

THE GYROPHORACEAE OF CALIFORNIA.

By ALBERT W. C. T. HERRE.

The Gyrophoraceae, an extremely natural group of lichens, include three genera, two of which, Gyrophora and Umbilicaria, are represented in the western part of North America. The family is essentially boreal and alpine.

Seventeen species and five subspecies are reported from North America under the name of Umbilicaria by Tuckerman, in his Synopsis of North American Lichens.^a Of the entire twenty-two forms he reports but six from California, two species and one subspecies being reported only from Californian or Pacific coast localities.

I am not informed how many species belonging to this family are now known to occur in North America, but the number is probably about twenty-five. According to the observations of Doctor Hasse and myself, ten species are now certainly known from California, while there are three more represented on the Pacific slope in the collections I have examined.

When one considers the great diversity of Californian topography and the consequent climatic diversity, this is a comparatively poor showing. Of course the Umbilicarias characteristic of the Southern Appalachians (*caroliniana*, *pennsylvanica*, etc.), can hardly be expected here. But we may confidently look for the occurrence in California of nearly all the alpine or arctic Gyrophoras reported from other parts of North America, when the higher peaks of the Sierras have been more carefully explored. Accordingly I have included in this paper all the members of this family now known to occur in the western third of the continent.

Several representatives of this group are very striking in appearance, attracting the attention of the general botanist and of the trapper or mountaineer as well as that of the specialist, while their adaptations to great extremes of heat and cold render them of considerable interest to the plant physiologist. While they are of no economic importance in this country, *Gyrophora esculenta* Miyoshi, a Japanese species, is prepared for human food, and in the Arctic regions

^a Part 1, 1882.

several species, grouped under the general name of *tripe de roche*, have often been the means of saving the lives of explorers and *voyageurs*. The more important of these are *Gyrophora proboscidea*, *G. muhlenbergii*, and *G. vellea*. Like all lichens, however, they contain a bitter principle which may be partially removed by boiling and soaking with alkalies, but even so, if eaten to any great extent they cause serious intestinal disorders.

It is hoped that the present paper will stimulate interest in this remarkable group. In its preparation I have had the use of the collections in the U. S. National Museum, and have also examined several other collections abroad and in this country. The major part of it, however, is based on the Bolander collection now in my possession, the extensive collections of Dr. H. E. Hasse, and the material collected in various parts of Europe and Western America by myself.

GYROPHORACEAE.

The thallus is foliaceous, one to many-leaved, attached by a central umbilicus. The underside may be naked and smooth or granular, or it may be more or less fibrillose or hirsute. An upper and an under cortex are present. The alga is Pleurococcus. The whole development is markedly xerophytic.

The apothecia are usually scattered over the upper surface, though in a few species they are mostly marginal. They may be innate, sessile, or somewhat elevated, or finally may be more or less proliferous. The proper margin is usually black, rarely inclosing a few gonidia beneath. The disk is seldom smooth, but is generally gyrose-plicate. The hypothecium is brownish to black. The asci have from 1 to 8 spores, these colorless or dark, simple, septate, or muriform-multilocular.

About 45 species are at present known in the three genera included in this family.

KEY TO THE CALIFORNIA GENERA.

- Spores simple, small, 8 in number..... 1. GYROPHORA.
 Spores muriform-multilocular, 1 or 2..... 2. UMBILICARIA.

1. GYROPHORA Ach.

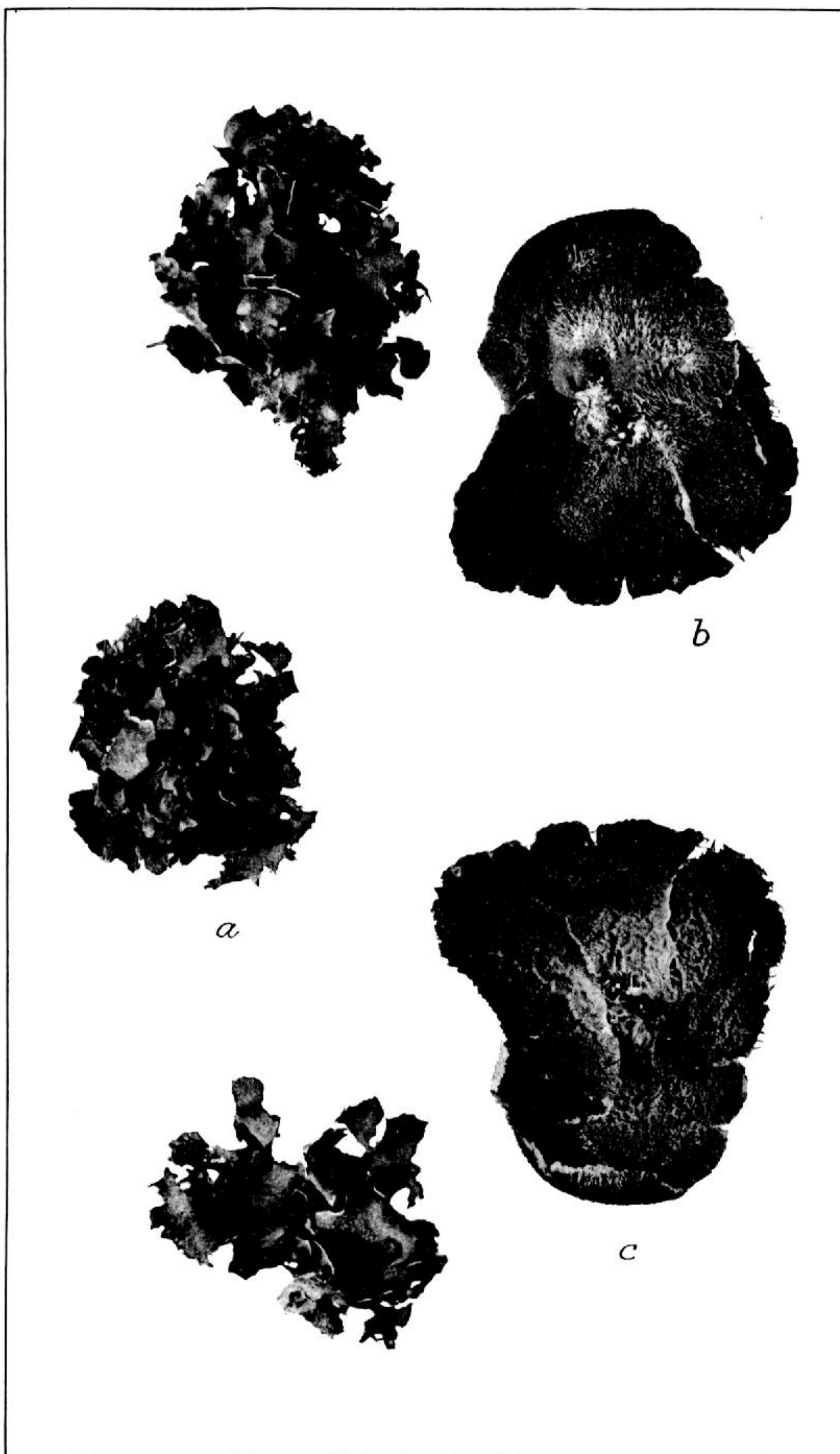
Gyrophora Ach. Meth. Lich. 100. 1803.

Characters mostly as above. Asci with 8 spores, these colorless or becoming brown with age, simple (plurilocular in a Peruvian species), ellipsoid or oblong, thin-walled, without gelatinous halo; hypothecium brownish to black.

The first species given by Acharius is *Gyrophora glabra*, first recognized by him as *Lichen glaber*.^a But earlier and later authors alike refuse to recognize this as a valid species. Acharius gave *polyphylla* as a variety of *glabra*, but all later authors of importance have reversed this and reckon *glabra* as a variety of *polyphylla*. One might, therefore, be justified in calling *polyphylla* the type, but this is open to the objection that this species does not represent the genus as satisfactorily as some other species. The first Linnæan species is *Lichen velleus*.^b Some would therefore claim *Gyrophora velleus* as the type of the genus, and it is as well entitled to such distinction as is *glabra*.

^a Ach. Vet. Akad. Nya. Handl. 15: 95. pl. 2. f. 5. 1794, following Westr. op. cit. 14: 48. 1793.

^b L. Sp. Pl. 1150. 1753, following Dill. Hist. Musc. pl. 82. f. 5. 1741.



GYROPHORA POLYPHYLLA (L.) BORR. & TURN. AND G. RUGIFERA (NYL.) TH. FRIES.

KEY TO THE SPECIES.

- Polyphyllous (as to American species) and always sterile (within our territory so far as known).
 Thallus smooth, black, often polished; lobes often narrowed, with spatulate tips..... 1. *G. polyphylla*.
 Upper surface more or less covered by a sooty or chaffy scurf. 2. *G. flocculosa*.
 Plants usually one-leaved (seldom many-leaved) and more or less freely fruiting.
 Apothecia simple, often elevated, not gyrose-plicate; upper surface more or less ridged and reticulate.
 Ridges hoary with hard, white granules; under side of plant smooth, more or less pruinose..... 3. *G. reticulata*.
 Ridges coarse, without white granules; plant thickly clad with long hairs beneath, or rarely these few or reduced to mere papillæ..... 4. *G. rugifera*.
 Apothecia more or less gyrose-plicate.
 Thallus pale, from whitish to mouse color.
 Under surface densely black-hirsute; thallus large to very large, ashy white, gray, or mouse color.. 5. *G. vellea*.
 Under surface not black-hirsute.
 Thallus small, ashy gray or mouse color; beneath grayish or blackish, naked or very rarely with fibrils..... 6. *G. grisea*.
 Thallus dirty gray or blackish gray; beneath smooth, naked, buff to dusky brown..... 7. *G. arctica*.
 Thallus light brown to chocolate and blackish.
 Under surface more or less densely fibrillose.
 Fibrils mostly paler than the lacerate under surface; apothecia angulate and stellate, but little convex..... 8. *G. angulata*.
 Fibrils black; under surface not lacerate; apothecia becoming very large, prominent, dome-like..... 9. *G. polyrrhiza*.
 Under surface not fibrillose.
 Upper surface irregularly papulose-wrinkled; under side smooth, often slightly pitted.. 10. *G. hyperborea*.
 Upper surface not papulose.
 Upper surface covered by intricate, black, indented lines resembling sutures; under surface radiately ridged..... 11. *G. erosa*.
 Upper surface without special characters; under surface smooth, granulose..... 12. *G. phaea*.

1. *Gyrophora polyphylla* (L.) Borr. & Turn. Lich. Brit. 214. 1839. PLATE 68, a.
Lichen polyphyllus L. Sp. Pl. 1150. 1753.

Umbilicaria polyphylla Tuck. Syn. N. Amer. Lich. 1: 85. 1882.

Thallus small to medium size, many-leaved, crinkled, cespitose, the surface smooth, often polished, irregularly much lobed and dissected, the erectish lobules often slender with dilated and rounded tips; margin crenate, dentate, unevenly cut, or erose, sometimes minutely and excessively dissected and crisped; color black or very dark brown; under surface naked, finely granulate, dull black.

Sterile with us and very rare in fruit anywhere; I have never seen specimens with apothecia.

Abundant in the Santa Cruz Peninsula at Devil's Cañon and on Mount San Bruno. Collected also by Doctor Hasse in the Tehachepi Range. I have also examined specimens from Vancouver Island, collected by Macoun. There can be no doubt that this lichen occurs in many localities on the Pacific side of the Sierras.

EXPLANATION OF PLATE 68.—*a*, Three plants of *Gyrophora polyphylla*, showing upper surface, material from the Santa Cruz Peninsula; *b*, under surface, and *c*, upper surface of *G. rugifera*, both from specimen collected by Bolander. All scale 2.

2. *Gyrophora flocculosa* Borr. & Turn. Lich. Brit. 217. 1839.

Lichen deustus (?) L. Sp. Pl. ed. 2. 1618. 1763.

Lichen flocculosus Wulf. in Jacq. Coll. 3: 99 and pl. 1. f. 2. 1789.

Umbilicaria flocculosa Tuck. Syn. N. Amer. Lich. 1: 85. 1882.

Thallus small to medium sized, thin, papery, one-leaved or more or less several-leaved, smooth, slightly pustulate or now wrinkled. Color dull blackish brown, more or less covered with a blackish, chaffy, or sooty scurf; beneath naked, smooth, almost or quite concolorous, and more or less pitted or lacunose.

Very rare in fruit; I have never collected any fertile specimens nor have I seen any in the herbaria examined.

Here described from material collected by Macoun at Robson on the Columbia River, British Columbia, and compared with specimens from Sweden and a large series collected by me in the Austrian Alps. No doubt this lichen will be found in the higher mountains of northern California, Oregon, and Washington.

A careful reading of Linnæus's description above cited reveals no character by which the plant he called *deustus* could be recognized; in the absence of further information at this time the name *flocculosa* must be used, though it is probable that an examination of herbarium material would show that *deustus* is entitled to precedence.

3. *Gyrophora reticulata* (Schaer.) Th. Fr. Lich. Scand. 1: 166. 1871. PLATE 69.

Gyrophora polymorpha reticulata Schaer. Naturw. Anz. Schw. Ges. 1: 7. 1818.

Umbilicaria anthracina reticulata Tuck. Syn. N. Amer. Lich. 1: 84. 1882.

Thallus small to medium sized, one-leaved; lobes few, with crenate, finally irregular margin; upper surface finely rimose and areolate, gray brown to blackish brown, covered with radiate folds and ridges which become reticulate, the ridges, particularly at the center, and sometimes the surface between them, hoary with hard white granules; under surface smooth, without fibrils, clear pale brown to dark brown, more or less pruinose, especially toward the margin; apothecia numerous, small to medium, elevated, circular, with a thick persistent margin, simple (in one specimen also occurring more or less plicate); spores ellipsoid to ovoid, simple, colorless, $\frac{6-8}{11-13} \mu$.

Here described from specimens in the U. S. National Herbarium (Willey Herbarium) collected in Oregon by Cusick and in Colorado by the Hayden Survey and by T. S. Brandegee. This species is very common on the rocks about Reno, Nevada, a few miles from the California State line, at an altitude of 1,440 meters and upward. It is common in the Sierra Nevada Mountains about the Truckee River, and is exceedingly abundant on Mount Rose in Nevada, which is the highest peak of the Sierras in the Lake Tahoe district. Here at an altitude of 2,600 meters and on to the summit at 3,600 meters it is the dominant lichen.

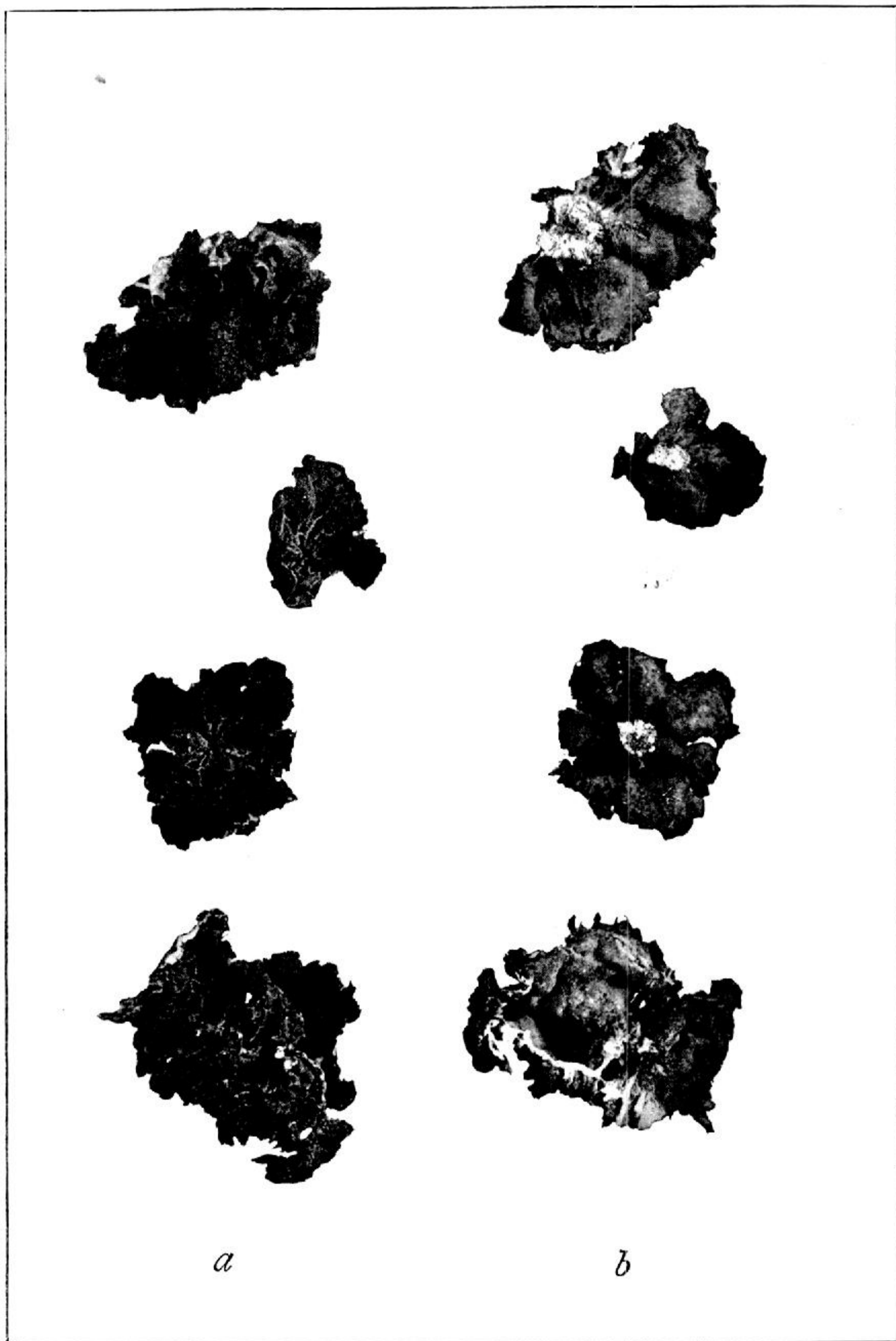
This material from the eastern Sierras is generally much darker in color than that above described, sometimes becoming black.

EXPLANATION OF PLATE 69.—*a*, Upper surface of thallus; *b*, lower surface. Specimens from Reno, Nevada. Scale 2.

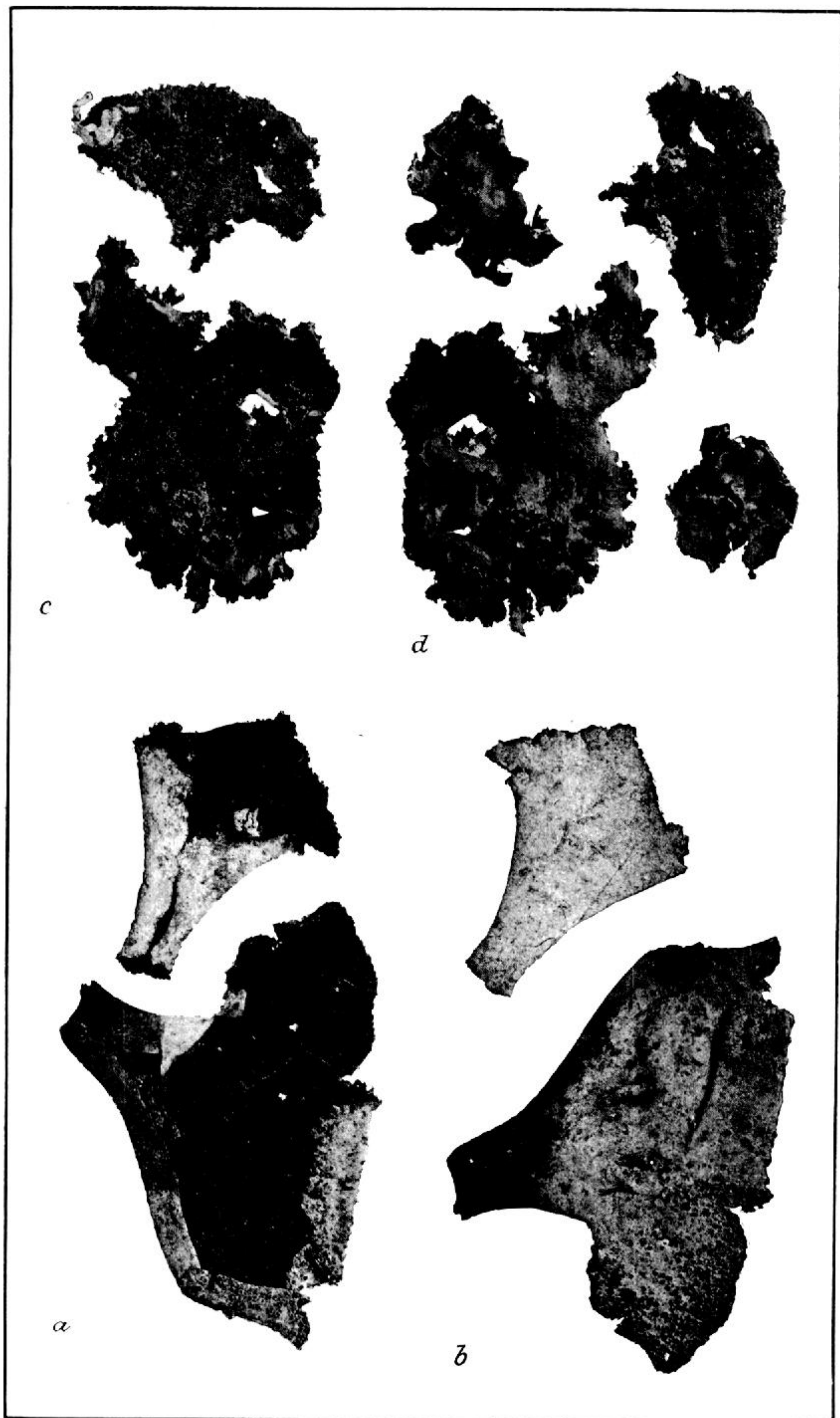
4. *Gyrophora rugifera* (Nyl.) Th. Fries, Lich. Scand. 1: 156. 1871. PLATE 68, *b*, *c*.

Umbilicaria rugifera Nyl. Lich. Scand. 117. 1860.

Thallus varying from medium-sized to rather small (rarely large), one-leaved to complicate-lobed, leathery, rigid, the margin more or less crenate; surface usually



GYROPHORA RETICULATA (SCHAER.) TH. FRIES.



GYROPHORA VELLEA (L.) ACH. AND G. POLYRHIZA KOERB.

more or less roughened and reticulate by coarse, often very high, ridges, rarely papulose with the ridges little evident; color varying from a pale ashen and ashy brown to olive brown or almost blackening above, beneath quite variable, usually a pale pink or roseate, but also buff, ashy brown, and blackening; under surface sometimes smooth with almost no hairs, those present reduced to mere papillæ, but more usually clothed with long simple hairs, these sometimes so numerous as entirely to conceal the surface, and either colorless or varying from pale pink or rose color to blackish; apothecia small to more than medium sized, usually numerous when present, at first adnate but finally prominent or elevated, simple, orbicular, with a narrow entire and finally flexuous margin; asci clavate to ventricose; spores rare, colorless in my specimens, ellipsoid in all Californian specimens, $\frac{4.5-9}{7-15} \mu$; according to Tuckerman the spores also fuscous; spermatia oblong, 3.5 to 5 μ long.

A plant of alpine peaks and arctic regions, probably occurring all over the western half of the continent; I have examined Californian specimens collected by Bolander and Lapham (no specific locality), and by Doctor Hasse from Mount San Bernardino at an altitude of 3,600 meters, Mount San Antonio at 3,000 meters, and the Tehachapi Mountains at an elevation of 2,500 meters. I have also collected this lichen about Reno, Nevada, at an altitude of 1,600 meters. It is abundant and finely developed, though rarely fruiting, on the summit of Mount Rose above 3,300 meters. It also occurs rather sparingly in the Sierra Nevada Mountains along the Truckee River at an altitude of 2,000 meters. Additional specimens were examined from the U. S. National Herbarium, collected in Colorado, Wyoming, Oregon, Labrador, New Mexico (?), and St. George Island, Bering Sea.

The plant probably occurs on all mountains in the West which rise to a height of 2,000 meters or more.

EXPLANATION OF PLATE 68.—See page 316.

5. *Gyrophora vellea* (L.) Ach. Meth. Lich. 109. 1803.

PLATE 70, a, b.

Lichen velleus L. Sp. Pl. ed. 2. 1617. 1763.

Umbilicaria vellea Tuck. Syn. N. Amer. Lich. 1: 87. 1882.

Thallus large to very large, one-leaved, thick, leathery, rigid, the upper surface usually smooth and entire, but sometimes becoming roughened and chinky, varying in color from pale ashy cream to darker, mouse color, yellowish, and brownish, also more or less white or bluish pruinose; under surface black, usually very hirsute, the short fibrils mostly intensely black, sometimes brown, sometimes with naked spots, these when present usually granular; apothecia mostly small to minute, usually near the margin, appressed, plicate, orbicular, more rarely becoming convex and prominent; fertile specimens infrequent. Spores colorless, rounded or short-ellipsoid, $\frac{6-8}{8-15} \mu$.

This lichen has not yet been collected in California, but may be expected in all the Western States. I have examined specimens from the National Herbarium collected in British Columbia, at Columbia Falls, Montana, in Yellowstone Park, and in Colorado. Recorded by Tuckerman from the "North West Coast, Douglas," which I interpret as being somewhere between the region of the mouth of the Columbia and Vancouver Island.

EXPLANATION OF PLATE 70.—a, Under surface, and b, upper surface of *Gyrophora vellea*, same specimen; c, under surface, and d, upper surface of *G. polyrhiza*. a, b, From specimen collected by C. F. Baker, in the foothills of the Rocky Mountains, Fort Collins, Colorado, April 5, 1896; c, d, from material collected at Devils Cañon. All natural size.

6. *Gyrophora grisea* Borr. & Turn. Lich. Brit. 236. 1839.

Lichen griseus Swartz; Westr. Vet. Akad. Handl. 52. 1793.

Umbilicaria hirsuta grisea Tuck. Syn. N. Amer. Lich. 1: 87. 1882.

Gyrophora hirsuta grisea Hasse, The Bryologist 11: 56. 1908.

Thallus small, one-leaved, somewhat lobed and crenate, minutely areolate-papillate, ashy gray or mouse colored; under surface finely granulose, scabrous, naked or very sparingly fibrillose, grayish or blackish; apothecia at length convex, immarginate, plicate; spores ellipsoid, colorless, $\frac{8-10}{14-18} \mu$.

The above description is compiled, as I have been unable to obtain authentic specimens. Sterile specimens collected in Alpine County, California, by I. A. Lapham, were placed under this species (as a variety of *hirsuta*) by Tuckerman. This species has also been reported by Doctor Hasse from the Tehachepi Mountains, and by Parish from Slover Mountain.

7. *Gyrophora arctica* Ach. Meth. Lich. 106. pl. 2. f. 6. 1803.

Umbilicaria proboscidea arctica Tuck. Syn. N. Amer. Lich. 1: 84. 1882.

Thallus from medium size to rather large, one-leaved, thick and rigid, the irregularly crenate and lacerate margin often reflexed; surface varying from granular and nearly smooth to exceedingly rough, pitted and corrugated; color of upper surface in my specimen a dull dirty gray or blackish gray, but in other specimens sometimes a brownish or blackish brown; under surface smooth (in some specimens minutely granular), naked, pale, varying from buff or flesh color and yellowish to dusky brown, and sometimes slightly pruinose; apothecia small, orbicular or sometimes elliptical, exceedingly numerous in my specimen, the thin entire margin soon disappearing and the fruit from flat becoming finally convex and plicate; paraphyses numerous and slender; thecium blue with iodine; spores colorless, often with a slight halo, $\frac{5.75-7.5}{11-15} \mu$.

Here described from the only Californian specimen seen, which was collected by Bolander somewhere in the Sierra Nevada Mountains, probably near Yosemite. Specimens were also examined from Greenland, Labrador, and Vancouver Island. This plant should be looked for on all high peaks from Mount Whitney northward. The Vancouver specimens were collected at an altitude of only 1,000 meters but it probably occurs in California only above 2,500 meters.

8. *Gyrophora angulata* (Tuck.) Herre.

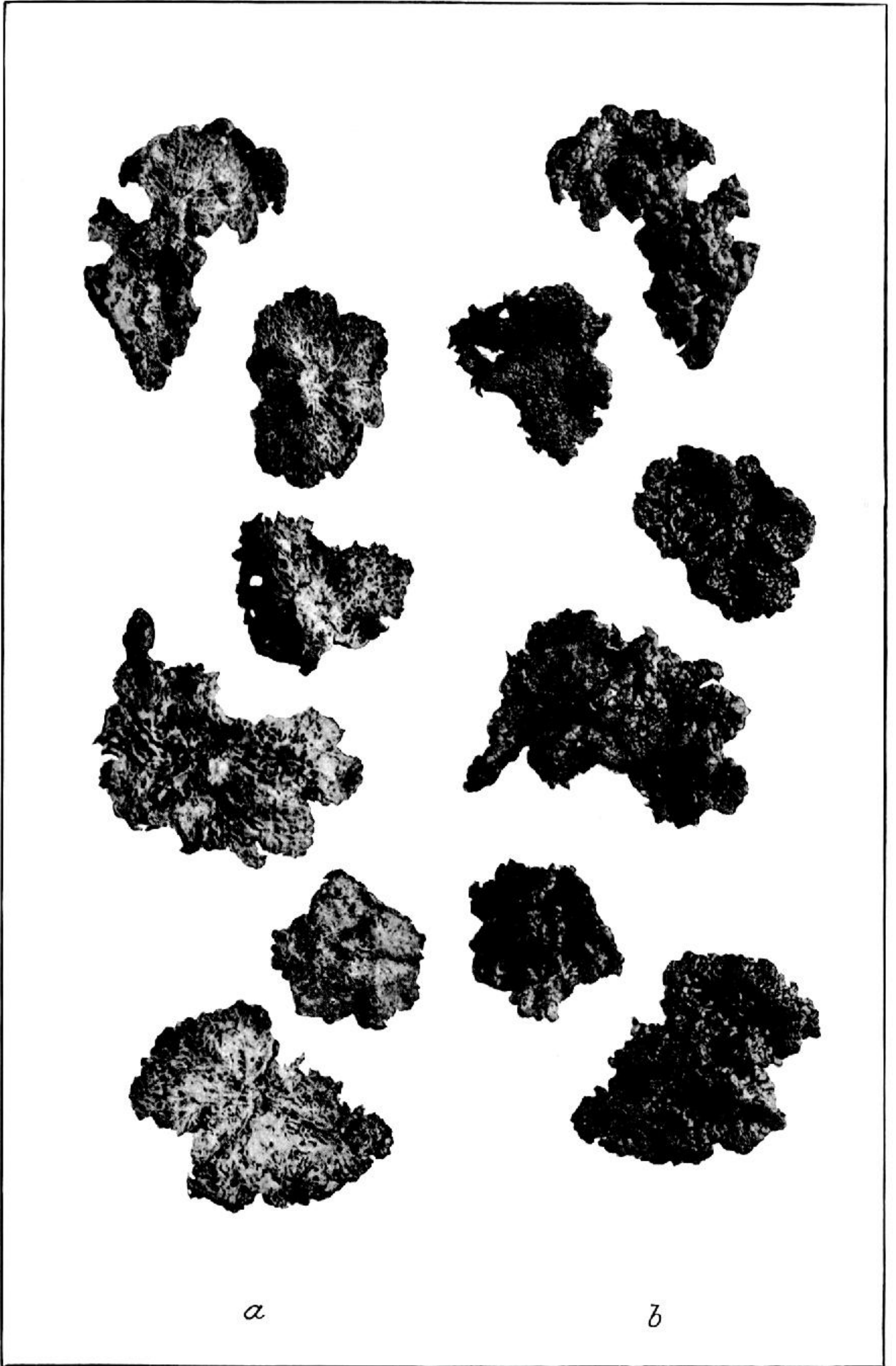
Umbilicaria angulata Tuck. Proc. Amer. Acad. 1: 266. 1847.

Thallus small to medium-sized or occasionally rather large, one-leaved, rigid, the surface usually smooth and somewhat polished, but in some specimens the peripheral portion thickly sprinkled with tiny black lumps; color above ashy brown to tawny and very dark brown, or sometimes a purple brown; under surface black, granulate, lacerate at the center, and finally more or less densely clothed with fibrils, these mostly paler than the surface to which they are attached; apothecia at first small and innate, appressed, angulate and stellate, at length convex and variously shaped, with a thick, persistent margin; paraphyses short, slender, but mostly confluent and degenerate; asci variously shaped, the contents more often not differentiated; thecium greenish and bluish, then wine red or tawny with iodine; spores ellipsoid, colorless, $\frac{5.75-11}{12-23} \mu$.

Tuckerman says "fronds (not) surpassing 2 inches in diameter," but a specimen in the National Museum collected by Bolander at Bear Valley has a diameter of $3\frac{1}{2}$ inches. However, it rarely reaches more than half that size.

Specimens have been examined as follows: "California," *Menzies*; Bear Valley, Mariposa County, *Bolander*; Siskiyou County, *C. F. Baker*; Mount San Jacinto, *Dr. H. E. Hasse*; Oregon, from the Willey Herbarium; Vancouver Island, *Macoun*.

Reported by Tuckerman as having been collected by *Menzies* on maritime rocks at Monterey, but a careful search by me has failed to disclose it anywhere in that region. Collected by Doctor Hasse in the Tehachepi Range and in the mountains about Santa Monica. The plant probably occurs throughout the Sierra Nevada Range and northward to British Columbia. At Devils Cañon, in the Santa Cruz Peninsula, I have found what seems to be a sterile form of *angulata*; otherwise it has not been met with in that part of the State.



GYROPHORA HYPERBOREA (HOFFM.) ACH.

9. Gyrophora polyrhiza Koerb. Par. Lich. 41. 1859.

PLATE 70, c. d.

Lichen polyrhizos L. Sp. Pl. ed. 2. 1151. 1763.*Gyrophora diabolica* A. Zahlbr.; Herre, Proc. Washington Acad. Sci. 7: 366. 1906.

Thallus small to medium, from one-leaved becoming many leaved and complicate; more or less orbicular, the edges torn or irregular; coriaceous, rigid, usually smooth and polished; color a very dark rich brown, becoming olive when moist, the under surface black, granulate, more or less covered with short, dense, black fibrils.

Fertile plants infrequent; apothecia at first innate and very small, but finally large, rounded or irregularly oblong, prominent and dome-like, reaching a diameter of 8 mm., beautifully gyrose-plicate, black; spores simple, colorless, short-ellipsoid,

$$\frac{5-7}{7.5-13.5} \mu.$$

Abundant in the Santa Cruz Peninsula at Devils Cañon, at an altitude of 600 to 690 meters; it occurs also sparingly at Castle Rock, altitude 900 meters, a few miles southeast of Devils Cañon. The plant is not rare on Mount Hamilton, altitude 1,270 meters, in the Inner Coast Range; according to Doctor Hasse it is abundant in the Yosemite Valley. It probably occurs all over California, wherever the altitude is over 900 meters. A few specimens were sent me from Rhett Lake, Modoc County, by Mr. Harold Hannibal, and I have no doubt it extends into Oregon and Washington.

I have compared my material with authentic fruiting material in the Imperial Museum at Vienna, identified by Dr. Th. M. Fries, and with material in the British Museum and in the Leighton Herbarium at Kew, collected and identified by the same lichenologist.

I do not know what else Miss Cummings may have collected at Wawona, Calif., but the two packets of no. 244, Cummings, Williams & Seymour, Decades of North American Lichens, in my possession, are both *G. polyrhiza*.

This lichen is recorded from northern Europe and Asia, but is not given by Tuckerman in any of his works. It has apparently been overlooked by both collectors and authors in this country till discovered by me in California. In various herbaria I have found a few specimens distributed under the name of *rugifera* or of *muhlenbergii* var. *alpina*, from both of which it is sufficiently distinct.

EXPLANATION OF PLATE 70.—See page 317.

10. Gyrophora hyperborea (Hoffm.) Ach. Meth. Lich. 105. 1803.

PLATE 71.

Umbilicaria hyperborea Hoffm. Deutschl. Fl. 111. 1796.

Thallus medium-sized to small, mostly one-leaved, or sometimes somewhat several-leaved, rather thin and parchment-like, few-lobed, with irregular, sometimes ragged or lacerate margins; surface irregularly papulose-wrinkled, or more rarely nearly smooth, often more or less perforate; color olive brown, chocolate, blackish, and black; the under surface smooth, often slightly pitted, unevenly furrowed, blackish to dark brown or paler, sometimes with a grayish cast; apothecia small, fairly abundant, at first minute and appressed, but eventually elevated, convex and plicate, variously shaped but mostly circular; paraphyses short, slender, tortuous; asci short, oblong to spatulate; thecium bluish greenish, then tawny and wine red with iodine;

spores ellipsoid or ovoid, colorless or pale yellowish, $\frac{5.75-7.5}{10-14} \mu$; according to Tuckerman measuring $\frac{6-9}{12-18} \mu$.

Californian specimens have been examined as follows: *Bolander*, exact region not known; *Prof. Clara Cummings*, Truckee; *Harold Hannibal*, Rhett Lake, Modoc County; numerous collections, valley of the Truckee River near the California-Nevada line, altitude 2,000 to 6,200 meters. It is also common about Reno, Nevada, at 1,600 meters and above. It probably occurs generally throughout the mountains about Lake Tahoe and northward. A specimen in the National Herbarium, identified by Tuckerman, was collected in Oregon by *E. Hall*.

Here may be cited also: Cummings, Williams & Seymour, Dec. N. Amer. Lich., no. 156, Mount Lafayette, N. H.; Cummings & Seymour, Dec. N. Amer. Lich., no. 60, Columbia Falls, Montana.

EXPLANATION OF PLATE 71.—*a*, (Left-hand column) under surface of thallus; *b*, (right-hand column) upper surface, same specimens. Material from Reno, Nevada. All scale 2.

11. *Gyrophora erosa* (Weber) Ach. Meth. Lich. 103. 1803.

Lichen erosus Weber, Spic. Fl. Goett. 259. 1778.

Umbilicaria erosa Tuck. Syn. N. Amer. Lich. 1: 86. 1882.

Thallus of moderate size, one-leaved, thin, rigid, the lobes few and rounded; margin very irregular, as if torn or gnawed; surface irregularly wrinkled and folded, much dissected by intricate black, indented lines and chinks, which resemble the sutures in a skull, these markings often passing into perforations and crevices cutting entirely through the thallus; color varying from clear clay brown to blackish brown; under side more or less radiately ridged, the ridges often foraminous, becoming ragged or finally passing into lacinate fibrils; usually minutely granulose, smooth, pale brown or blackish; apothecia at first small, innate or plane, variously shaped, with a thin margin; soon prominent, convex, plicate, the margin finally disappearing and the apothecia moderately large; paraphyses short, slender, mostly coherent; thecium greenish blue, soon changing to tawny or red brown with iodine; spores colorless, ellipsoid, $\frac{5-7}{7, 3-9} \mu$; according to Tuckerman "fuscescent or decolorate, $\frac{5-7}{9-12} \mu$."

Collected on rocks at Yosemite by Dr. H. E. Hasse, at an altitude of about 1,540 meters, and by me in the Sierras east of Truckee at 2,000 meters. As I have collected it also at Reno, Nevada, we may safely say that it occurs from the Lake Tahoe region northward. Other specimens were examined from Lake Pend d' Oreille, Idaho, where it is said to be abundant on granite ledges, and from Great Slave Lake, British America. I also found it mixed with herbarium specimens of *Gyrophora hyperborea*, from Columbia Falls, Montana.

12. *Gyrophora phaea* (Tuck.) Herre, Proc. Washington Acad. Sci. 7: 366. 1906.

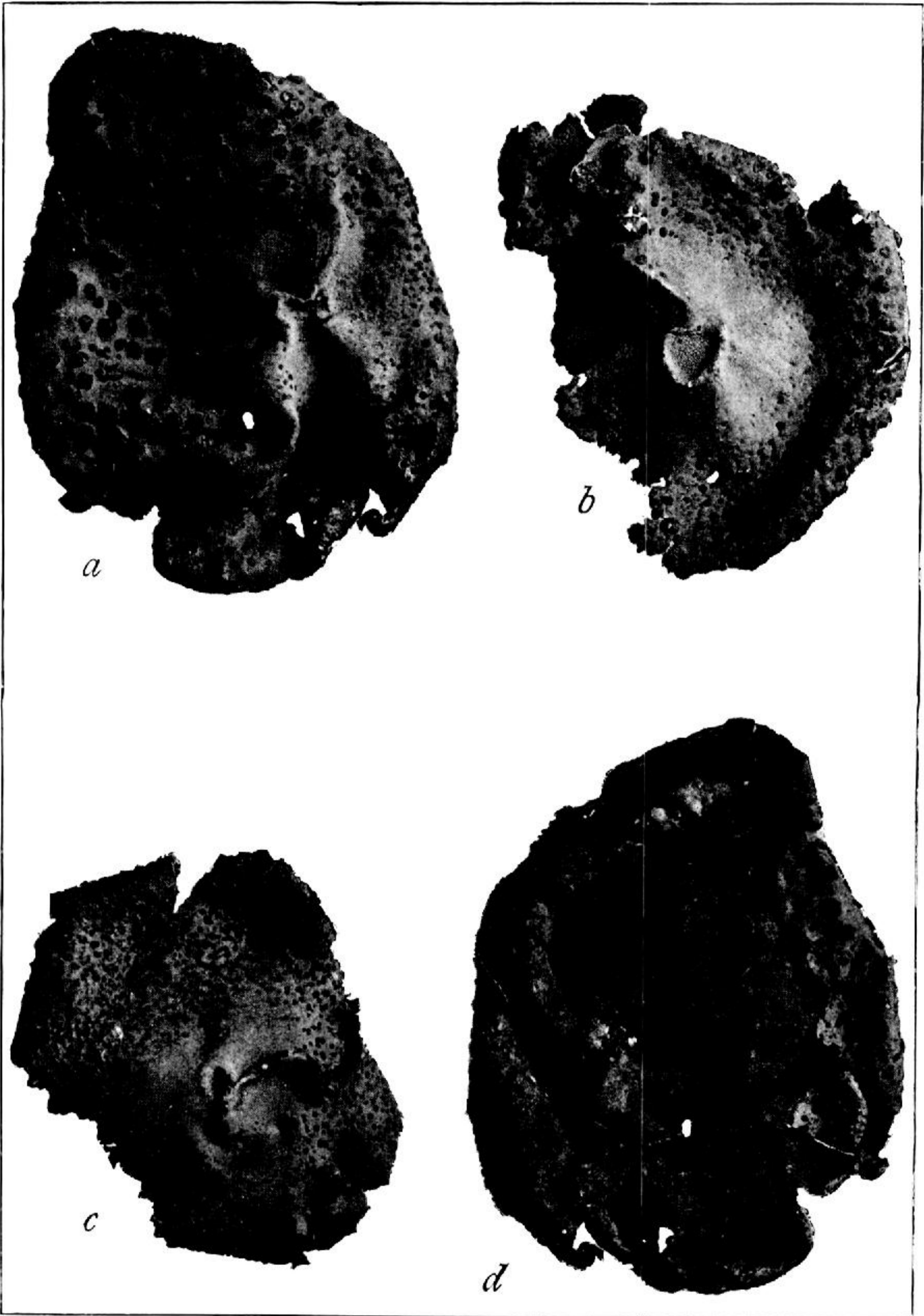
PLATE 72.

Umbilicaria phaea Tuck. Lich. Calif. 15. 1866; Syn. N. Amer. Lich. 1: 86. 1882.

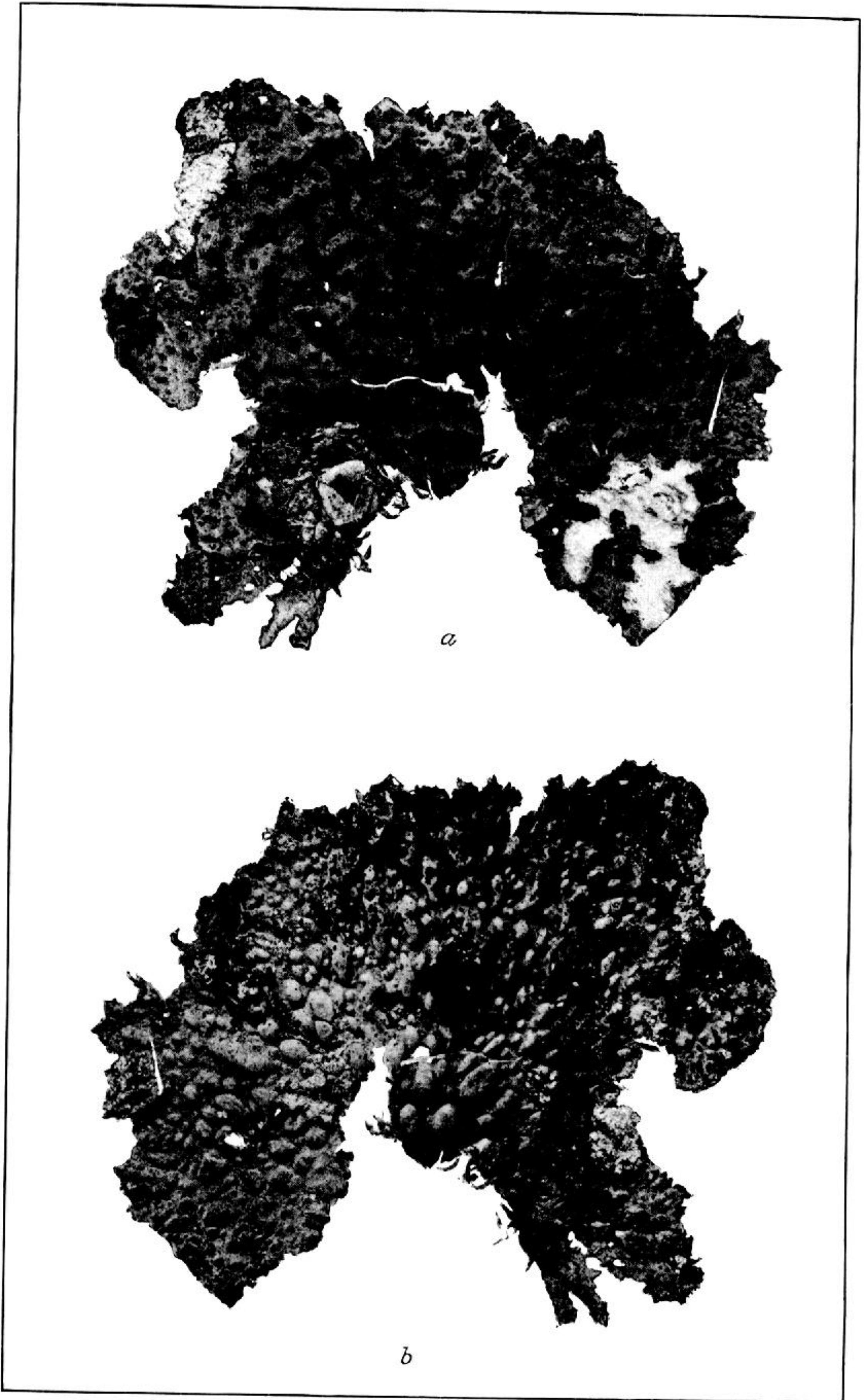
Thallus usually quite small or medium, rarely becoming large, one-leaved (occasionally polyphyllous); upper surface smooth, brown, but varying from greenish or grayish to olive and dark tawny brown; under surface without fibrils and granular, usually darker brown than the upper surface, or even blackish, but sometimes paler, with a pale bloom; apothecia numerous, black; at first innate, but finally prominent, angular or rounded and plicate; thecium brown with iodine, the spores turning a faint greenish yellow; spores simple, colorless to brown, variously arranged in the asci, ellipsoid, $\frac{5-8}{10-13.5} \mu$ and $\frac{8-10}{13-16} \mu$.

The commonest and most characteristic Californian representative of the family. According to Tuckerman found only between 300 and 1,000 meters altitude, but really extending much above and below these limits. In the Santa Cruz Mountains and in Alum Rock Park near San José it occurs at about 90 meters above sea level, while I have collected it in the Sierra Nevada Mountains along the Truckee River and in the desert about Reno, Nevada, at altitudes of from 1,650 meters to 2,000 meters. In the Tehachepi Mountains it occurs at an altitude of 1,700 meters, according to Doctor Hasse.

This is one of the hardiest and most successful xerophytes known. In the deserts of western Nevada where the rainfall is but 8 to 10 inches it grows on the most exposed parts of the south side of bare cliffs and detached boulders hung high above the soil, where it would seem impossible for any plant to exist. In such places it is usually very small and becomes practically a crustaceous or subcrustaceous lichen which



GYROPHORA PHAEA (TUCK.) HERRE.



UMBILICARIA PUSTULATA (L.) HOFFM.

crowds out all other forms but one, *Acarospora thamnina*, though it is doubtful if any other lichens besides these two could exist on such dry, hot rocks as they monopolize.

In addition to numerous localities in the Santa Cruz Peninsula I have examined material from other Californian localities as follows: Inner Coast Range, Mount Hamilton and Mount Santa Aña; Tuscan Butte, Shasta County; Napa Valley, *J. Torrey*, 1865; Marin County, *Bolander*; Klamath, Siskiyou County; Hood's Peak, Sonoma County; Sims, Shasta County; Mount Diablo; Tehachepi Mountains, *Doctor Hasse*; Vallecito, Lower California; Moreno, Cummings, Williams & Seymour, Dec. N. Amer. Lich. no. 157.

This lichen seems to reach a greater thalline development in the dry inner Coast Range than elsewhere. A specimen in the Tuckerman Herbarium from Mount Diablo has a diameter of 7.5 cm., while I have collected specimens on Mount Santa Aña with a breadth of 10 cm.

This species ranges from Vancouver Island on the north to Guadalupe Island, off Lower California, a specimen from the latter locality being in the Tuckerman Herbarium, and from the western part of Nevada to the Pacific.

EXPLANATION OF PLATE. 72.—*a, b, c*, Upper surface of thallus; *d*, under surface of plant shown in *a*. Specimens from Mount Santa Aña.. All scale 2.

2. UMBILICARIA (Hoffm.) Flot.

Umbilicaria Hoffm. Descr. Pl. Crypt. 1: 7. pl. 2. f. 1-4. 1790.

Thallus attached by a central or nearly central umbilicus, without rhizoids. Apothecia usually simple, with smooth disk, in some forms becoming elevated, plicate, and proliferous. Spores rarely more than 1 or 2 in the asci, brown, though often a long time colorless, muriform-multilocular.

The type species is presumably *Umbilicaria pustulata* (L.) Hoffm. (Pl. 73). Species about a half dozen in number, mostly of the temperate zone.

EXPLANATION OF PLATE 73.—*a*, Under surface showing pitted formation; *b*, upper surface. Both natural size.

1. *Umbilicaria semitensis* Tuck. Gen. Lich. 41. 1872.

Umbilicaria angulata semitensis Tuck. Syn. N. Amer. Lich. 1: 88. 1882.

Thallus small to medium (3 to 5 cm. in diameter, Hasse), one-leaved or sometimes several-leaved, rigid, often undulate; upper surface varying from smooth or even polished to finely areolate or sometimes granulose, in color smoky gray, gray brown, and dark brown or chocolate; under surface black or gray black, coarsely granular; radiately ridged, the ridges becoming lacerate and passing into scattered fibrils; apothecia small to medium, innate or appressed, usually crowded toward the circumference, and often confluent, angular, circular, or irregular, plicate, black, with a thick persistent margin; paraphyses slender, free or more often confluent, hardly longer than the clavate or ventricose asci; thecium blue, finally red brown with iodine; spores in Yosemite specimens solitary or in couples, muriform, usually colorless, but at last brown, $\frac{13-15}{19-23.5} \mu$; specimens from the Tehachepi Range yield spores $\frac{16-20}{24-26} \mu$.

In specimens collected by Bolander in 1868, locality unknown, there are, as a rule, one or two spores in the asci, but they also occur in 8's. and measure $\frac{15-20.5}{26-30} \mu$.

This plant has been collected at Yosemite Valley by Bolander, Prof. Clara Cummings, and Doctor Hasse; the latter has also found it in the Tehachepi Range and in the Santa Monica Range. As yet it is not known to occur outside California or north of the latitude of the San Francisco Bay region. Cummings, Williams, & Seymour, Dec. N. Amer. Lich. no. 148, Yosemite Valley, California.