Additions to Galapagos Fungi

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IN CONNECTION with the investigations on tropical deterioration conducted by the Quartermaster Corps of the United States Army, opportunity was afforded for a brief visit to South Seymour Island, in the Galapagos group, in early September, 1945, in company with Dr. E. S. Barghoorn and Mr. R. T. Darby.

Traveling by plane from the Canal Zone, we also made short stops at Salinas, Ecuador, and Talara, Peru. In all three areas samples of textiles, chiefly tentage, paulins, sandbags, and camouflage cloth, which had been exposed in the course of service, were collected. All of these regions are extremely arid, and it seemed worth while to attempt to learn what fungi had been able to attack fabrics under such conditions. That deterioration had occurred was abundantly evident from the state of the material sampled and, while the relative importance of biological agencies as compared with chemical and physical factors in causing such deterioration is difficult to evaluate, the suggestion is very strong that in fabrics in contact with or near the soil, the bulk of the deterioration is due to fungi.

Since cultures were to be made from all samples, a supply of previously sterilized test tubes, bottles, and heavy paper folders was carried, and all samples were placed in such sterilized containers at the time of collection. In each locality, a few hours were available for miscellaneous collections, and these also were placed, whenever it was suspected that cultures might profitably be made, in such sterile packets. The following account treats only of those samples taken in the Galapagos.

South Seymour Island is small, roughly triangular in shape, about 5 miles long and 3½ miles wide in the southern portion, separated from the much larger Indefatigable (Santa Cruz) Island to the south by a narrow strait scarcely ½ mile wide. It is relatively low, although in the southeast it fronts the sea with precipitous cliffs arising abruptly for 200 feet. The surface is extremely irregular, with volcanic boulders of every size making progress difficult, except on the excellent roads.

Svenson (1946) has recently published an extensive account of the vegetation of all three areas visited, and more than a casual mention of particular features connected with the fungi would be superfluous. The average annual rainfall on South Seymour Island is less than 4.5 inches, virtually all of it falling in the first 4 months of the year. Yet, despite this and the numerous goats roaming the island, vegetation was surprisingly abundant in early September. The two most conspicuous plants are *Bursera graveolens* (HBK) Triana & Planch., a small, pale-barked tree, and a columnar-trunked *Opuntia,* presumably *O. insularis* Stewart, but there are numerous other woody species, including the dark-green *Scutia spicata* (Willd.) Weberb., looking like a juniper or yew at a short distance, and several legumes, one of which was in bloom at the time, its bright yellow flowers attracting numerous bees. Everywhere there is evidence of what must be a rather abundant growth of grass in the rainy season.

The only extensive account of Galapagos fungi appears to be that of Bonar (1939), who cites the scanty earlier reports (four species under five names) and reports 59 species and

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varieties represented in the material he studied, one of which is duplicated in an earlier report, making a total of 62 species or varieties from the archipelago. None of the species reported by Bonar was recognized in the collections here noted.

All Myxomycetes and a majority of the other fungi were developed in moist chambers in Iowa City. The collections were removed from their sterile containers or wrappings, put into sterile Petri dishes with flamed forceps, wet with sterile carbon water, and incubated at room temperature. In several dishes Myxomycetes fruited in 3 to 5 days after wetting. Molds usually appeared a little later. On the other hand, several species of Myxomycetes were slow in appearing but, once started, continued to develop over a considerable period.

In the listing which follows, species marked with an asterisk are those which developed in moist chambers. The numbers given are my own collection numbers. All specimens are deposited in the herbarium of the State University of Iowa. Where material permits, portions will be distributed to other institutions. A number of species not listed here are in the hands of various specialists for study.

Acknowledgments: I am indebted to Dr. H. K. Svenson for determination of host species, to Dr. G. R. Bisby for determining the *Hysterographium* and for comments on other specimens examined by him, to Dr. L. E. Wehmeyer for describing and illustrating the new *Phaeopeltosphaeria,* and to Dr. D. P. Rogers for determining the *Sebacina.*

MYXOMYCETES

***Arcyria cinerea** (Bull.) Pers.

On dead wood of *Bursera, 6314, 6322*[2]; on thorns of *Scutia spicata, 6318.* This is the small, slender, long-stalked phase of this common species which is often encountered in the tropics.

[2] Two numbers listed as occurring on the same substratum indicate two different collections.

***Badhamia affinis** Rost.

On wood of *Bursera, 6329.* The early fruitings, which began to appear the third day after wetting, were typical. Later fruitings tended to be smaller, with smaller spores, relatively longer stalks, and a somewhat physaroid capillitium, but the manner of appearance was such as to suggest that all arose from the same plasmodium, although the plasmodium itself was not observed.

***Badhamia gracilis** Macbr.

On dead stems of *Opuntia, 6326.* Cacti and yuccas are favorite substrata for this species.

***Clastoderma Debaryanum** Blytt

On wood of *Bursera, 6311.*

***Comatricha elegans** (Racib.) Lister

On wood of *Bursera, 6315, 6324.*

***Cribraria languescens** Rex

On wood of *Bursera, 6310.* Originally wet on October 17, 1945, the wood on which this grew produced this species later in the same month. Still later, it bore six additional species of Myxomycetes (*6311* to *6316*) but no more *C. languescens* until it was allowed to become completely dry in January, 1947. It was again wet with sterile carbon water about March 1, and by March 6 a typical fruiting had matured.

***Cribraria violacea** Rex

On wood of *Bursera, 6312.*

***Echinostelium minutum** deBary

On wood of *Bursera, 6313.*

***Perichaena corticalis** (Batsch) Rost.

On wood of *Bursera, 6316, 6323.* This species appeared shortly after the wood was wet and continued to develop singly or in small clusters for a period of about 3 months. The majority of the sporangia are characterized by a prominent circumscissile ridge marking the line of dehiscence, and this often joins with a coarse and prominent reticulation on the upper surface. The spores were at first bright ochra-

ceous in mass, but have tended to become duller with age. They are uniformly warted and 10–11μ in diameter. The plasmodium was dingy on emergence, becoming dull rose just before transformation. Numerous mounts have revealed no trace of capillitium. *P. corticalis* var. *liceoides* G. Lister (1911: 251) was erected for forms with scanty or no capillitium and with few granular deposits in the wall of the peridium. Examination of a large series of collections from numerous localities shows that these two characters vary independently and suggests that the varietal name is superfluous. This is, of course, even more true of the specific names which the varietal name was intended to supersede.

***Perichaena depressa** Libert

On thorns of *Scutia, 6317.* Typical, except that the majority of the fructifications are solitary and very small, correlated with the small thorns on which they developed. All are strongly flattened, with the circumscissile dehiscence characteristic of the species, and there are several small clusters. This material was wet on November 28, 1945. The *Perichaena* began to appear about a month later, and a few sporangia were still developing as late as April, 1947. This period of over 16 months is, in my experience, by far the longest time during which any collection has produced myxomycete fructifications. Also on goat dung, *6309;* larger and more clustered.

***Perichaena vermicularis** (Schw.) Rost.

On wood of *Bursera, 6327.*

***Stemonitis pallida** Wingate

On thorns of *Scutia, 6319.* On wood of *Bursera, 6328.*

ASCOMYCETES

***Ascophanus argenteus** (Curr.) Boud.

On goat dung, *6282.*

***Ascophanus carneus** (Fries) Boud.

On goat dung, *6331.*

Gloniopsis sp. (Fig. 2*a–e*)

On the dead wood of *Bursera* there were numerous elongate black bodies suggesting hysterothecia. These were extremely abundant, occurring on perhaps a majority of the dead branches seen. It was not until they were examined microscopically that it was recognized that three species were involved. Two were the *Hysterographium* and the *Phaeopeltosphaeria* listed below; the third was a *Gloniopsis.* The hysterothecia (Fig. 2*a*) are black, fusoid, and striate, and most of them appear to be raised well above the general surface of the wood. A cross section (Fig. 2*b, c*) shows that the base is composed of scarcely altered wood flanked on either side by a black stromatic layer representing a continuation of the walls of the hysterothecium. The subhymenial layer is distinctly thinner than the hymenium. The latter is composed of densely compacted, gelatinous, apparently unbranched paraphyses penetrated by scattered asci in various stages of development, only a few at a time bearing mature spores. The asci (Fig. 2*d*) are short-cylindrical and for the most part 4–6-spored. The ascospores (Fig. 2*e*) are oval, hyaline, muriform or somewhat irregular in their septation, and extremely variable in size, the great majority ranging from 25–31μ in length by 11–18μ in width. One ascus was seen containing but two ascospores, one of which measured 58$\times$20μ. A number of species of *Gloniopsis* with large spores are listed in Saccardo. Of these *G. somala* Baccarini (see Saccardo, 1928: 1119), from Italian Somaliland, could represent this species, and the specimens are provisionally filed under Baccarini's name. On dead limbs and branches of *Bursera, 6245, 6254.*

Hysterographium mori (Schw.) Rehm

On dead wood of *Bursera, 6252, 6255.* Determined by G. R. Bisby. Dr. Bisby notes that No. *6252* approaches *H. guaranicum* Speg., as

described, but does not believe that it is sufficiently distinct to be worthy of recognition.

Phaeopeltosphaeria irregularis Wehmeyer, sp. nov. (Fig. 1)

In superficie caulis maculas dense dispersas, ellipticas, 1–1.5 mm. longas, 0.5 mm. crassas, tumidas, nigricantes formans; ostiolo centrali papilliformi vix erumpenti; perithecia 300–550μ diametro, 200–350μ alta, singula in lignum sub maculis clypeiformibus immersa; pariete crasso, prosenchymatoso, ab ligno adjacenti separato; asci late cylindrici, 90–95μ longi, 12.5μ crassi, saepe 6–7-spori; paraphyses numerosae, filiformes, persistentes, 1μ diametro; sporae uniseriatae, subglobosae vel ellipsoidales, 10.5–18μ longae, 7–9μ crassae, olivaceae, varie septatae, 1-cellulae vel muriformes, cum 1–3 septis transversalibus, ad septa constrictae, cellulis aliquibus verticaliter 1–septatis.

Appearing on the surface as thickly scattered, elliptic, raised, blackened spots, 1–1.5$\times$0.5 mm., with a central, barely erumpent, papillate ostiole; perithecia 300–550$\times$200–350μ, immersed singly in the wood, beneath a clypeus-like blackening of the surface tissues; wall 10–20μ thick, prosenchymatous, free from the surrounding wood tissue which is somewhat blackened; asci stout-cylindric, 90–95$\times$12.5μ, with a claw-like base, and often with only 6 to 7 spores; paraphyses numerous, persistent, filiform, 1μ in diameter; spores uniseriate, subglobose to ellipsoid, 10.5–18$\times$7–9μ, olive-brown, variously septate, one-celled to muriform with one to three transverse septa and one or more cells with vertical septa, somewhat constricted at the septa.

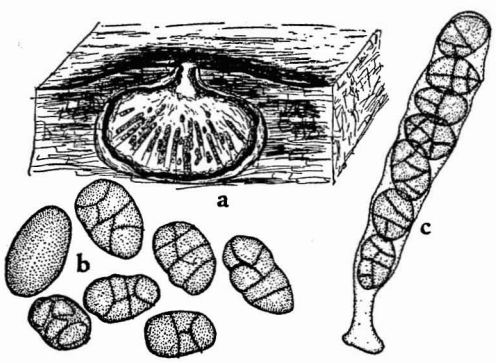

FIG. 1. *Phaeopeltosphaeria irregularis: a,* radial section of a perithecium showing the clypeate blackening of the surface; *b,* ascospores, illustrating variation in septation; *c,* ascus with ascospores.

GALAPAGOS: South Seymour Island. On dead, decorticated wood of *Bursera graveolens,* September 6, 1945, *6251,* **type.**

The genus *Phaeopeltosphaeria* Berl. and Pegl. (1892:139) was based upon *P. caudata,* on woody stems, which might be considered as a *Peltosphaeria* with brown spores or a *Pleospora* with a clypeate blackening about the perithecium. It has fusoid spores which are much larger than those of *P. irregularis. Phaeopeltosphaeria panamensis* Stev. and King. (Stevens, 1927:50) seems to be the only subsequently described species. Its spores are described merely as "muriform, fusiform; olivaceous or straw-colored; 16$\times$5μ," but the figures (81–83) given show them to be more irregularly 3-septate than in this species and with tapered rather than rounded ends. It is also found on leaves of *Chaetochloa,* and the authors state that it resembles the spots of *Phyllachora Chaetochloae* Stev. on this host. On the basis of this latter statement, Petrak (1929:387) claims that *P. panamensis* is a *Pleospora* [*Pleospora panamensis* (S. & K.) Petr.] and probably parasitic in the *Phyllachora* stroma.

The collection from the Galapagos Islands is quite distinct from either of these described species. It is true that there is a variable degree of blackening of the tissues above the perithecia of certain species of *Pleospora,* but if the genus *Phaeopeltosphaeria* is to be recognized at all, this collection is a typical species.

BASIDIOMYCETES

Sebacina petiolata Rogers

On dead wood of *Bursera, 6246.* Recently described (Rogers, 1947:99) from Cuba, Hawaii, and the Marshall Islands. The Galapagos collection, determined by D. P. Rogers, was growing at the base of an old dead trunk of *Bursera* beneath the soil level and was revealed only when the trunk was pulled over. On the

basis of examination with a hand lens it was recognized in the field as probably a *Sebacina* and so entered. Early in October it was soaked and put in a moist chamber and a scanty but adequate spore-print was secured. Rogers describes the spores as "evenly oblong to ellipsoid-oblong, 9–11×6–7.5μ, or ellipsoid-subglobose, 7–9×6–8μ." This description is in close agreement with that of spores found in mounts from the dried specimen. The spores from the spore-print are almost all globose, 10–11μ in diameter.

The only other Basidiomycetes collected are a unique, rough-spored *Coprinus* isolated from goat dung and a small *Pleurotus* which appeared on *Bursera* wood. Both were secured in pure culture. The *Coprinus* fruits readily in culture, and has been referred to Dr. A. H. Smith for detailed study. The *Pleurotus* has thus far failed to form fructifications.

FUNGI IMPERFECTI

***Helicosporium guianensis** Linder

Referred to this species on the basis of the yellow color of the conidia in mass; the slender conidiophores, 4.5μ in diameter below, with a tendency to slightly swollen, rounded tips; the branching, bladder-like projections on which the spores are borne; and the size of the spores. Differing from the species as described (Linder, 1929: 280) in the branching of the conidiophores, which is much like that of *H. aureum* (Cda.) Linder, from which species it differs, however, in the more slender conidiophores and the character of the spore-bearing branches. Further study may reveal that such forms merge by imperceptible degrees into *H. aureum,* but for the present it seems permissible to maintain the distinction. On thorns of *Scutia spicata.*

***Memnoniella echinata** (Riv.) Galloway

This widespread species occurred in several cultures and was particularly abundant on dead *Opuntia* stems.

***Tetracrium incarnatum** sp. nov. (Fig. 2*f–h*)

Sporodochiis pulvinatis, pallide cinnamomeis vel incarnatis, 0.4–0.8 mm. diam.; conidiophoris elongatis, tenuatis, basibus 5μ diam., apicibus 2μ diam., protrudentibus usque ad 80μ; conidiis 3–8-digitatis, ramis radiatio-cylindraceis, pluriseptatis, 45–50μ longis, 3.5–4.5μ latis.

Sporodochia pulvinate to subglobose, at first white, becoming pale cinnamon, pallid ochraceous or flesh-colored (close to pale ochraceous buff of Ridgway), 0.4–0.8 mm. in diameter; conidiophores slender, protruding from body of sporodochium 60–80μ, 5μ in diameter at base, tapering to 2μ at apex just below constriction marking junction of spore; conidia digitate, of 3–8 multiseptate, subparallel, cylindrical arms, 45–50μ in total length, the arms 3.5–4.5μ in diameter.

GALAPAGOS: South Seymour Island. On dead stem of *Opuntia* sp. collected September 5, 1945, moistened October 25, 1945, developed January, 1947, *6333,* **type.**

After the appearance of the Myxomycetes already noted, the material in the moist chambers became covered with various molds which soon disappeared and were replaced by a dense growth of the *Memnoniella,* which appeared to cover the substratum completely. It was not until January, 1947, that the sporodochia of the *Tetracrium* were noted, although they may have appeared earlier. They tended to form at the tips of spines or other projections. The conspicuously protruding conidiophores made the sporodochia appear, under the binocular, as though covered with glandular hairs. Further examination showed that the *Memnoniella* had been almost completely replaced by a *Curvularia.*

The genus *Tetracrium* was established by Hennings (1902: 116) for a fungus from Brazil occurring on orange leaves covered with insect larvae. Hennings believed the fungus attacked the larvae first and then spread to the leaves and twigs. Although a few mites were present in the chambers, there was no evidence of any connection between them and the fungus here described. Hennings assigned his genus to the Mucedinaceae. Höhnel (1911: 405) reexamined Hennings' material and found that it

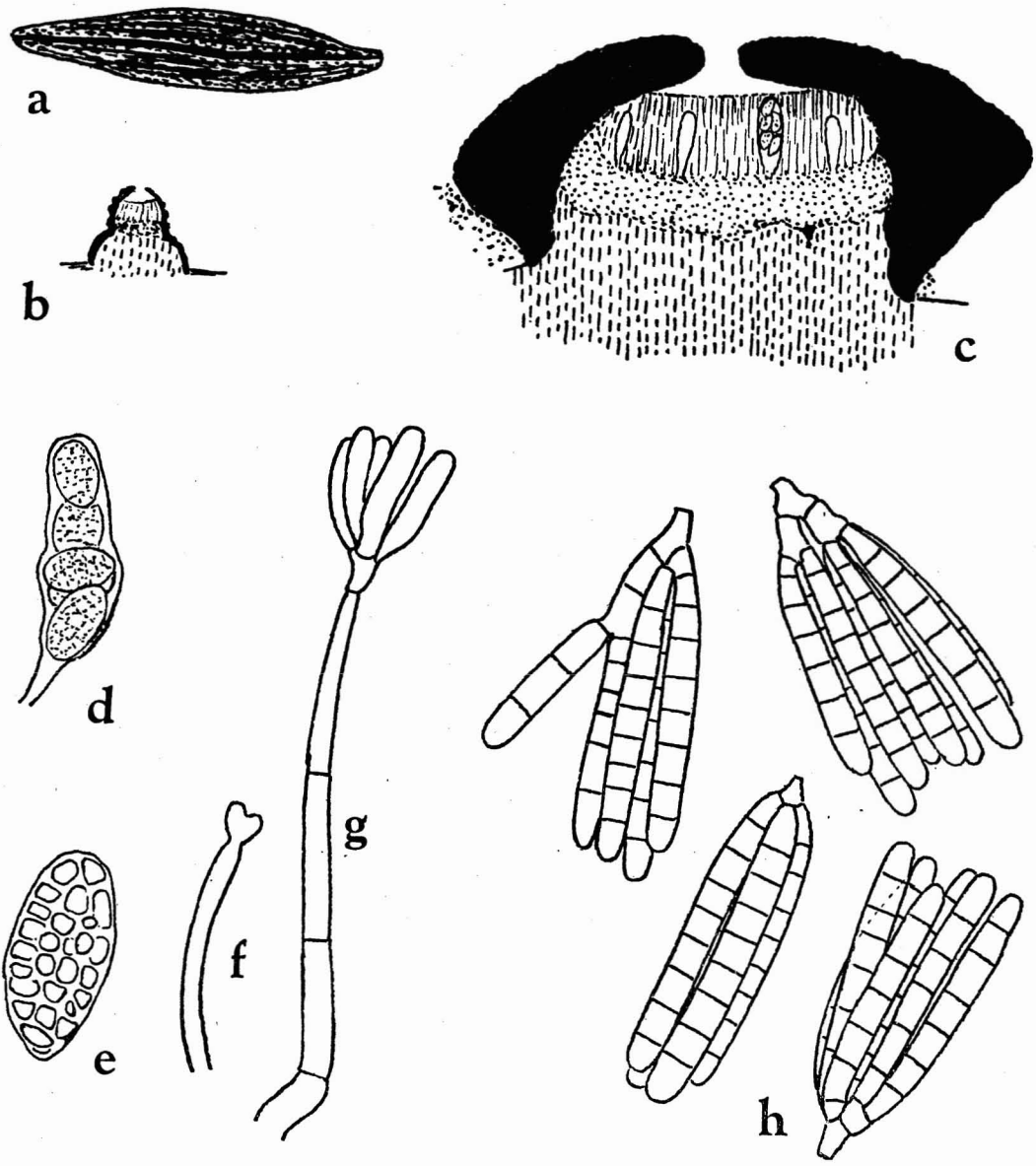

FIG. 2. *a–e, Gloniopsis* sp.: *a,* habit, from above, × 18; *b,* cross section showing crust on wood, × 18; *c,* cross section with more massive walls, × 100; *d,* ascus, × 400; *e,* ascospore, × 1000. *f–h, Tetracrium incarnatum: f,* young conidiophore with characteristic tip which will develop into basal cell of spore; *g,* later stage with arms of conidium formed but not yet septate; *h,* four mature conidia; *f–h,* all × 1000.

was associated with the perithecia of a *Puttemansia,* of which it was obviously the conidial stage. He transferred the genus *Tetracrium* from the Mucedinaceae to the Tuberculariaceae, noting the number of arms in the conidia, described as four by Hennings, varied from two to seven. Saccardo (1906: 560) compiled the name as *Tetracium,* and his error is copied by Clements and Shear (1931). *T. Aurantia* Henn., the type, differs from the present species in several respects, notably in color (white to chalky), in the much larger spores, and in the very short

conidiophores. Höhnel established a second species, *T. coccicola,* based on the conidial stage of *Ophionectria coccicola* (Ell. & Ev.) Berl. & Vogl. as described and illustrated by Zimmermann (1901:874). In this species the three arms are very long, up to 240μ according to Zimmermann, and at right angles to each other. Seaver (1909: 198) describes the conidia of the same species, using the name *Scoleconectria coccicola* (Ell. & Ev.) Seaver, as having three to five arms, each up to 150μ long. It is certainly distinct from the Galapagos fungus.

The species was readily secured in pure culture. It grows rather slowly and fruits sparsely on most of the ordinary culture media, but forms good sporodochia on weak malt-extract agar and on agars prepared from soil–grass decoction and dung decoction.

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