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REVISION OF THE GENUS *FRENCHIA* WITH DESCRIPTION OF A NEW SPECIES (HOMOPTERA: COCCOIDEA: ASTEROLECANIIDAE)

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Abstract.—The genus *Frenchia* is redescribed, and its taxonomic status is discussed. The immature and adult female stages of a new species, *F.* **banksiae**, are described and illustrated. Also, redescriptions and illustrations are provided for *F. casuarinae* Maskell and *F. semiocculta* Maskell. Numerical data on the external morphological structures of each stage are given, and keys are provided for determination of the three species in each stage. Plant galls and other malformations produced by each species are illustrated and described, and the economic importance of each species is discussed. Species of *Frenchia* occur only in the Australian Region, and are considered to form a distinct branch of the family Asterolecaniidae.

The genus *Frenchia* was erected by Maskell (1892) to include the species *F. casuarinae*, a gall-forming coccoid from Australia. Later, Maskell (1895) included a second species, *F. semiocculta*, in the genus. Froggatt (1898, 1921, 1933) provided additional data on gall formation, hosts, and distribution for both species. Morrison and Morrison (1922, 1927) redescribed both species but stated that they were unable to see several morphological characters of the various instars because of the poor quality of the slide-mounted material. It is for this reason and for the interesting new species recently recognized in a shipment from Australia, that we are revising this genus.

Morphological descriptions and illustrations have been prepared for all available stages of the three *Frenchia* species to show relationships. Keys to the adult females and first- and second-instar females are presented to assist with species determination. Measurements are given in microns; averages are followed by ranges in paranthesis. Abbreviations for the names of institutions from which material was obtained or is deposited are: Australian National Insect Collection, Canberra, Australia (ANIC); British Mu-

seum (Natural History), London, England (BM); Department of Scientific and Industrial Research, Auckland, New Zealand (DSIR); U. S. National Museum of Natural History, Beltsville, Maryland (USNM); University of Tennessee, Knoxville, Tennessee (UT); Virginia Polytechnic Institute and State University, Blacksburg, Virginia (VPI); and Waite Agricultural Research Institute, Adelaide, S. Australia (WARI). For type-material designations and material studied lists, the first digit indicates the number of specimens, the second digit in parenthesis is the number of slides.

Frenchia Maskell, 1892

Type-species.—*Frenchia casuarinae* Maskell, 1892, by original designation and monotypy.

Type-locality.—Australia.

Diagnosis.—Probably all 3 species bisexual; however, male descriptions lacking because of rarity of specimens. Males of different stages seen in *F. banksiae*, n. sp. and in *F. semiocculta*. Galls produced by males known in *F. semiocculta*. Adult females occur within galls, or in pitlike malformations.

Adult female body variable in form; pyriform, or ovoid with acutely tapered abdomen. Dorsum with numerous quinquelocular pores, except in *F. semiocculta*; often with few 8-shaped or simple disc pores on abdomen, large 8-shaped pores few or absent, many scattered tubular ducts, these without terminal filament (usually absent on posterior abdominal segments), anal region rounded or acute at apex, distinct anal lobes and apical setae absent. Venter with unsegmented antennae, legs absent, bilocular pores on cephalothorax, usually with quinquelocular pore band in submarginal area or at least in spiracular furrows, anal ring indistinct without setae, or distinct with setae, tacklike setae scattered on both body surfaces.

Second-instar female body pyriform or elliptical, tapering toward caudal end. Quinquelocular pores numerous on dorsal and ventral submarginal area, or restricted to a marginal row on venter, or absent, except in spiracular furrows. Dorsum without tubular ducts, setae rare, large 8-shaped pores and simple disc pores absent or present. Venter with short unsegmented antennae, scattered bilocular pores and often with few trilocular pores in spiracular furrows, quinquelocular pores in marginal row or band and in spiracular furrows, anal ring poorly developed.

First-instar body elliptical. Dorsum with large 8-shaped pores and simple disc pores in segmental or longitudinal rows, setae rare, most tacklike. Venter with 6-segmented antennae, elliptical eyes, 5-segmented legs, a campaniform sensillum at base of each tarsus, apparently none on trochanter, slender pairs of tarsal and claw digitules, at least 1 trilocular pore associated with each spiracle, few bilocular pores on derm, anal ring without or with setae, anal lobes with prominent apical setae.

Notes.—*Frenchia* originally was included by Maskell (1892) in the family Brachyscelidae because of formation of plant galls. This family name was changed to Apiomorphidae because *Brachyscelis* Schrader was preoccupied in the Coleoptera in 1834, and was replaced by *Apiomorpha* Rübsaamen, 1894. Other workers realized that besides the gall-forming habits, the type-species of the genus morphologically had very little in common with *Apiomorpha*, but much more with Asterolecaniidae.

Morrison and Morrison (1922) placed *Frenchia* in a group of genera containing *Asterolecanium*. Russell (1941) assigned *Frenchia* to the subfamily Asterolecaniinae and noted that it belonged to a group of genera most closely related to *Amorphococcus*, *Asterolecanium*, and *Polea*.

Borchsenius (1960) placed *Frenchia* in the tribe Polliniini in association with the genera *Callococcus* Ferris, *Mycococcus* Ferris, and *Pollinia* Targioni-Tozzetti. Koteja (1974a), based on characters of the mouthparts, disagreed with the latter assignment. It appears from Koteja's and our studies that *Frenchia* occupies a distinct status among the asterolecaniids and is probably not closely related to any of the recently studied genera in this family; therefore, it probably needs to be transferred into a new subfamily. Studies on the poorly known genera of Asterolecaniidae to be undertaken by the first author in the near future should assist with the proper phylogenetic placement of the genus *Frenchia*. Taxonomic information on the adult males in these genera also would be helpful.

Key to Adult Females of *Frenchia*

1. Anal region not sclerotized; large 8-shaped pores absent on dorsum of cephalothorax; anal ring without setae 2
– Anal region heavily sclerotized; large 8-shaped pores present on dorsum of cephalothorax; anal ring with setae .. *banksiae*, new species
2. Abdominal region more than twice as long as cephalothorax; quinquelocular pores present on dorsum ..... *casuarinae* Maskell
– Abdominal region less than twice as long as cephalothorax; quinquelocular pores absent on dorsum ..... *semiocculta* Maskell

Key to Second-Instar Females of *Frenchia*

1. Anal ring absent or incomplete; dorsal 8-shaped pores absent; antennae with 2 or 3 setae 2
– Anal ring well developed; dorsal 8-shaped pores present; antennae with 4 setae ..... *banksiae*, new species
2. Quinquelocular pores present on dorsum and in submarginal band on venter; anal ring absent ..... *casuarinae* Maskell
– Quinquelocular pores absent on dorsum and restricted to spiracular furrows on venter; anal ring present, but incomplete .... *semiocculta* Maskell

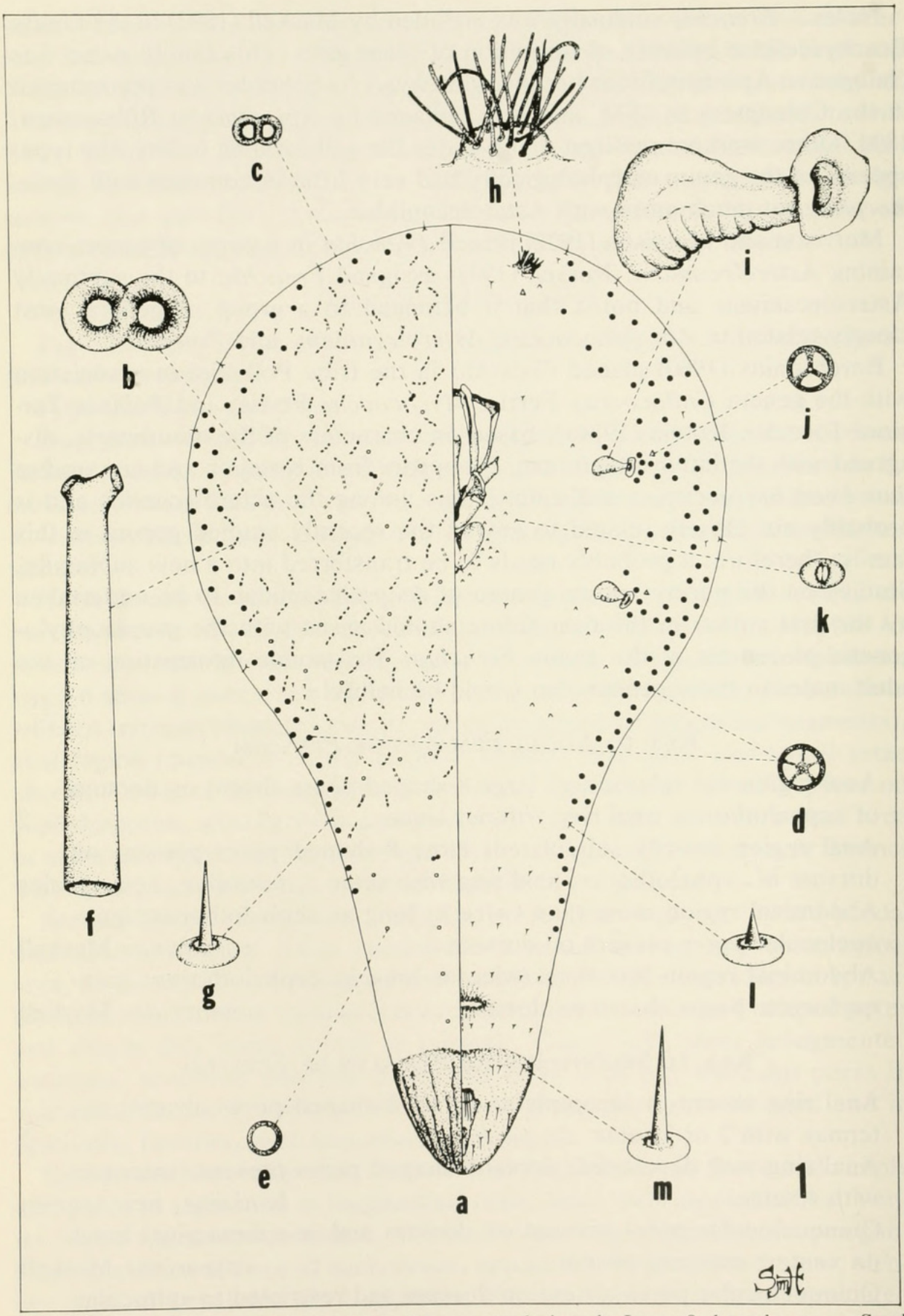

Fig. 1. *F. banksiae*, adult female. a, Dorsoventral view. b, Large 8-shaped pore. c, Small 8-shaped pore. d, Quinquelocular pore. e, Simple disc pore. f, Tubular duct. g, Tacklike seta. h, Antenna. i. Spiracle. j, Trilocular pore. k, Bilocular pore. l, Tacklike seta. m, Needlelike seta.

Key to First-Instar Females of *Frenchia*

1. Large 8-shaped pores in 6 long (extending almost entire body length) and 2 short (extending less than halfway on body) longitudinal rows; 1 trilocular pore associated with each spiracle; labium with 4 or less pairs of setae 2
– Large 8-shaped pores in 4 long (extending almost entire body length) and 2 short (extending less than halfway on body) longitudinal rows; 2 trilocular pores associated with posterior spiracle; labium with 5 pairs of setae ..... *semiocculta* Maskell
2. Large 8-shaped pores not forming 2 intermedial longitudinal rows; anal ring without setae; 2 pairs of setae between antennal base and clypeolabral shield; bilocular pores on submarginal area of anterior abdominal segments and near clypeolabral shield .... *casuarinae* Maskell
– Large 8-shaped pores forming 2 intermedial longitudinal rows; anal ring with setae; 3 or more pairs of setae between antennal base and clypeolabral shield; bilocular pores only near clypeolabral shield ..... *banksiae*, new species

Frenchia banksiae Lambdin and Kosztarab, New Species

Adult Female

Figs. 1a–m

Type-material.—From leaf galls of *Banksia serrata* L., 5(3), Nr. Bairnsdale, Victoria, Australia, 11 Aug. 1976, P. Gullan Coll. (WARI); 3(3) Mallacoota, Victoria, Australia, 20 Feb. 1976, P. Gullan Coll. (WARI No. 5/76) (2 at WARI and holotype deposited at ANIC); 2(1), 20 mi. W. of Bairnsdale, Victoria, Australia, 31 Jan. 1972, J. W. Beardsley Coll. (WARI); on *Banksia* sp., 10(5), Sydney, New South Wales, Australia, G. Compere Coll. No. 248 (USNM); 3(1), G. Compere Coll. No. 178 (USNM); 3(1), New South Wales, Australia, G. Compere Coll. No. 691 (USNM); 6(2), Australia, 10 Mar. 1977, coll. at San Francisco. (Quarantine No. 8200), P. T. Meyerson Coll. (USNM). Material deposited as follows: Holotype 1(1) and paratypes 5(3), (ANIC); other paratypes 1(1), (BM); 16(7), (USNM); 1(3), (UT); 1(3), (VPI); 3(2), (WARI).

Body (Fig. 1a).—Pyriform, 1190 (1080–1320) long, 711 (604–900) wide; derm membranous.

Dorsum.—Large 8-shaped pores on margin. An occasional pair of 8-shaped pores (Fig. 1b) on 1st or 2nd abdominal segment; each 8 (8–9) long, 5 wide. Four pairs of small 8-shaped pores (Fig. 1c) on cephalothorax and anterior abdominal segments; each 4 (3–5) long, 3 (2–4) wide. Quinquelocular pores (Fig. 1d) in marginal-submarginal band 1–8 pores wide from anterior cephalothoracic region to 4th or 5th abdominal segment; each 4 (3–5) in diameter. Simple disc pores (Fig. 1e) in transverse segmental rows on

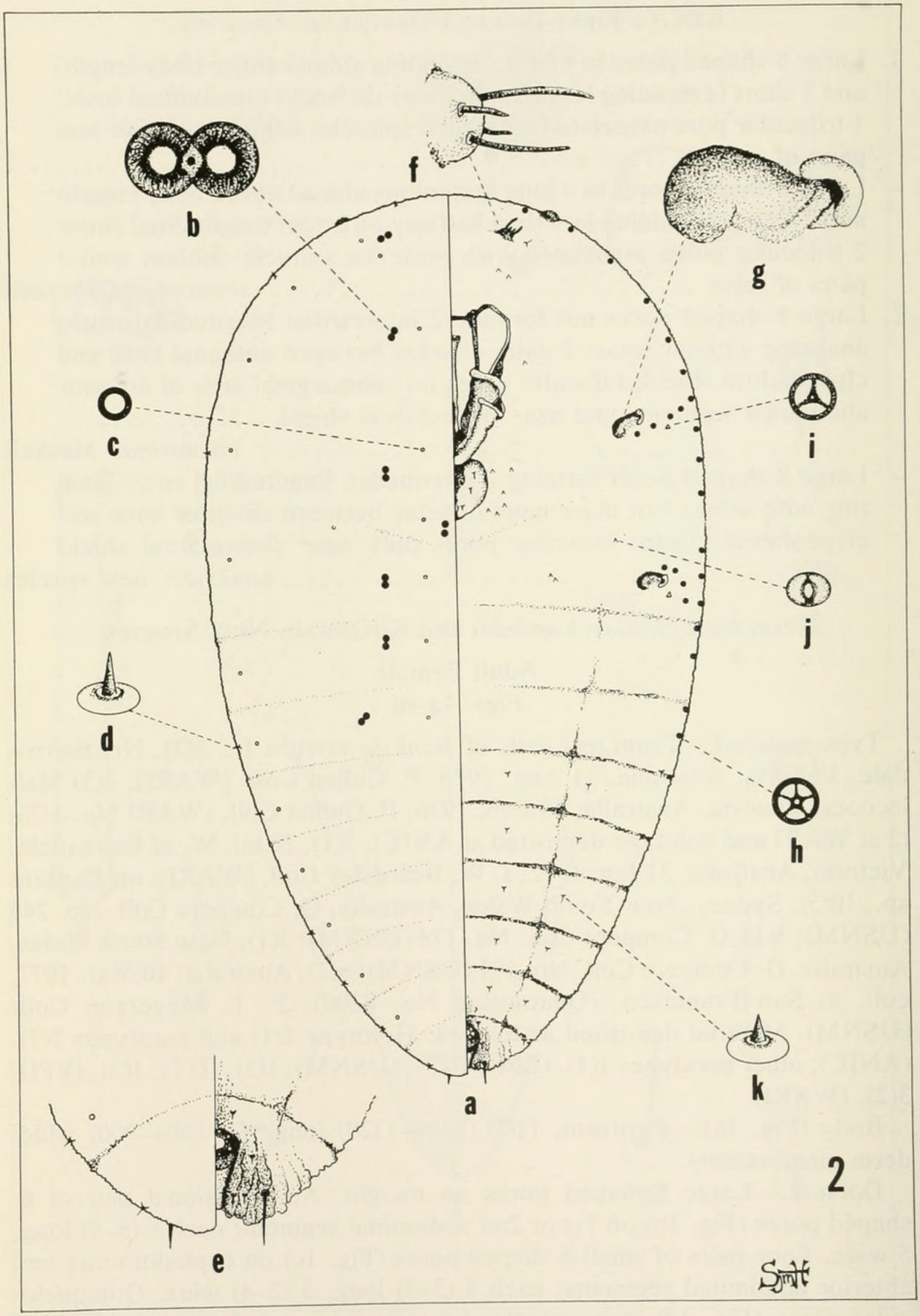

Fig. 2. *F. banksiae*, second-instar female. a, Dorsoventral view. b, Large 8-shaped pore. c, Simple disc pore. d, Tacklike seta. e, Anal region. f, Antenna. g, Spiracle. h, Quinquelocular pore. i, Trilocular pore. j, Bilocular pore. k, Tacklike seta.

cephalothorax and anterior abdominal segments, each 3 (2–4) in diameter. Tubular ducts without terminal filament (Fig. 1f) on cephalothorax and anterior abdominal segments; each 34 (31–37) long, 2 (1–2) wide. Tacklike setae (Fig. 1g) on body margin; each 5 (4–7) long. Anal region well developed, heavily sclerotized, rounded at apex and lacking setae.

Venter.—Antennae (Fig. 1h) unsegmented, 22 (16–29) long, 23 (19–25) wide; with 18 (11–23) setae, some bifid. Clypeolabral shield 157 (135–174) long, 114 (103–121) wide. Labium unsegmented, 53 (50–63) long, 69 (64–76) wide; with 2 pairs of slender setae 10 (7–13) long. Legs absent. Spiracles (Fig. 1i) on submargin; 59 (54–62) long, 24 (18–34) wide, atrial opening 8 (6–10) in diameter. Associated quinquelocular pores (Fig. 1d) near spiracles and in marginal band that extends from antennae to about mid-abdomen, shape and size as those on dorsum. Few trilocular pores (Fig. 1j) also associated with spiracles. Cluster of 18 (14–22) bilocular pores (Fig. 1k) near mouthparts on each side, 1 near base of antenna and a few on each anterior abdominal segment; each 3 (2–4) long, 3 (2–5) wide. Tacklike (Fig. 1l) to needlelike setae (Fig. 1m) in medial and submarginal regions of cephalothorax and in 5 transverse rows on abdomen; each 5 (4–8) long. Anal ring positioned anterior to heavily sclerotized anal tube; 16 (12–20) long, 15 (11–18) wide. Anal ring with 6 setae, each 40 (36–42) long. Anal area setae in oblique rows in sclerotized region; anterior row with outer seta 8 (7–10) long, medial pair 9 (7–11) long; medial row lateral of anal ring with outer seta 21 (18–24) long, medial pair 12 (11–16) long; posterior row with outer seta 24 (22–27) long, medial seta 8 (6–11) long, inner seta about 19 long.

Note.—Females present in galls formed on leaves of *Banksia* (Figs. 9, 10).

Second-Instar Female
Figs. 2a–k

Paratypes studied.—On *Banksia serrata*, 21(8), Mallacoota, Victoria, Australia, 20 Feb. 1976, P. Gullan Coll. (WARI); 3(1), 20 mi. W. of Bairnsdale, Victoria, Australia, 31 Jan. 1972, J. W. Beardsley Coll. Material deposited as follows: 3(1), (ANIC); 2(1), (BM); 3(1), (USNM); 7(1), (UT); 2(1), (VPI); 8(3), (WARI).

Body (Fig. 2a).—Ovoid, 594 (501–666) long, 345 (248–465) wide; derm membranous.

Dorsum.—Six (3–8) submedial pairs of large 8-shaped pores (Fig. 2b) in irregular longitudinal row on cephalothoracic and anterior abdominal segments; 1 pair in median area of cephalothorax; each 8 (7–8) long, 6 (4–6) wide. Simple disc pores (Fig. 2c) in submarginal row, 1 pair per segment, extending from cephalothorax to 8th abdominal segment, and in 2 irregular submedial rows on cephalothorax and a few on anterior abdominal segments; each 2 in diameter. Usually 1 pair of tacklike marginal setae (Fig. 2d) per segment, each 3 (2–4) long. Anal lobes (Fig. 2e) slightly pronounced.

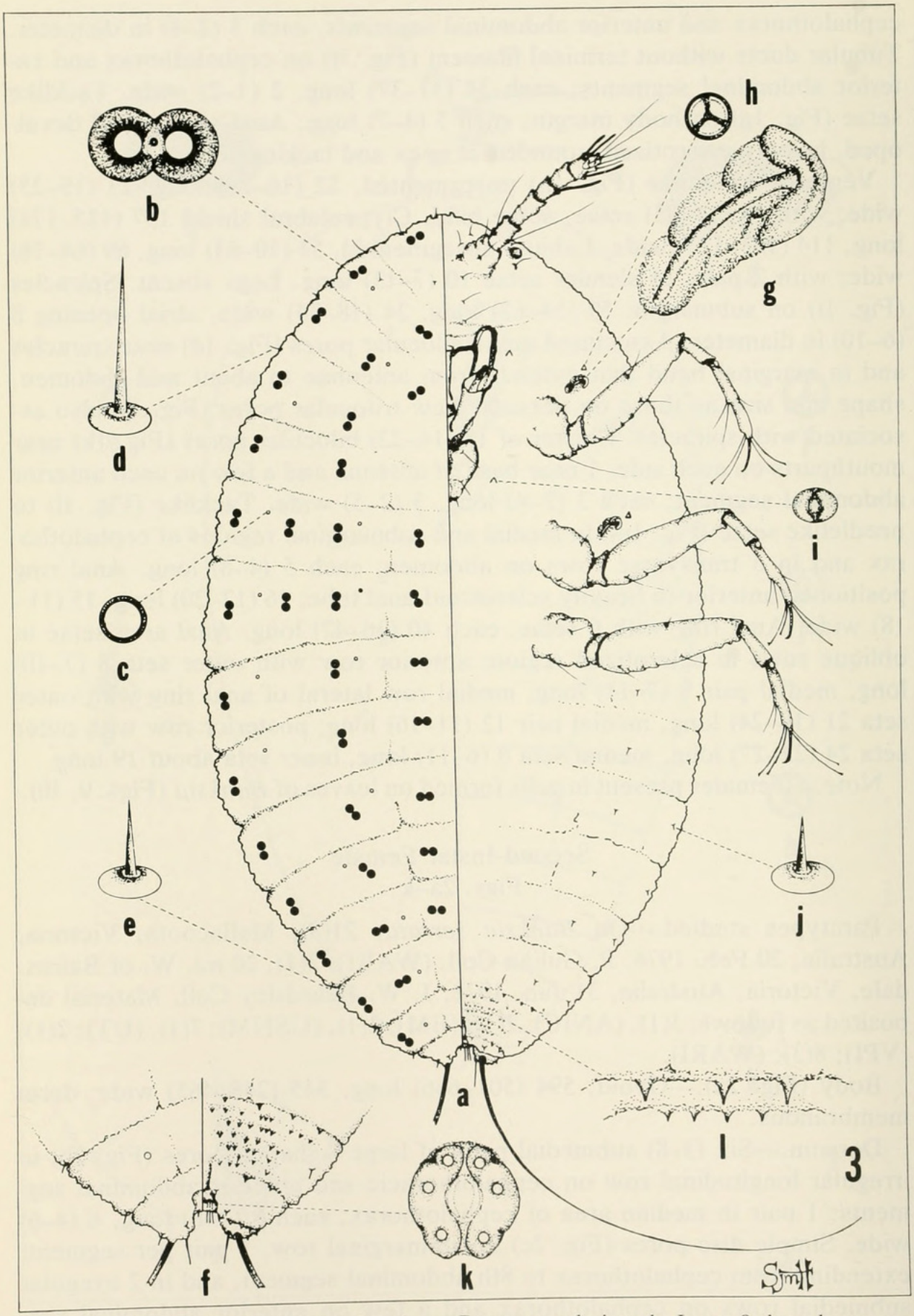

Fig. 3. *F. banksiae*, first-instar female. a, Dorsoventral view. b, Large 8-shaped pore. c, Simple disc pore. d, Needlelike seta. e, Tacklike seta. f, Anal lobes. g, Spiracle. h, Trilocular pore. i, Bilocular pore. j, Tacklike seta. k, Anal ring. l, Macrospines and microspines.

Venter.—Antennae (Fig. 2f) unsegmented, 9 (7–12) long, 13 (12–16) wide; with 4 fleshy setae, each 11 (7–14), 7 (6–10), 4 (4–5) and 2 (1–2) long. Clypeolabral shield 114 (106–122) long, 86 (74–118) wide. Labium 44 (32–61) long, 57 (50–60) wide; with 3 pairs of setae, each 4 (2–6) long. Legs absent. Spiracles (Fig. 2g) 32 (24–37) long, 11 (8–13) wide, atrial opening 3 (2–5) in diameter. Quinquelocular pores (Fig. 2h) associated with spiracles and forming 2 marginal rows, 17 (12–19) per row, extending from eyes to anterior abdominal segments, each 4 (3–4) in diameter; occasionally a few aberrant trilocular (Fig. 2i) or multilocular pores present in spiracular furrows. Most bilocular pores (Fig. 2j) near mouthparts, 8 (7–10) pores on each side, each ca. 2 in diameter. Anal ring (Fig. 2e) 13 (13–14) long, 13 (12–14) wide; with 6 setae, each 18 (11–23) long. Tacklike abdominal setae (Fig. 2k) in 5 or 6 transverse rows, each 3 (1–4) long. Each ½ of anal area (Fig. 2e) with 1 seta anterior to anal ring, 5 (4–7) long, 1 laterad of anal ring and 2 mesad of apical seta, each 6 (5–8) long, apical seta 14 (11–16) long.

First-Instar Female
Figs. 3a–l

Paratypes studied.—On *Banksia serrata*, 5(2), Mallacoota, Victoria, Australia, 20 Feb. 1976, P. Gullan Coll. (WARI); 1(1), 20 mi. W. of Bairnsdale, Victoria, Australia, 31 Jan. 1972, J. W. Beardsley Coll. No. 4-76 (WARI); on *Banksia* sp., 40(5), Sydney, Australia, G. Compere Coll. No. 248 (USNM); 1(1), G. Compere Coll. No. 178 (USNM). Material deposited as follows: 4(1), (ANIC); 41(6), (USNM); 2(2), (WARI).

Body (Fig. 3a).—Ovoid, 243 (180–345) long, 120 (69–150) wide; derm membranous.

Dorsum.—Large 8-shaped pores (Fig. 3b) on each ½ of body in 4 longitudinal rows (3 complete and 1 incomplete); marginal row with 13 (10–14) pores; submarginal row with 2 (1–3) pores on posterior cephalothoracic region; submedial row with 10 (8–12) pores; medial row with 9 (8–10) pores on each side; each pore 13 (10–16) long, 8 (6–11) wide. Simple disc pores (Fig. 3c) apparently associated with 8-shaped pores, usually arranged in an incomplete submarginal and a submedial row; each 1 (1–2) in diameter. Anterior cephalothoracic segments with 5 marginal setae on each side (Fig. 3d); each 10 (8–11), 14 (13–14), 11 (7–17), 10 (5–17), 3 (2–4) and 6 (2–12) long, respectively from anterior to posterior; posterior 3 abdominal segments each with 2 tacklike setae (Fig. 3e) 2 (1–4) long. Anal lobes (Fig. 3f) slightly pronounced; each lobe with an apical seta 118 (84–151) long; outer margin with a tacklike seta 2 (1–4) long; inner margin with a needlelike seta 11 (8–13) long and a tacklike seta 3 (2–4) long.

Venter.—Antennae 6-segmented, 68 (59–80) long, width at base 17 (14–18). Scape 12 (11–16) long. Segments II to VI: 14 (12–18), 12 (7–16), 8 (6–10), 7 (6–8), and 15 (12–19) long, respectively. Segments: I with 2 hairlike

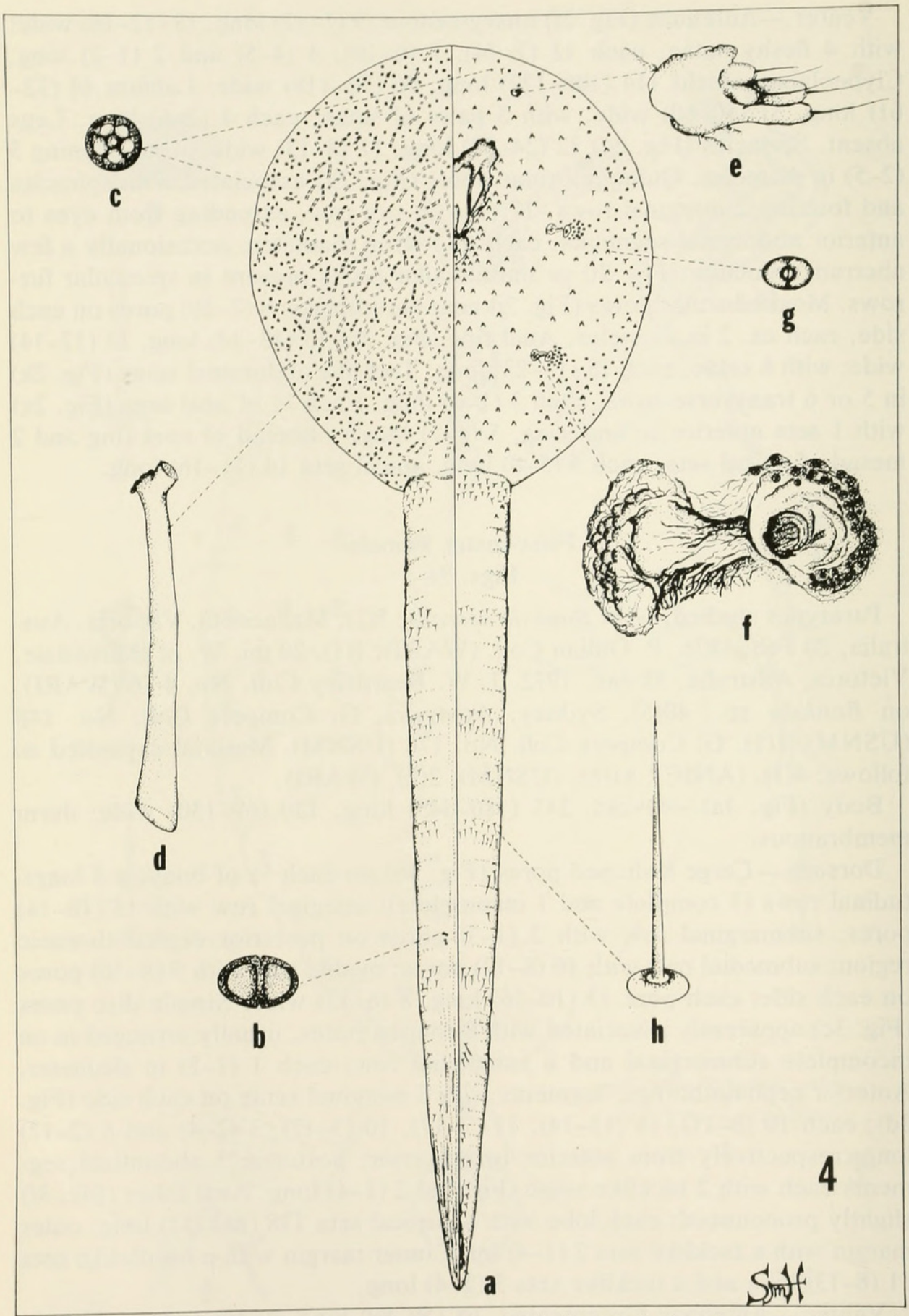

Fig. 4. *F. casuarinae*, adult female. a, Dorsoventral view. b, 8-shaped pore. c, Quinquelocular pore. d, Tubular duct. e, Antenna. f, Spiracle. g, Bilocular pore. h, Abdominal seta.

setae, II with a sensory pore, 2 long hairlike setae, III without setae, IV with 1 fleshy seta, V without setae and terminal segment with 3 fleshy, 3 needlelike, and 2 hairlike setae. Simple eyes elliptical, between antennal base and body margin. Clypeolabral shield 72 (52–114) long, 56 (42–72) wide. Labium heart-shaped, 35 (30–47) long, 34 (29–38) wide; with 3 pairs of hairlike setae 11 (5–17) long, and a sclerotized apical projection 2 (1–2) long. Legs well-developed, 5-segmented, tarsal digitules 35 (29–38) long, claw digitules 21 (16–24) long. Claw without denticle. Size of leg segments as follows:

Part of Leg	Lengths		
	Prothoracic	Mesothoracic	Metathoracic
Coxa	25 (18–30)	30 (24–38)	34 (26–38)
Trochanter	11 (11–12)	10 (8–12)	11 (7–13)
Femur	51 (42–64)	55 (40–67)	58 (43–65)
Tibia	19 (14–24)	20 (13–25)	21 (13–26)
Tarsus	41 (31–43)	53 (42–67)	53 (43–60)
Claw	11 (7–14)	21 (14–28)	20 (17–23)
Entire Leg	156 (132–179)	182 (142–227)	196 (151–222)

Spiracles (Fig. 3g) 12 (8–17) long, 7 (5–10) wide, peritreme 3 (1–4) in diameter; each with an associated trilocular pore (Fig. 3h) anterolateral to each spiracle, each 3 (2–4) in diameter. Two pairs of bilocular pores (Fig 3i) associated with mouthparts, each 2 (1–2) in diameter. Setae sparse, 5 pairs of hairlike setae in a submedial longitudinal row extending from anterior of antennal scape to clypeolabral shield, each 6 (6–7), 10 (7–11), 7 (6–7), 14 (13–14), and 32 (28–38) long, from anterior to posterior; a pair of setae associated with simple eye, anterior about 16.8 long, posterior 7 (5–8) long; abdomen with tacklike segmental setae (Fig. 3j) in submarginal and marginal regions, each 1 (1–2) long. Anal ring (Fig. 3k) 10 (10–11) long, 9 (8–11) wide; with 3 pairs of fleshy setae, each 8 (6–11) long. Few macro- and microspines (Fig. 3l) on derm of posterior abdominal segments.

Note.—No adult males observed in the available material, but second- and third-instar (pupae) males have been found along the midrib of leaves in the Bairnsdale, 11 Aug. 1976, sample, 13(3), and in the Mallacoota material, 2(1), of 20 Feb. 1976, both from Victoria.

Frenchia casuarinae Maskell, 1892

Adult Female

Figs. 4a–h

Type-material.—From the syntype series we have designated and marked as LECTOTYPE an adult female on one slide, and as paralectotypes the re-

maining incomplete specimens (on 3 slides). All labeled: on *Casuarina* sp., Australia, 1891, W. M. Maskell Coll. Material deposited as indicated: Lectotype 1(1), and paralectotypes, specimen fragments (3), (DSIR); 2(1), (USNM No. 7308); 1(1), Australia (Maskell Coll. No. 125).

Additional material.—On *Casuarina equisetifolia* L., 2(2), Canberra, A.C.T., Australia, 25 Aug. 1972, M. Kosztarab Coll. (VPI-No. Au-18a,b); *C.* "*quadrivalvis*," 5(2), Hobart, Tasmania, Rec'd 15 Nov. 1909 (USNM); on *Casuarina* sp., 2(1), Kanmantoo, S. Australia, 5 Aug. 1954, M.V. Carter Coll. (WARI No. 153/54); 2(2), Aldinga Beach, S. Australia, 5 Feb. 1966, H. M. Brookes Coll. (WARI No. 5/66); 2(1), Hobart, Tasmania, A. M. Lea Coll. (BM).

Body of adult female (Fig. 4a).—Cephalothoracic region subcircular, most of abdomen acutely elongate; 6090 (4360-8410) long, 2163 (1850–2400) wide. Live females reddish yellow changing to red and dark brown with age, and covered with fine white waxy powder. Because of their tubular abdomen, resemble upturned slender-stalked mushrooms.

Dorsum.—Large 8-shaped pores absent. Occasionally 1 or 2 small 8-shaped pores (Fig. 4b) irregularly spaced on abdomen, each 7 (5–8) long, 4 (4–7) wide. Quinquelocular pores (Fig. 4c) most numerous on marginal and submarginal areas of cephalothorax, each 6 (6–7) in diameter. Tubular ducts without terminal filaments (Fig. 4d) irregularly spaced on cephalothorax, each 38 (29–43) long, 3 (2–4) wide. Setae on cephalothorax rare, abdomen with transverse segmental bands of needlelike to hairlike setae that extend onto venter. Abdomen tapered, apex slightly rounded and without pores, ducts, or setae.

Venter.—Antennae (Fig. 4e) unsegmented, 23 (15–31) long; with 5 (3–8) setae. Clypeolabral shield 630 (615–642) long, 485 (481–510) wide. Labium appears unsegmented, 121 (96–141) long, 133 (120–153) wide; with 2 pairs of setae, median pair hairlike about 27 long, apical pair about 4 long. Spiracles (Fig. 4f) 217 (186–255) long, 126 (108–135) wide, atrial opening 41 (36–48) in diameter. Quinquelocular pores (Fig. 4c) associated with spiracles and in marginal-submarginal band on cephalothorax, size same as for those on dorsum. Bilocular pores (Fig. 4g) most abundant around mouthparts, irregularly spaced throughout medial and submedial cephalothoracic region and on anterior of abdomen; each pore 4 (2–5) in diameter. Anal ring apparently absent. Anal opening elongate, heavily sclerotized. Slender setae on cephalothoracic submargin 6 (5–6) long, those near antennae 12 (9–15) long. Abdomen with setae (Fig. 4h) in segmental bands. Number of setae per segment decreases anterior to posterior from 44 to 4; size of setae on abdominal segments varies from 8 to 132 with an additional pair on apical tip of abdomen 4 (4–5) long.

Note.—Individual female galls on smaller twigs, 5–6 mm in diameter, averaged 15 mm long and 8–10 mm wide; on branches 10–12 mm diameter

(Fig. 11), these multiple galls usually occurred with 2–3 inhabitants per gall, and galls were globular with medial region 18–25 mm in diameter. When fully developed the wooden tubes were first yellow, but later became reddish brown to almost black with age and were 4–5 mm in diameter in the middle. The apical end, 6–9 mm long, extended out from the gall. Total length was 9–14 mm, and 6–8 mm thick at base (Fig. 13) when fully developed. The inside wall of the tube, especially close to the female, was covered with white waxy powder.

Careful extraction of the wooden tube (Fig. 13) revealed the gall cavity (Fig. 12) to be broad and closed at the base, while the nipple-shaped upper end had a central small slitlike aperture, allowing nymphs to escape. The woody closure or platform at the bottom of the tube, to which the adult female is attached from inside, was detached with a scalpel. Dead adult females found inside were brown, but covered with a fine white waxy powder. The enlarged placoid cephalothorax of each female was attached to a platform at the bottom of the tube, while the tapered abdomen extended into the inner cavity of the tube, giving a thumblike appearance. Apparently the wooden tube, lined with waxy powder, provided protection for the newly hatched nymphs from desiccation, parasites, and predators. A few nymphs were occasionally found entrapped in this cavity, especially when the aperture did not properly develop. After the galls dried, some of the wooden tubes split open (Fig. 13).

Second-Instar Female
Figs. 5a–h

Type-material.—On *Casuarina* sp., 2(1), Australia, 1891, W. M. Maskell Coll. (USNM No. 7308); 5(1) McLaren Flat, S. Australia, 7 Jul. 1965, H. M. Brookes Coll. (WARI No. 24/65).

Additional material.—On *C.* "*quadrivalvis,*" 4(1), Hobart, Tasmania, Rec'd. 15 Nov. 1919 (USNM).

Body (Fig. 5a).—Pyriform, 1218 (1150–1330) long, 1014 (840–1066) wide; derm membranous. Live specimens reddish yellow.

Dorsum.—Large 8-shaped pores and simple disc pores absent. Quinquelocular pores (Fig. 5b) numerous on cephalothoracic and anterior abdominal segments, on abdomen appearing to be arranged in 3 partial segmental bands, each pore 5 (5–6) in diameter. Setae sparse, with 6 (5–7) hairlike setae (Fig. 5c) on margin of posterior abdominal segments, each 35 (28–40) long, and a needlelike pair at apex (Fig. 5d) of abdomen, each 6 (4–8) long.

Venter.—Antennae (Fig. 5e) unsegmented, 11 (10–12) wide at base, with 2 hairlike setae. Maskell (1892), noted 5-segmented antennae, probably by confusing this with first-instars before molting. Clypeolabral shield 225 (207–243) long, 140 (130–153) wide. Labium unsegmented, 73 (66–78) long, 104

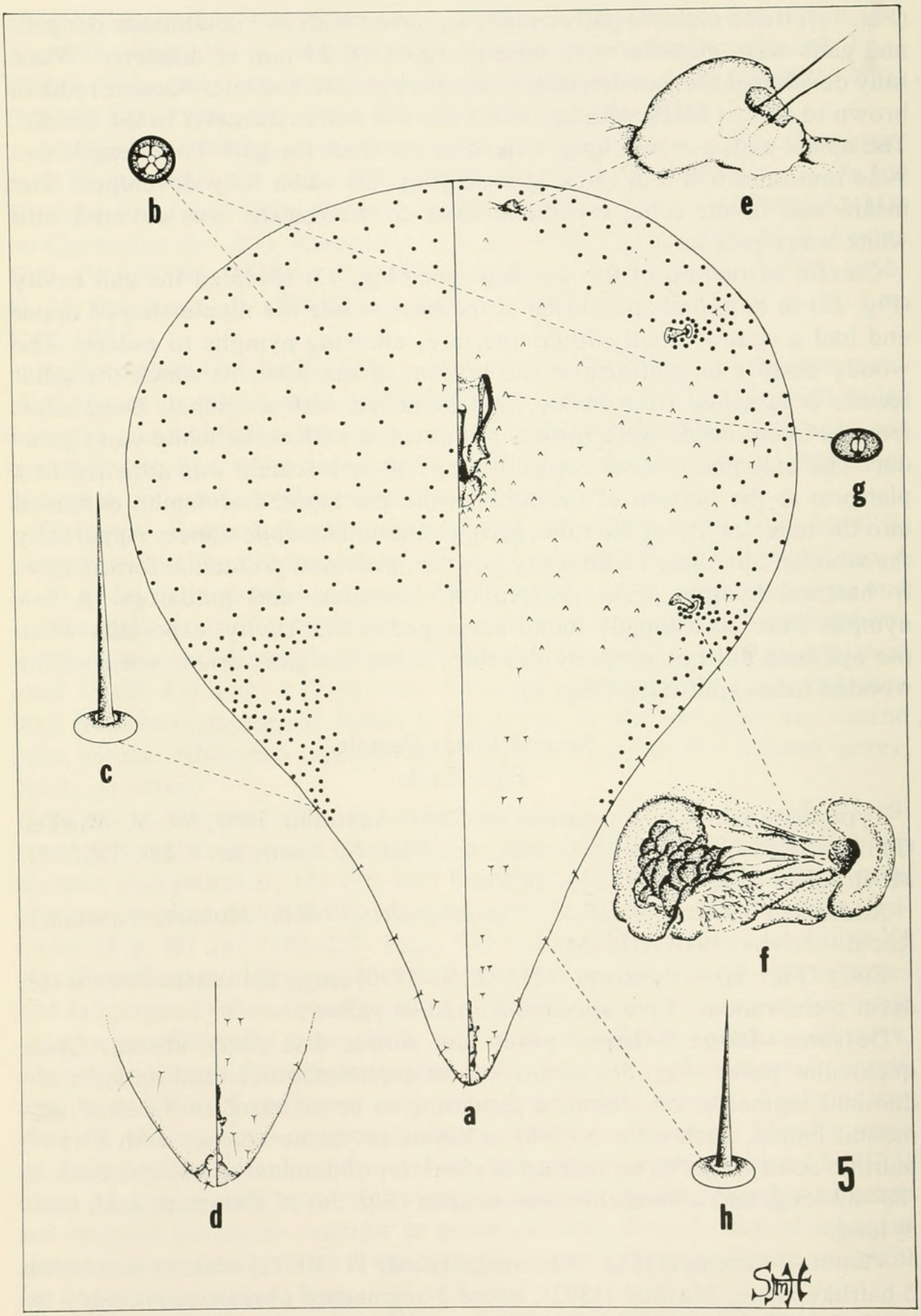

Fig. 5. *F. casuarinae*, second-instar female. a, Dorsoventral view. b, Quinquelocular pore. c, Hairlike seta. d, Anal region. e, Antenna. f, Spiracle. g, Bilocular pore. h, Abdominal seta.

(93–120) wide; with 2 pairs of setae, each 10 (8–11) long. Legs absent. Spiracles (Fig. 5f) ornate, 85 (74–99) long, 86 (78–97) wide, atrial opening 34 (27–38) in diameter. Quinquelocular pores (Fig. 5b) on margin and submargin of cephalothorax and anterior abdominal segments, size same as those on dorsum. Bilocular pores (Fig. 5g) most numerous around mouthparts, extending laterad to spiracular area, each 3 (2–5) in diameter. Needlelike setae (Fig. 5h) in 7 or 8 transverse rows on abdomen; marginal setae 22 (18–29) long, medial and submedial setae 6 (2–11) long.

Note.—Maskell's (1892) second-instar description refers to a first-instar about to molt.

First-Instar Female
Figs. 6a–i

Paralectotypes.—On *Casuarina* sp., 9(4), Australia, 1891, W. M. Maskell Coll. (DSIR).

Additional material.—On *C.* "*quadrivalvis*," 21(1), Hobart, Tasmania, Rec'd 15 Nov. 1909 (USNM); on *Casuarina* sp., 9(1), McLaren Flat, S. Australia, 7 Jul. 1965, H. M. Brookes Coll. (WARI No., 24/65); 9(1) same lot (UT).

Body (Fig. 6a).—Ovoid, 443 (369–609) long, 238 (141–555) wide; derm membranous. Yellow when alive.

Dorsum.—Large 8-shaped pores (Fig. 6b) on each ½ of body in 3 complete longitudinal rows and with 0–4 pores between marginal and submarginal rows on cephalothorax; marginal row with 14 (13–14) pores, submarginal row with 12 pores (found some specimens, possibly males, with 4–5 pores) and submedial row with 11 (10–12) pores; each pore 14 (12–16) long, 8 (8–10) wide. Simple disc pores (Fig. 6c) appearing to be associated with 8-shaped pores, on each half of body in an interrupted submarginal row of 8 (7–9) pores, and a submedial row of 7 (5–10) pores, each 1 in diameter. Simple eyes on margin, 13 (11–14) in diameter. Setae rare, few on margin, most tacklike (Fig. 6d). Anal lobes prominent, each with an apical seta 121 (108–138) long, laterad a pair of tacklike associated setae, each 1 (1–2) long.

Venter.—Antennae 6-segmented, 85 (79–90) long, width at base 19 (13–23). Scape 14 (12–17) long. Segments II to VI: 17 (14–19), 17 (16–19), 11 (10–14), 7 (6–10), 19 (17–23) long, respectively. Segments: I with 1–3 slender setae, II with 2 hairlike setae and a sensory pore, III without setae, IV with a fleshy seta, V without setae, VI with 1 or 2 needlelike, 2 hairlike, and 2 fleshy setae. Maskell (1892) illustrated it with 7-segmented antennae. He probably noted a false division on segment III. Clypeolabral shield 74 (65–91) long, 60 (52–73) wide; Koteja and Liniowska (1976), who compared this structure in the genera of Asterolecaniidae, found it to be rather elongate, pentagonal, with anterior tentorial arms well developed in this species. Labium unsegmented, 41 (36–54) long, 36 (30–48) wide; with 4 pairs of setae,

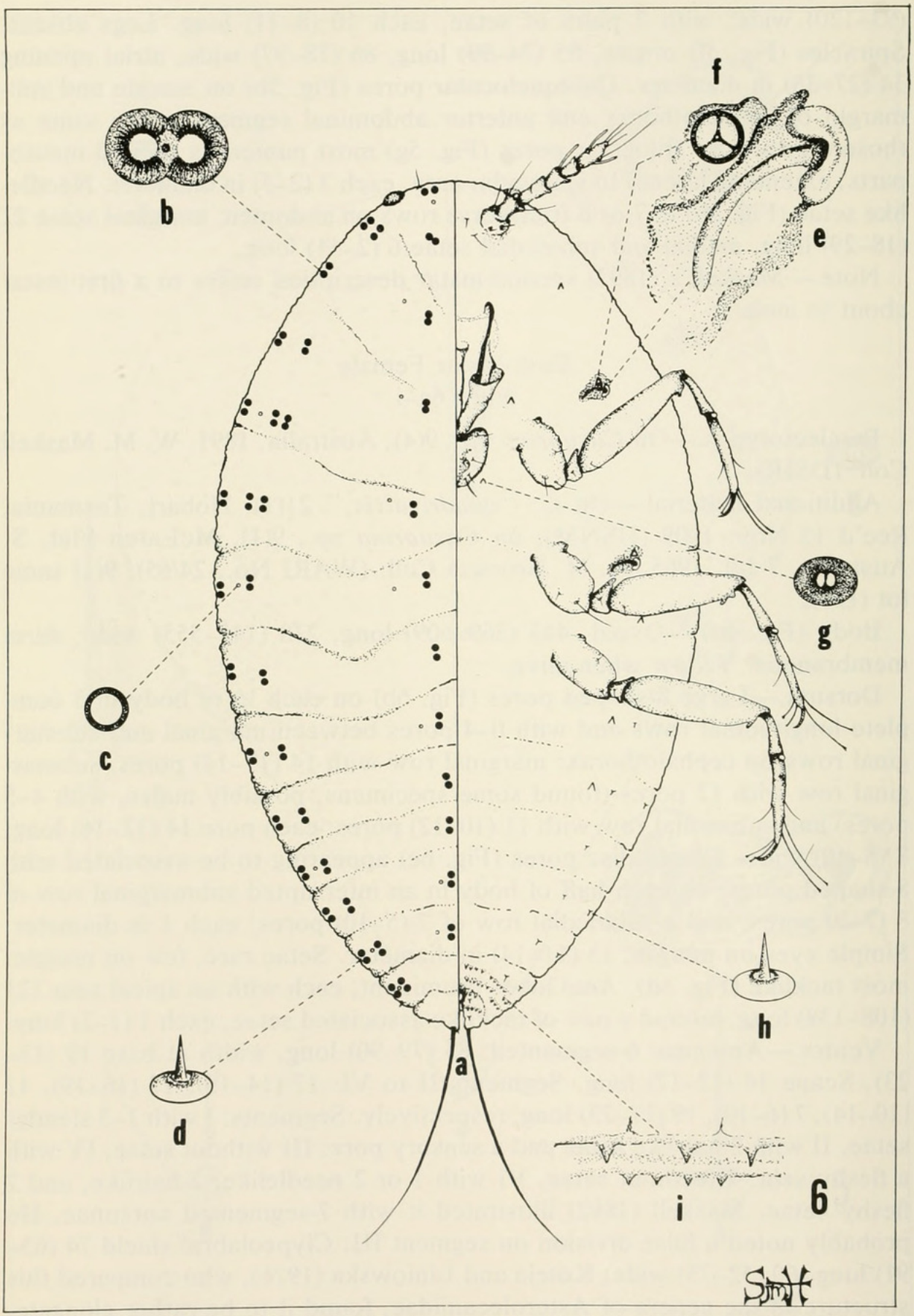

Fig. 6. *F. casuarinae*, first-instar female. a, Dorsoventral view. b, Large 8-shaped pore. c, Simple disc pore. d, Tacklike seta. e, Spiracle. f, Trilocular pore. g, Bilocular pore. h, Tacklike seta. i, Macrospines.

each 11 (6–17) long. Legs well developed, 5-segmented, tarsus with sensillum, tarsal digitules 36 (29–41) long, claw digitules 24 (19–28) long. Claw without denticle. Size of legs as follows:

Part of Leg	Lengths		
	Prothoracic	Mesothoracic	Metathoracic
Coxa	27 (18–36)	31 (20–37)	37 (35–40)
Trochanter	12 (7–14)	10 (8–13)	12 (7–17)
Femur	51 (42–57)	57 (40–67)	63 (53–71)
Tibia	23 (14–35)	23 (20–28)	23 (19–26)
Tarsus	42 (34–44)	52 (43–58)	57 (48–61)
Claw	15 (11–20)	21 (16–23)	22 (20–24)
Entire Leg	171 (151–190)	195 (161–215)	215 (182–231)

Spiracles (Fig. 6e) 14 (11–17) long, 7 (6–8) wide, atrial opening 2 (1–2) in diameter; each with an associated trilocular pore (Fig. 6f) near anterior and posterior spiracle, each 4 (3–5) in diameter. Bilocular pores (Fig. 6g) located in submargin of cephalothorax and anterior 2 abdominal segments and 2 pairs associated with mouthparts, each about 4 long. With 2 pairs of slender setae between antennae and clypeolabral shield; anterior pair 3 (1–4) long, posterior pair 6 (5–7) long; tacklike setae (Fig. 6h) on margin and submargin of abdomen, each 2 (1–2) long. Anal ring absent. Few microspines (Fig. 6i) on posterior abdominal segments.

Note.—Koteja (1974b) found campaniform sensillum on the tarsus of nymphs of this species.

Frenchia semiocculta Maskell, 1895

Adult Female

Figs. 7a–h

Type-material.—From the syntypes an adult female has been designated and marked as LECTOTYPE on 1 slide and 2 adult females on 2 slides as paralectotypes (DSIR). All labeled: *Frenchia semiocculta,* Australia, 1894, W. M. Maskell Coll. From Maskell's (1895) original description and Froggatt's (1933) article we are assuming that it was collected from *Casuarina suberosa* Otto and Dietrich, at Thornleigh near Sydney.

Body (Fig. 7a).—Subcircular with tubular abdominal region, 2078 (915–3240) long, 1860 (900–2820) wide. According to Maskell (1895) the live females are yellowish or with a tinge of red, mated females become dull-red and increase in size, dorsum somewhat convex and venter slightly concave.

Dorsum.—Large 8-shaped pores, quinquelocular pores and simple disc pores absent. Tubular ducts (Fig. 7b) numerous, without terminal filament,

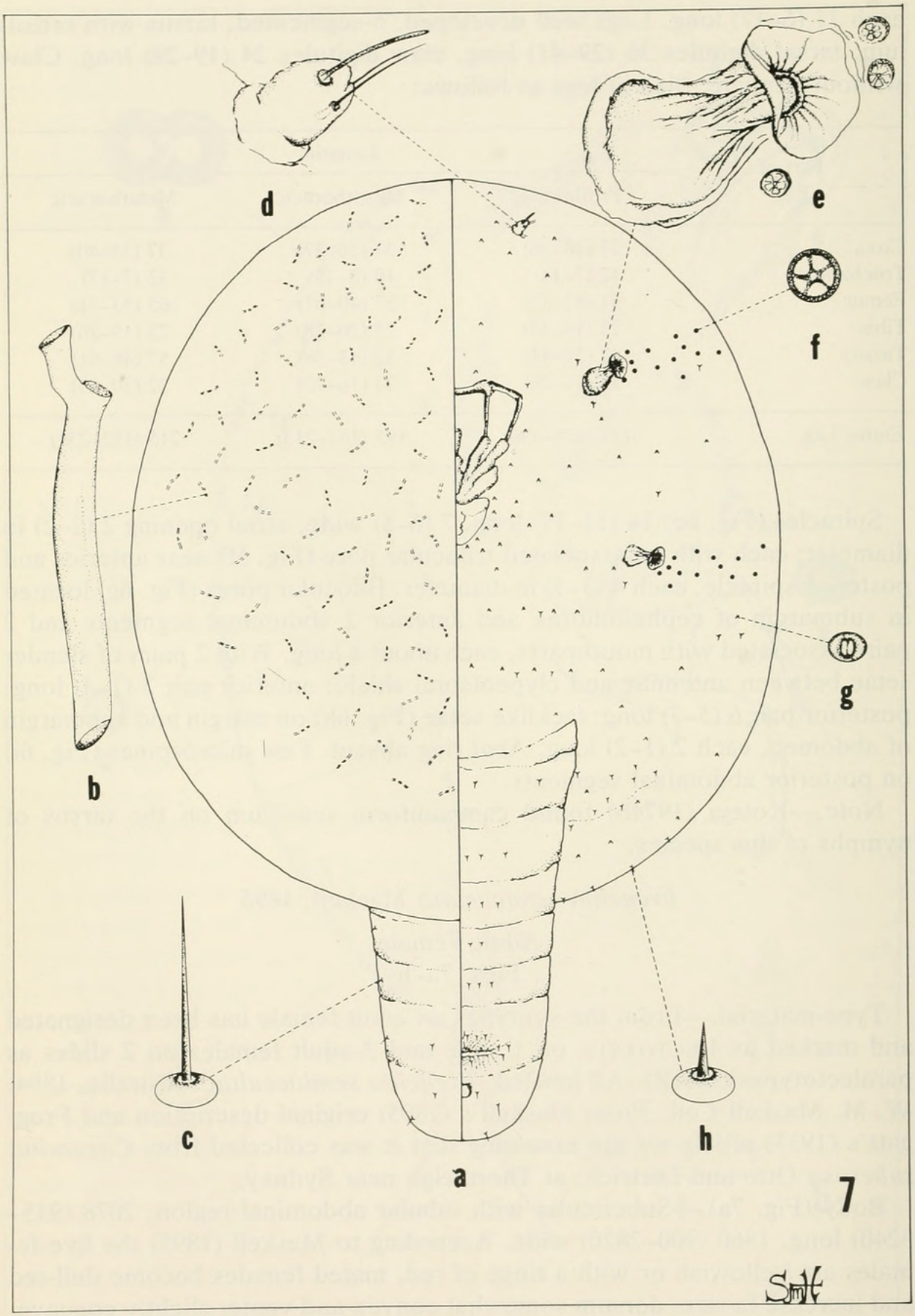

Fig. 7. *F. semiocculta*, adult female. a, Dorsoventral view. b, Tubular duct. c, Needlelike seta. d, Antenna. e, Spiracle. f, Quinquelocular pore. g, Bilocular pore. h, Tacklike seta.

each 34 (30–44) long, 3 (2–5) wide. Setae rare, minute segmental setae (Fig. 7c) located on posterior abdominal segments, each 6 (4–8) long.

Venter.—Antennae (Fig. 7d) unsegmented, with 1 fleshy and 2 slender setae, each antenna 21 (11–36) long, 19 (6–36) wide. Clypeolabral shield 161 (111–255) long, 130 (68–240) wide. Labium unsegmented, 52 (44–63) long, 66 (54–84) wide, apparently without setae. Legs absent. Spiracles (Fig. 7e), anterior pair larger than posterior pair; anterior 107 (94–114) long, 56 (48–64) wide, atrial opening 17 (16–19) in diameter; posterior 83 (76–91) long, 37 (31–46) wide, atrial opening 6 (5–7) in diameter. Associated quinquelocular pores (Fig. 7f) extend from spiracles to margin, 15 (8–26) per spiracular furrow, each pore 6 (5–7) in diameter. Bilocular pores (Fig. 7g) most numerous around mouthparts, each 3 (2–4) long, 2 (1–2) wide. Setae (Fig. 7h) on cephalothorax between spiracles and in segmental rows on abdomen, each 6 (4–8) long, prevulvar setal pair about 12 long. Anal ring with setae absent. Anal opening about 6 in diameter.

Note.—Maskell (1895) reported that the adult female lives under the bark and produces a slight swelling on the bark (Fig. 14). A minute pustule with an orifice was present in the middle of the swelling. Occasionally the tip of the female's abdomen was found to protrude through this orifice, probably releasing sex pheromones for the attraction of males. Froggatt (1933) also reported this species from *Casuarina lehmanniana* Baker at Euston, New South Wales.

Second-Instar Female

We were unable to locate the specimens Morrison and Morrison (1927) used to describe this instar. Their brief description of the second-instar is summarized here.

Body pear shaped, 620 long, 520 wide, with derm entirely membranous. Dorsum apparently without pores, 3 pairs of tacklike setae in the submarginal band of abdomen. Venter with unsegmented platelike antennae, each bearing 2 small setae; clypeolabral shield and labium well developed; legs absent; spiracles slender with associated quinquelocular pores, apparently 5 or 6 pores each at anterior and 2 each at posterior spiracles (no other type of pores observed by the Morrisons); few small setae on derm, most on abdomen, and a pair of large apical setae; anal ring close to caudal end of body, simple and incomplete.

First-Instar Female

Figs. 8a–i

Type-material.—On *Casuarina* sp., 32(4), Australia, 1894, W.M. Maskell Coll. (DSIR); 10(1) same lot (VPI); 8(1) same lot (UT).

Body (Fig. 8a).—Ovoid, 346 (331–366) long, 221 (216–225) wide; derm membranous.

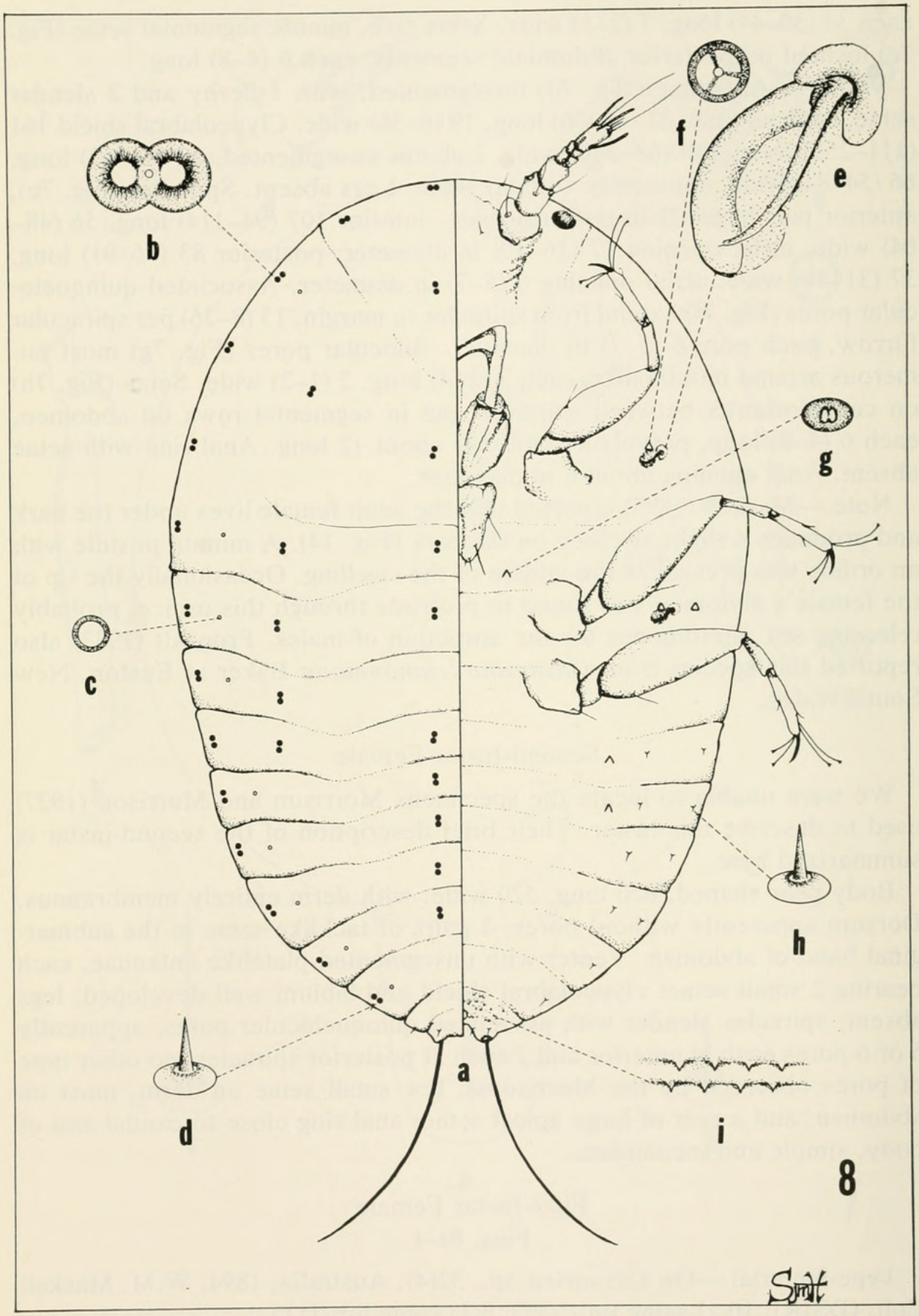

Fig. 8. *F. semiocculta*, first-instar female. a, Dorsoventral view. b, Large 8-shaped pore. c, Simple disc pore. d, Tacklike seta. e, Spiracle. f, Trilocular pore. g, Bilocular pore. h, Tacklike seta. i, Microspines.

Dorsum.—Large 8-shaped pores (Fig. 8b) on each half of body in 3 longitudinal rows (4 complete and 2 incomplete); marginal row with 14 pores, submarginal row with 5 pores, and submedial row with 9 (9–11) pores; pore distribution as illustrated; each pore 8 (6–10) long, 5 (4–5) wide. Simple disc pores (Fig. 8c) in submarginal row consisting of about 9 pores, each 2 in diameter. Setae rare, few tacklike (Fig. 8d) on posterior abdominal segments, each 2 long. Anal lobes prominent, each with an apical seta 82 (75–87) long, and a tacklike seta.

Venter.—Antennae 6-segmented, width of base 20 (17–24). Scape 13 (12–17) long. Segments II to VI: 16 (14–17), 10 (8–12), 6 (6–7), 6 (5–7), 16 (14–18) long. Segments: I with 1 hairlike seta, II with 2 hairlike setae and a sensory pore, III without setae, IV with a fleshy seta, V without setae, VI with 2 needlelike, 2 hairlike and 3 fleshy setae. Simple eyes elliptical, laterad of antennal base. Clypeolabral shield 61 (58–72) long, 49 (46–53) wide. Labium unsegmented, 40 (37–42) long, 33 (31–35) wide; with 5 pairs of setae, each 9 (2–17) long. Legs well developed, 5-segmented, with sensory pore on tarsus, tarsal digitules 31 (29–32) long, claw digitule 19 (16–23) long, claw without denticle. Size of leg segments as follows:

Part of Leg	Lengths		
	Prothoracic	Mesothoracic	Metathoracic
Coxa	32 (25–38)	35 (34–36)	28 (25–31)
Trochanter	11 (8–17)	9 (7–10)	12 (7–13)
Femur	44 (42–50)	48 (46–54)	48 (40–55)
Tibia	13 (8–14)	16 (14–18)	15 (12–17)
Tarsus	32 (24–36)	40 (38–41)	42 (40–46)
Claw	14 (12–16)	13 (12–13)	13 (10–16)
Entire Leg	146 (120–172)	161 (151–172)	156 (133–178)

Spiracles (Fig. 8e) on submargin, each 14 (12–16) long, 8 (4–8) wide, atrial opening 2 (1–4) in diameter; with 1 (rarely 2) trilocular pores (Fig. 8f) associated with anterior spiracle and 2 with posterior spiracle, each 4 (4–5) in diameter. One pair of bilocular pores (Fig. 8g) near labium and 2 pairs on abdomen, each 2 (2–3) in diameter.

Small tacklike setae (Fig. 8h) in segmental rows on abdomen, and 1 submedial pair between antennal bases, each 4 (4–5) long; 2 slender setae on each anal lobe, 2 long; apical anal lobe setae, each 51 (46–56) long; anal ring and setae absent; microspines (Fig. 8i) present on terminal abdominal segments.

Note.—Two of the syntype slides included one male and its test. Both in too poor condition for study.

On dry twigs of the type material, the male galls were reddish dark-brown,

broad conical, diameter about 2 mm at base, 1 mm at top, about 1 ½ mm high with a wide thick-rimmed opening on top (Fig. 15). Galls produced by males resembled those of *Apiomorpha* males, while the swelling produced by females resembled those made by females of *Asterolecanium*.

Economic Importance of *Frenchia*

The known hosts of *Frenchia* species are in the genus *Banksia*, which belongs to the family Proteaceae, and the genus *Casuarina* (Beefwood, Australian Pine), which belongs to the Casuarinaceae. Both genera are restricted to the Australian Region.

The woody gall formations of *Frenchia casuarinae* on *Casuarina* trees (Fig. 11) subject the limbs to breakage, especially during high winds, in addition to making them less desirable for use by farmers or industry. The galls of *F. banksiae* on *Banksia serrata* produce severe deformations and discolorations on leaves (Figs. 9, 10), and may occasionally cause premature leaf drop. *F. semiocculta* adult females occupy a pit in a swelling on the bark of twigs on *C. lehmanniana* and *C. suberosa* (Fig. 14). Males produce a more distinctive conical gall (Fig. 15). Further information on the tree hosts of *Frenchia* spp. is given by Uphof (1968) as follows: *Banksia serrata* L.—"Wattung-Urree," or Redwood Banksia. The wood of this Australian tree is used for furniture, window frames, and boat and ship building; *Casuarina equisetifolia* L.—Swamp or Bull Oak, Horsetail Beefwood, is a tree widely distributed in Australia. Its wood is used for fencing, gates, and shingles; *C. stricta* Ait. (= *quadrivalvis*).—Shingle or River Oak, Coast Beefwood. In Australia, the wood is used for furniture, shingles, axe-handles, etc.; *C. suberosa* Otto and Dietr.—Swamp or River Black Oak, Erect Beefwood, is a common tree in Australia, especially New South Wales, Queensland and Tasmania. The bark sometimes is used for tanning.

Acknowledgments

We express our appreciation to James O. Howell, University of Georgia, for his review of this manuscript. Appreciation is also extended to Helen

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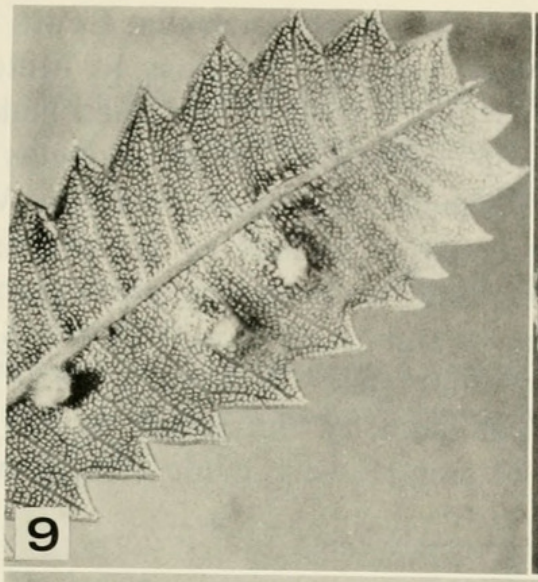
Figs. 9–15. Galls and damage of *Frenchia* spp. 9. Galls on leaf of *Banksia serrata* L. produced by *F. banksiae*. 10. Heavy infestation of *F. banksiae* causing severe deformations of leaves. 11. Galls on branch of *Casuarina equisetifolia* L. produced by *F. casuarinae*. 12. Cross-section of gall cavity of *F. casuarinae* after the removal of the wooden tube and adult female. 13. Old, split wooden tube, removed from gall cavity of *C. equisetifolia*. The removed adult female occupied the base of wooden tube. 14. Bark swelling with pits produced by females of *F. semiocculta* Maskell on *Casuarina* sp. 15. Conical galls with large openings on top produced by males of *F. semiocculta* on *Casuarina* sp. twig.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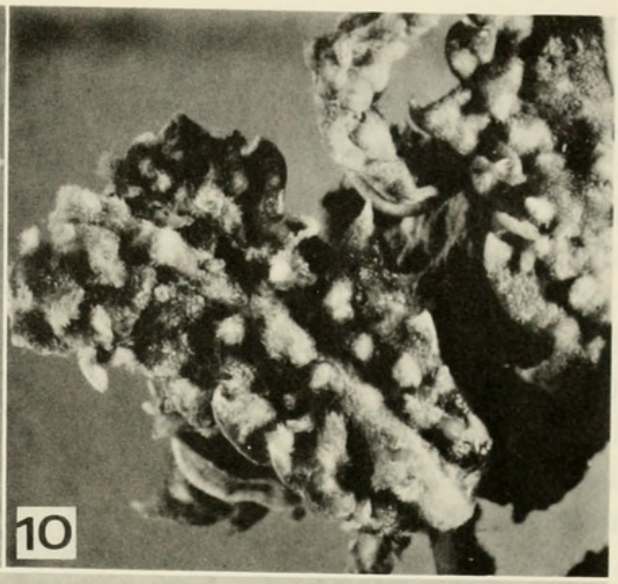
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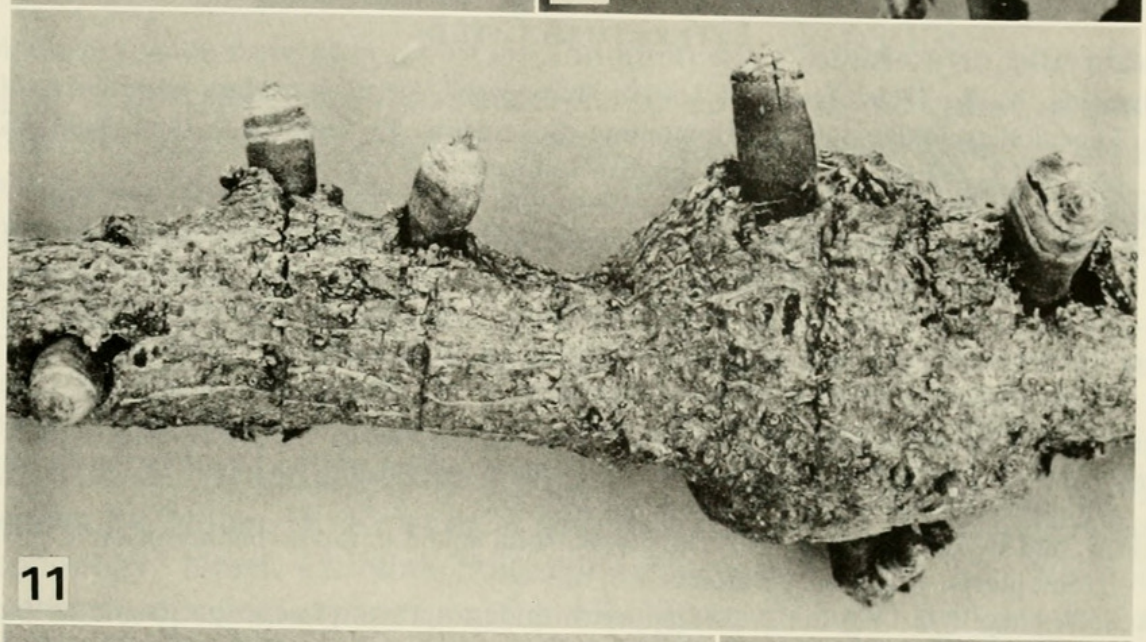
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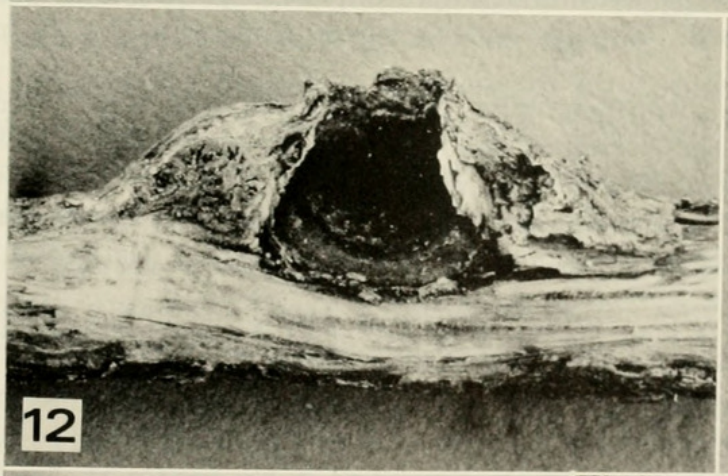
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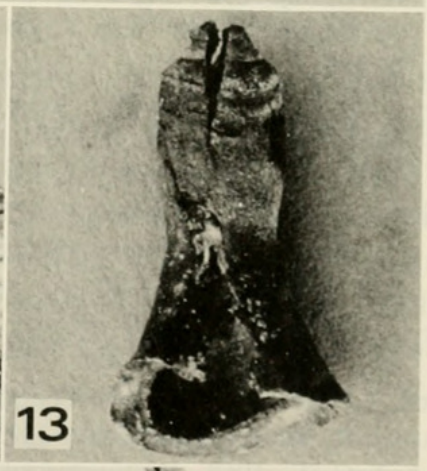
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