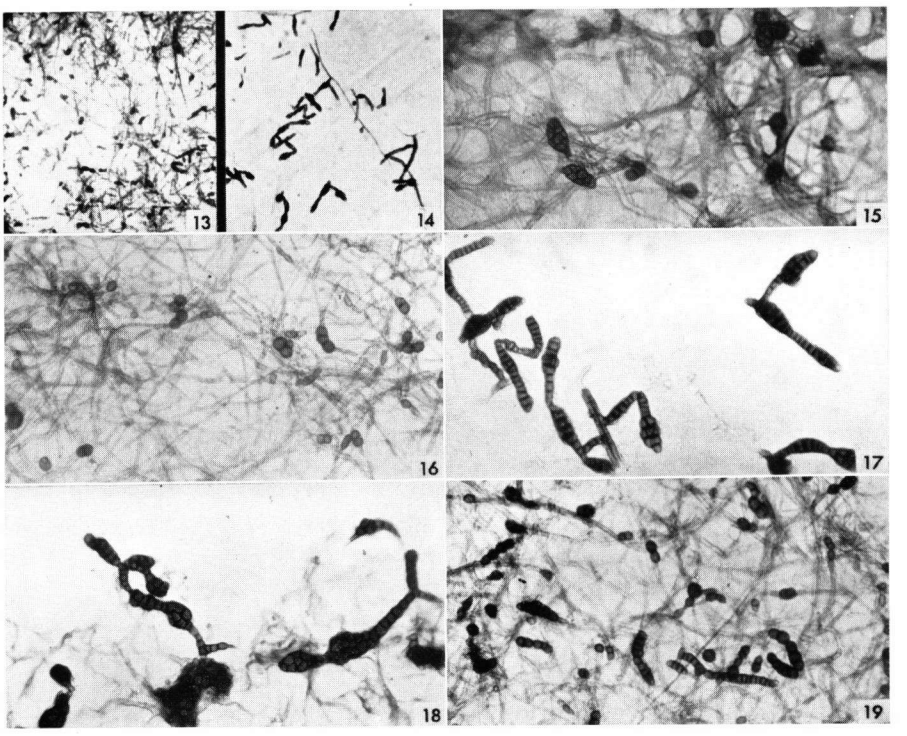
10

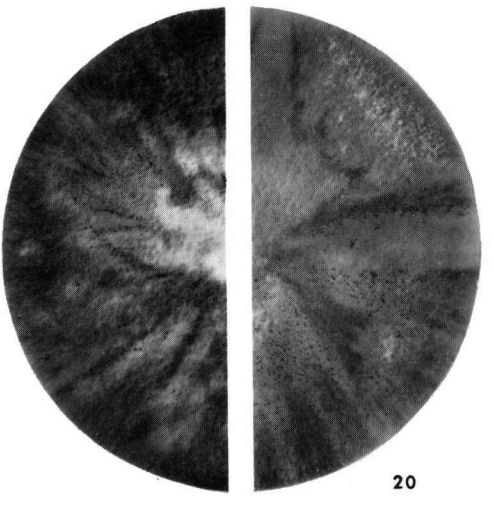


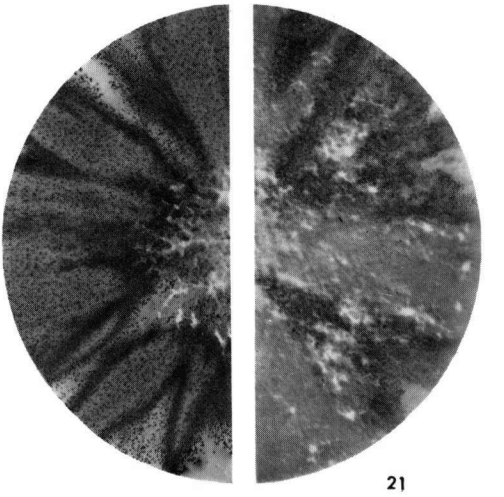
11

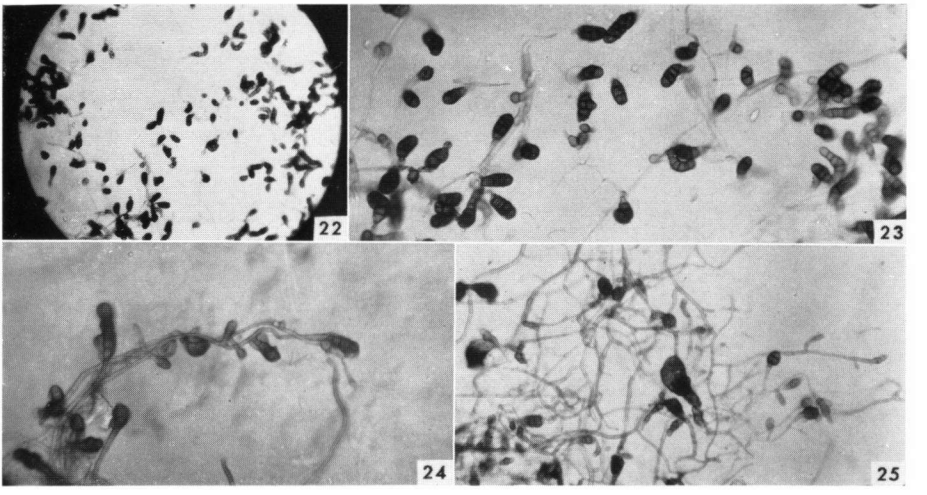


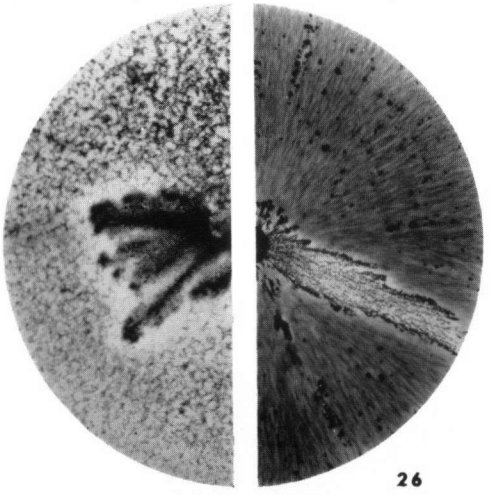
12

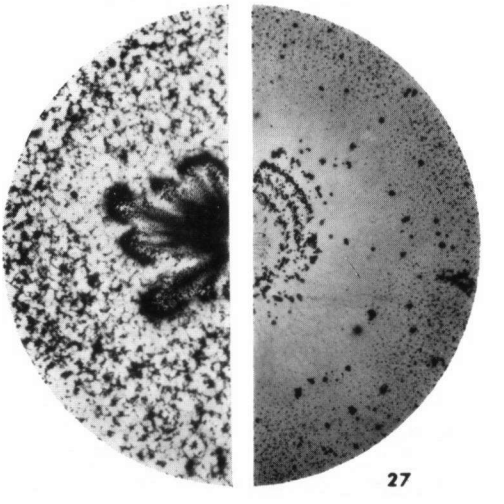

13
14
15
16
17
18
19


20


21


22
23
24
25


26


27