BOTANY.—*Scab of* Cinchona *in South America caused by* Elsinoë.[1] ANNA E. JENKINS, U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering.

The U. S. Board of Economic Warfare, later the Foreign Economic Administration, in charge of collecting strategic materials for the war effort, sent a group of botanists to Central and South America to examine existent stands of *Cinchona* and to determine which species would be suitable for harvest. Herbarium specimens were preserved as vouchers for bark samples analyzed and for future botanical work. On a survey in Colombia, obviously diseased fruits of *C. pubescens* Vahl were found on February 11, 1943, at Lavaderos, near San Agustín, Dept. de Huila, by Dr. F. R. Fosberg. The same capsule deformation was again observed in the Department of Nariño in October 1943. On this occasion Fosberg was accompanied by W. C. Davis, plant pathologist, then on an official mission of the Office of Foreign Agricultural Relations to Colombia. Representative specimens from three different trees (*Davis* 28, 29, and 30, corresponding to *Fosberg* 21255, 21283, and 21281), were referred to the writer for examination upon Davis's return to the United States late in 1943. Laboratory study revealed that capsules, leaves, and young stems were abundantly infected by a fungus of the genus *Elsinoë*. Following Fosberg's recent return to the United States and the receipt of his specimens here, he placed his ample gathering from the tree at Lavaderos (*Fosberg* 20065) at the writer's disposal for study and also permitted her to select part of it for mycological herbarium record (*Fosberg* 20065a).

The symptoms of the disease herein described and the diagnosis of the pathogen as a new species of *Elsinoë* are based particularly on the Davis and Fosberg dry herbarium specimens just mentioned.

Based on his observations during botanical surveys for *Cinchona* in Colombia, Ecuador, and Peru, Fosberg has furnished a general statement relative to the range of the scab in this part of South America, as follows:

"The disease is distributed practically throughout the range of *C. pubescens* in Colombia, i.e., throughout the three Cordilleras of the western half of the country; moreover, a collection of *C. pubescens* and one of *C. delessertiana* Standley from Peru show the same symptoms. Although symptoms of the scab have been looked for on *C. officinalis* L., they have been noticed only on trees of this species in the Coromoro area, east of Charalá and near Florian, both in the Department of Santander, Colombia. In the nursery at Popayán, Cauca, situated among trees affected with the disease, seedlings of the succirubra form of *C. pubescens* were unaffected. In Ecuador the disease was not noted on wild plants of this variety, nor on half a million seedlings growing under nursery conditions."

Typical lesions of the disease are present on botanial specimens collected by Pennell and Killip in the Department of Cauca, Colombia, in 1922 (cf. "Specimens examined," p. 350).

The disease under discussion, being hyperplastic in nature, is here termed "scab of *Cinchona*." This is in accordance with the nomenclature suggested elsewhere (12) for diseases of this type caused by *Elsinoë*, or by *Sphaceloma* De Bary (1, 17) in which form genus they are classified when only the conidial stage is known (cf. 16, p. 307, and 17).

It is impossible at this time to make a statement relative to the actual or potential economic importance of scab of *Cinchona*. Since leaves and young stems are affected (Fig. 2), it is possible that the disease might prove destructive if it were present in the nursery under conditions favorable for its development.

Leaf spot.—On leaves the spots are comparatively few to extremely numerous and may be scattered over a greater or less area of the blade or concentrated on or near the veins; occasionally they are aggregated near the leaf margin (Fig. 1, *A;* Fig. 2, *A*, *E*, and *F*). They are often circular to subcircular but may be elliptical to oblong or irregular, particularly when involving the veins (Fig. 2, *B* and *G;* Fig. 3, *D*).

[1] Received August 29, 1945.

Lesions are raised, dome-shaped, or flattened (Fig. 2, *A* and *B*); in some cases the central part of the spot is marked by an apiculus (Fig. 2, *B*, *b*, and *C*). Where spots are closely grouped, a few may coalesce (Fig. 3, *D*). Abundant infection on veins and midrib results in crowded or extensive coalesced lesions along these structures (Fig. 2, *E*, *F*, and *G*). In general the spots are 0.5 to 1.5 mm, rarely 2 mm, in diameter.

Lesions prominent on the upper leaf surface are often "cinnamon-drab."[2] Where mostly covered by fructifications of the fungus as in Fig. 2, *A*, *a*, they are "dark vinaceous-brown." The coloration of the particular lesion shown in Fig. 2, *A*, *b*, enlarged in *B*, *b*, and *C*, is as follows: Light area around the central apiculus "ecru drab," this surrounded by a "blackish brown" zone constituting a palisade of conidiophores of the pathogen (*Elsinoë*), rim of the platformlike spot where not fungus covered "light brownish drab"; finally, narrow discolored zone surrounding the elevation "dark vinaceous-brown." Where lesions are almost too small to be detected without magnification, the dark surrounding zone assists in marking their position (Fig. 1, *A*). Spots originating on the upper leaf surface are apparent on the pubescent lower side of the blade chiefly as faint vinaceous discolorations. Lesions originating below often are "vinaceous to brown." In this case the lesions form short conical to flattened elevations not uncommonly apiculate; on the upper side of the blade they appear merely as pocklike depressions. Occasionally spots fall away leaving the leaf perforated or with only a transparent network of tissue. The pathological histology of the lesion, which is hyperplastic in nature (see Fig. 3, *E*), corresponds closely to that of sour orange scab, caused by *Elsinoë fawcetti* Bitancourt and Jenkins (4) as carefully depicted by Cunningham (9).

Stem cankers.—Cankers on young stems, as well as on rachis and branches of the inflorescence, may be present in greater or less numbers over a given area, being distributed over all or only part of the circumference. On *Davis* 28 stem cankers are mostly elliptical, or irregularly so, reaching 4 by 5 mm in diameter. Those in close proximity may coalesce, although ordinarily the outline of the original lesion may be followed. Cankers are raised, with rounded to flattened surfaces usually accented by a small central apiculus, smooth as though polished. The main surface of the canker may be longitudinally or concentrically roughened; also, there may be fissures, particularly at the upper and lower margins. The cankers just described (Fig. 2, *D*) are "cinnamon-drab" as compared with the "dark vinaceous-brown" of the stem. Scale-like cankers on a rachis of *Fosberg* 20065 (Fig. 3, *A*, *a*, and *B*) are concolorous with the healthy stem.

Capsule lesions.—Practically all the many fruits on a single inflorescence may be affected by the scab as exemplified by the several complete inflorescences of *Fosberg* 20065 (Fig. 1, *A–C*; Fig. 3, *A*) and by the Pennell and Killip botanical specimens already mentioned. As alluded to previously, it was during the gathering of his no. 20065 that Fosberg's attention was attracted to the diseased condition of the capsules. The striking symptom noted in the field was that, instead of being straight or nearly so, capsules were abnormally curved, at times forming a crescent or practically a circle (Fig. 1, *B*, *a*, and *C*, *a;* Fig. 3, *A*, *a* and *b*) or were otherwise bent and distorted. Such severely affected fruit also may be dwarfed as the specimens show. It is probable that young capsules severely attacked fail to develop or soon fall away.

On capsules, lesions are often particularly numerous as well as generally more conspicuous than on leaves and stems. They are circular to elliptical, ranging from 1 mm or less to 3 mm in diameter, or elongate. Because of their large numbers or extensive coalescence they may occupy much of the capsule surface (Fig. 1, *A–C;* Fig. 3, *A*, *a* and *b*). On this substrate the spots are, as usual, raised, short conic or flattened; the apiculation already described in the case of leaf and stem lesions may be present. On the dry capsules of *Fosberg* 20065, spots appear as "wood brown" encrustations contrasting

[2] Names of colors in quotation marks are from "Color Standards and Color Nomenclature," by Robert Ridgway (1912).

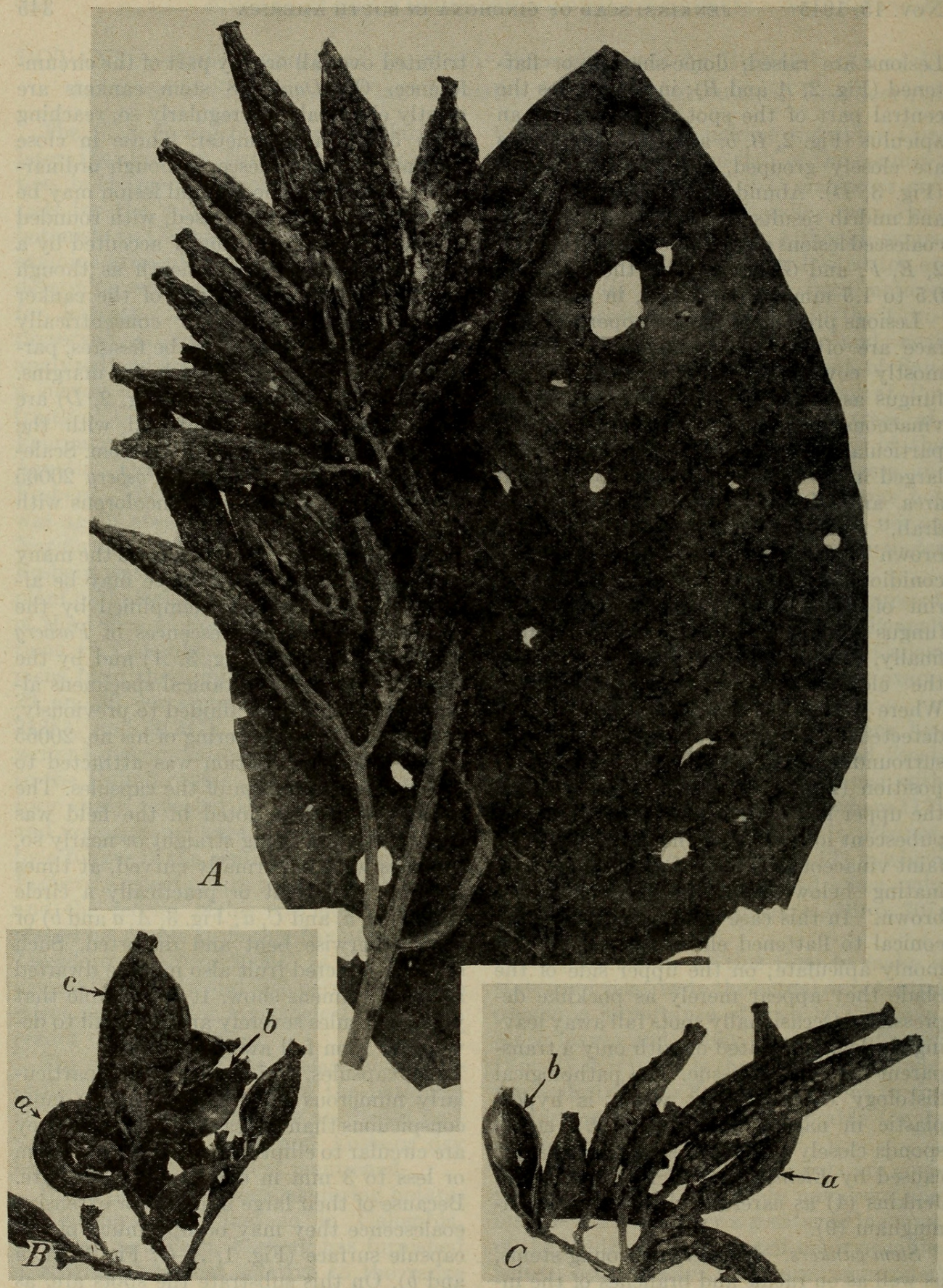

FIG. 1.—Scab on *Cinchona pubescens*, Lavaderos, Colombia, February 11, 1943, *F. R. Fosberg* 20065a: *A*, Part of panicle with numerous cankers on capsules; also leaf with many spots, the greater number clustered on or near midrib and veins and practically all too small to be viewed adequately without magnification, ×1; *B*, *C*, terminal parts of another inflorescence showing abundantly infected fruits; *a*, capsules curved out of normal position; *b*, open capsules showing healthy endocarp; *c*, pericarp of open capsule roughened by the numerous small, in part confluent, lesions covering most of the surface; ×1. Photograph by R. L. Taylor.

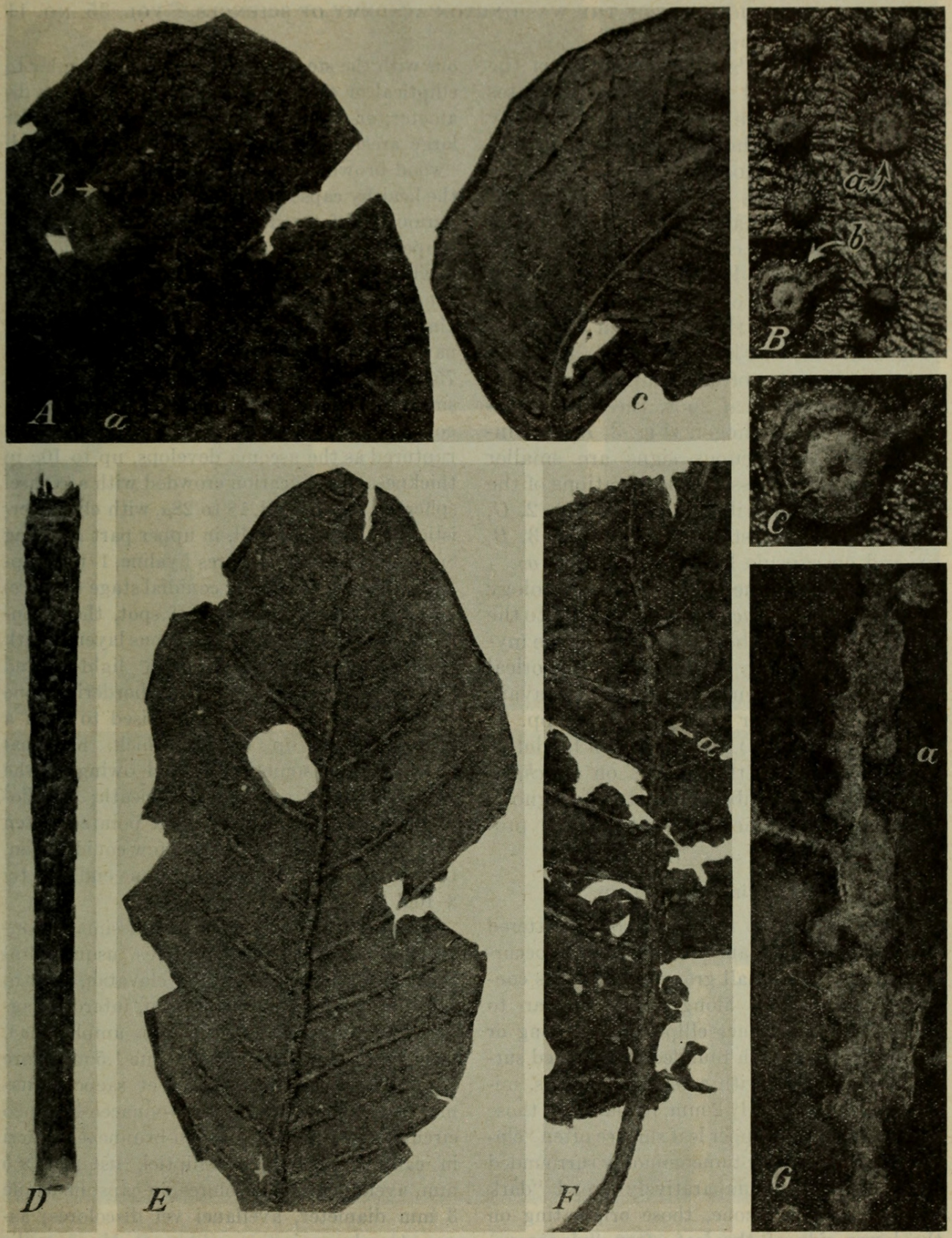

FIG. 2.—Leaf spots and stem cankers of the scab on *Cinchona pubescens*, *A–E*, vic. Chachagui, Colombia, October 16, 1943, *W. C. Davis* 28; *F* and *G*, La Unión, Colombia, October 21, 1943, *W. C. Davis* 29; *A*, *a*, *b*, Spotting prominent on upper side of the leaf; *c*, on lower surface of another blade, ×1; *B*, several raised spots from *A*, *a*, mostly darkened by the palisade of conidiophores of the pathogen (*Elsinoë*) over their surfaces (cf. Fig. 3, *E*), only outer zone covered in *a* and *b*, ×9; *C*, still greater detail of *A*, *b*, ×14; *D*, prominent cankers on young stem, ×1; *E*, *F*, continual vein infection on (*E*) lower surface of a comparatively young leaf, and (*F*) on upper surface of an older leaf, both ×1; *G*, detail of *F*, in the region of *a;* in the original specimen, dark, punctate masses, fructifications of the pathogen, scattered over the surface of the lesion, are best seen in the region of *G*,*a*, ×6. Photographs by M. L. F. Foubert (*A–E*) and by Taylor (*F* and *G*).

sharply with the "sorghum brown" of the smooth unaffected surface. In some cases capsule lesions are not distinguished by their color and, where of small size, would ordinarily be overlooked.

Prominent signs of the scab, visible as seen through a hand lens, are the dark more or less even covering over the entire or outer zone (see Fig. 2, *A* and *B*) of leaf spots, composed of a palisade layer of conidiophores of the pathogen (*Elsinoë*) (Fig. 2, *B* and *C;* Fig. 3, *E* and *F*) and dark pulvinate masses often occupying the central area of the leaf spot, these being ascomata of the pathogen (Fig. 3, *D*, and inset). Less conspicuous signs are smaller dark pulvinate masses, fructifications of the pathogen, on midrib lesions (cf. Fig. 2, *G*, legend for *a*), on stem cankers (Fig. 3, *B*, *a*), and on capsule lesions (Fig. 3, *C*, *a*).

Etiology.—On the basis of its morphology the pathogen of *Cinchona* scab belongs to the genus *Elsinoë* Raciborski (17, 20) of the myriangiaceous family Elsinoaceae. Historical sketches of this genus and family are available elsewhere (for example, cf. 10, pp. 5–8; 16, pp. 306–308). So far as can be determined at present the species on *Cinchona* has not been described hitherto; a diagnosis under a new name is therefore here presented as follows:

Elsinoë cinchonae, n. sp.

Producing few to numerous spots scattered over leaves, stems, and fruit; leaf spots occurring singly or in small groups, sometimes confluent, particularly along veins circular to subcircular, sometimes elliptical to oblong or irregular, raised with rounded or flattened surface, occasionally with a central apiculus, minute to 1.5 mm, rarely 2 mm, in diameter, those originating on the upper leaf surface often "cinnamon-drab" and not uncommonly surrounded by a narrow or comparatively broad "dark vinaceous-brown" zone, those originating on the lower side of the leaf often "vinaceous-brown"; stem cankers mostly elliptical or nearly so, reaching 4 by 5 mm in diameter, sometimes crowded or coalescent, raised with rounded to flattened often roughened surfaces, at times with a central smooth apiculus, occasionally fissured, particularly at upper and lower margins, "cinnamon-drab," or concolorous with the stem; spots on capsules circular to elliptical or elongate, up to 3 mm or so in diameter, or elongate, sometimes confluent over large areas, raised, short conical or flattened, "wood brown" or sometimes concolorous with the healthy capsule surface; entire fruit may be variously deformed, often circular or crescent-shaped; ascomata scattered over the lesions as small raised dark to black punctate areas, most conspicuous as grouped on central area or margin of the leaf spot, round to elliptical, pulvinate, reaching as many as 300μ in diameter by 75μ in thickness, although usually much smaller, erumpent superficial, stroma light colored, dark epithecium, which may become ruptured as the ascoma develops, up to 10μ in thickness, fructification crowded with asci; asci spherical to ellipsoid, 18 to 28μ, with characteristically thickened wall, in upper part reaching 8μ in thickness; ascospores hyaline, 1- to 3-septate, reaching 15 by 15μ; conidial stage (*Sphaceloma*) well developed on leaf spot, there consisting of a more or less continuous layer of dark conidiophores arising from a light-colored stroma covering all or only the bordering zone of the lesion, at the margin raised to form a sporodochium, up to 50μ thick, marginal sporodochium sometimes tilted owing to the development of an ascoma beneath; conidiophores dark, cyclindrical, apex pointed, often 1-septate, 3.5–5 by 8–15μ; the few conidia seen, brown, elliptical or spiculate at one end, 4–5 by 8–10μ.

Maculae plerumque numerosissimae, conspersae, circulares, subcirculares, usque ellipticae, interdum elongatae, elevatae, centro saepe plus minusve apiculiformi, interdum aggregatae vel confluentes, in foliis amphigenae, interdum nervisequentibus, usque 1.5 mm, rare 2 mm, superne conspicuores et saepe cinnamonea-griseae, margine nigro-vinaceo-brunneo circumdatae, inferne vinaceo-brunneae; cancri in caulibus generaliter elliptici, usque 4×5 mm, avellanei, vel discolores, in capsulis usque 3 mm diameter, avellanei vel discolores; ascomata plus minusve numerosa, in maculis foliorum epigena conspicuoria, rotunda usque elliptica, pulvinata, exposita, usque 300μ diameter, 75μ crassa, superficialiter nigro-brunnea; epithecium fuscum, 10μ crassum; asci numerosi, sub-epithecio in regione stromatica hyaline distributi, globosi usque ellipsoidei, apice incrassati, 18–20μ diameter; ascosporae

FIG. 3.—*A–D*, additional illustrations of the scab from *Fosberg* 20065 and 20065a: *A*, *a*, part of an inflorescence, with scalelike cankers on rachis; *b*, capsule abnormally crescent-shape, surface mostly covered with confluent lesions; *c*, leaf spots grouped near midrib, ×1; *B*, rachis cankers from *A*, *a*, fructifications of the *Elsinoë* on them barely visible as minute dark punctate masses (*a*); *C*, *a*, dark fructifications of the pathogen clearly distinguishable on lesions from capsule shown in *A*, *b*; *D* (exclusive of inset), leaf spots from *A*, *c*, with dark ascomata prominent on their surfaces; individual ascomata distinguishable on *a*. *B–D*, ×1; *D* (inset), photomicrograph showing part of an ascoma produced on margin of a lesion from *D*; *b*, epithecium; *c*, two asci with clear, thickened walls, ascospores, dark in photograph, stained red with erythrosin, *d*, epidermis of leaf. *E*, tangential section (unstained) through a leaf spot from Fig. 2, *A*, *a*, showing disorganized hyperplastic tissue of lesion and (*a* to *b*) conidiophore palisade over surface (cf. Fig. 2, *B* and *C*), ×125; *F*, *a*, sporodochium from another section, in comparable position to *E*, *b*, individual conidiophores distinguishable at right, ×225. Photographs by Taylor (*A–D*), Lilian Guernsey (*D*, inset), and by Foubert (*E* and *F*).

immaturae, 1–3-septatae, hyalinae, 15–5μ; status conidiophorus (*Sphaceloma*) in maculis foliorum epigenus prominens; condiophora in palum compactum, expositum superficialiter nigro-brunneum, plus minusve continuum, ex stromate hyaline oriundum, fructificatione tota 30μ crassa, vel marginem maculae versus usque 50μ; conidiophora cylindrica apice acuminato, generaliter continua vel uniseptata, 3.5–5 by 5–15μ; conidia rare visa, brunnea, elliptica, 4–5 by 8–10μ.

Distribution.—Producing the disease "scab of *Cinchona*" on leaves, stems, and fruits of *Cinchona pubescens* Vahl, rarely on *C. officinalis* L., in Colombia, Peru, and possibly Ecuador and on *C. delessertiana* in Peru. *Cinchona* is a genus of the family Rubiaceae.

Specimens examined:[3]

ON CINCHONA PUBESCENS VAHL

Cuatro Esquinas to Río Piendamo, Cauca Valley, Dept. de Cauca, Colombia, from tree in thicket growth ("machimbi"), alt. 1,700–1,900 meters, June 6, 1922, *F. W. Pennell* and *E. P. Killip* 6380 (US). Infection on capsules.

"El Ramal" to Río Sucio, west of Popayán, Dept. de Cauca, Colombia, woodland, alt. 2,000–2,200 meters. July 3, 1922, *F. W. Pennell* and *E. P. Killip* 8088 (US; also in NY). Abundant infection on the many capsules.

Barbosa, 22 km south, on road to Chiquinquira, Dept. de Santander, Colombia, roadside tree 6 meters high, January 4, 1943, *W. C. Steere* 7066 (US). Typical spotting on leaves, inflorescence branches, and on capsules.

Lavaderos, on ridge between Río Naranjo and Río Granadilla, 15 km south of San Agustín, Dept. de Huila, Colombia, in clearing between patches of moist woods, alt. 2,000 meters, February 11, 1943, *F. R. Fosberg* 20065a. Type (USM 90159, IB). This specimen is part of *Fosberg* 20065 (USNA). It was through his observation of the strikingly deformed fruits on this specimen that Fosberg discovered the disease "scab of *Cinchona*" in Colombia.

Vic. Chachagui, 18 km north of Pasto, Dept. de Nariño, Colombia, steep slope, alt. 2,100 meters, October 16, 1943, *W. C. Davis* 28 (USM, IB).

La Unión, about 6 km above, toward Pasto, along road, Dept. de Nariño, Colombia, alt. 2,010 meters, October 21, 1943, *W. C. Davis* 29 (USM).

San Bernardo, on trail to La Cruz, alt. about 2,200 meters, Dept. de Nariño, Colombia, October 21, 1943, *W. C. Davis* 30 (USM).

(The Davis labels indicate that his nos. 28, 29, and 30 were collected in company with Fosberg whose corresponding botanical numbers are 21255, 21283, and 21281 (USNA).

Urubamba River, near the beginning of trail, up to Machu Picchu, Prov. de Quillabamba, Dept. de Cuzco, Peru, June 1943, Hernan Augusto (*Hodge* 6201) (USNA).

ON CINCHONA DELESSERTIANA STANDLEY

Quebrada Pajonal, above Tabaconas, Prov. de Jaen, Dept. de Cajamarca, Peru, November 14, 1943, Earl Rogers s.n. (USNA).

ON CINCHONA OFFICINALIS L.

La Belleza, 10 km north of Florian, Dept. de Santander, Colombia, September 20, 1944, *N. C. Fassett* 25773 (USM). Fassett's regular botanical specimen from the tree bears his number 25772 (USNA).

Discussion.—*Elsinoë* species characteristically infect young growth of their suscepts. From the four species originally described (20), the group has grown, especially in recent years, until it is now admittedly large (cf. 3, pp. 512–513; 8, pp. 150–151; 16, table 1; 18, pp. 165–166), with suscepts ranging from the ferns to the composites. So far as has been determined by inoculation tests, a particular species of *Elsinoë* does not infect unrelated plants (for example, cf. 14); instead, individual species are limited in their pathogenicity to closely related plants or even to a single species in a genus (for example, cf. 13). The example just cited describes inoculation tests on species of different legume genera with a culture of *E. phaseoli* Jenkins (13) from *Phaseolus lunatus* var. *macrocarpus* Benth. Three of the legume genera of the

[3] The herbaria in which are filed the specimens examined during this study are indicated by symbols as follows: IB, Seccão de Fitopatologia, Instituto Biologico de São Paulo, Brazil; NY, New York Botanical Garden, Bronx Park, New York, N. Y.; US, United States National Herbarium, Smithsonian Institution, Washington, D. C.; USM, Mycological Collections of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Plant Industry Station, Beltsville, Md.; USNA, United States National Arboretum, United States Department of Agriculture, Plant Industry Station, Beltsville, Md. The US, NY, and USNA specimens were collected as phanerogamic material and are so deposited.

experiment, other than *Phaseolus*, were known suscepts of other species of *Elsinoë*. In this series of inoculations, which included several commercial varieties of *P. vulgaris* L., only *P. lunatus* var. *macrocarpus* became infected.

Parallel cultural comparisons may serve to demonstrate a close genetic relationship among species of *Elsinoë* from suscept genera within the same family. An example of this is afforded by two species from rosaceous suscepts, i.e., *E. veneta* (Burk.) Jenkins on *Rubus* and *Sphaceloma rosarum* (Pass.). Jenkins on *Rosa*. It is here inferred, of course, that the perfect stage of *S. rosarum*, when and if found, will be referable to *Elsinoë*. As described and illustrated (11, p. 332, pl. 7, *A* and *C*), these two organisms were strikingly similar when cultured under like conditions, although they were also separable. In inoculation experiments on the same set of plants of *Rosa*, *S. rosarum* gave positive results, *E. veneta* negative (11, p. 334).

With such results as these as a background, it would seem that *E. cinchonae* may be limited to genera within the tribe to which *Cinchona* belongs, or even to the genus alone.

Among the Rubiaceae we find *Sphaceloma genipae* Bitancourt (2) described on *Genipa americana* L. and *Elsinoë puertoricensis* Jenkins and Bitancourt (19) on *Randia* spp. including *R. mitis* L. Both *Genipa* and *Randia* belong to another tribe of this family than does *Cinchona*. *E. cinchonae* in its conidial stage is probably to be distinguished morphologically from *S. genipae*. To compare the two critically, however, would require strictly comparable growth of each. For example, small hyaline conidia, such as are described for *S. genipae*, should be compared with similar hyaline conidia of *E. cinchonae;* these latter doubtless exist, although they were not seen during the present study. Conidia from cultures may be required for such a comparison, and after cultures are available still further special culturing (cf. 15, pp. 25–28, figs. 1–9) may be necessary to obtain conidia. It must be borne in mind also that conidia of *Elsinoë* may begin to swell as soon as formed and that this feature presents a real hazard in making species comparisons on the basis of conidial measurements. The diversity of characters in species referable to the form genus *Sphaceloma* has led to difficulties in their taxonomy, as has already been discussed (16, p. 307; 17). The general similarity of growth of these fungi in culture, together with the possibility of separating them by this means, has proved a valuable asset. Colored plates illustrating parallel cultural comparisons of this group are available elsewhere (6, pl. 22; 7, pl. 15; 15, pl. 3); a method of making original isolations by means of microtechnique also has been delineated in another connection (5, p. 134, pl. 18, *H–M*).

Fructifications of the perfect stage of species of *Elsinoë* may be sufficiently distinctive to differentiate them, although care must be exercised in making comparisons. It is not rare, for example, to find only immature ascospores, as in the case of the specimens of *E. cinchonae* examined. Naturally, under all the circumstances, the description of a newly discovered fungus of the genus *Elsinoë* as new, or its identification as a species previously described, may be more or less provisional. In this way it is possible to record taxonomically more of the new suscepts of *Elsinoë* and *Sphaceloma* that are constantly being discovered in various parts of the world than would otherwise be the case. As additional pertinent data are obtained appropriate revisions may be made.

As at present described, *E. cinchonae* and *E. puertoricensis* appear to be distinct species. *E. puertoricensis* has pulvinate as well as applanate ascomata, with an indefinite epithecium. Asci, not particularly crowded in the fertile stroma, are often distributed in one horizontal plane. In *E. cinchonae* only pulvinate or practically hemispherical ascomata have been seen; this more regular form may be accounted for by the better-developed epithecium, which in one instance had ruptured, exposing the underlying hyaline ascigerous stroma. In this species on *Cinchona* the fertile stroma is extremely crowded with asci, which are oriented in different planes.

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BOTANY.—*Accessory vascular bundles in* Murraya koenigii *(Linn.) Spreng. (Rutaceae: Aurantioideae).*[1]

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From time to time plant anatomists have reported the presence of "accessory," "free" or "unattached" vascular bundles in various floral parts of several plant families. Varying amounts of significance have been given them by investigators. Unattached bundles, which are amphiphloic, or concentric, are described by Arber (*1*) as occurring in the genera *Lunaria, Sisymbrium,* and *Raphanus* and are figured in petals of *Lunaria,* stamens of *Sisymbrium,* and ovule of *Raphanus.* These bundles are described as passing through an amphiphloic stage, finally becoming collateral by the time the petals are free.

Considerable study has been given the various members of the subfamily Aurantioideae in regard to the vascular systems of their flowers. Tillson and Bamford (*2*) studied the floral vascular anatomy of 94 species belonging to 29 genera of the Aurantioideae. They make no mention of accessory bundles in any of the genera or species they studied. Their observations showed that in the genus *Murraya,* including *M. koenigii,* the vascular bundles supplying the various floral parts arose individually from the central cylinder of vascular tissue in the pedicel and that there was no exchange of lateral branch bundles between floral parts.

Accessory bundles were mentioned as occurring in the flowers of the Eureka Lemon, a cultivated variety of *Citrus limon,* by Ford (*3*), and are described as several groups of small vascular traces below the sepals.

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