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A Synopsis of the Lichen Genus *Xanthoparmelia* (Vainio) Hale (Ascomycotina, Parmeliaceae)

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ABSTRACT

Hale, Mason E. A Synopsis of the Lichen Genus *Xanthoparmelia* (Vainio) Hale (Ascomycotina: Parmeliaceae). *Smithsonian Contributions to Botany*, number 74, 250 pages, 75 figures, 1990.—A world-level synopsis is presented for *Xanthoparmelia* with full synonymies, typification of all taxa, species descriptions, and keys. The genus is characterized by the presence of usnic acid in the cortex, a positive lichenin test, oil bodies in the rhizines, saxicolous or terricolous habit, uniform small ellipsoid colorless spores, and bifusiform or rarely cylindrical conidia. The lower surface is rhizinate except in a few species and brown or black. Cilia are lacking. The 406 species occur primarily in southern Africa (212) and Australia (145).

Two new species are described: *X. greytonensis* Hale and *X. kasachstania* Hale. Four new combinations are made: *X. mutabilis* (Taylor) Hale, *X. perplexa* (Stizenberger) Hale, *X. sigillata* (Brusse) Hale, and *X. verecunda* (Brusse) Hale. One new name is proposed: *X. neopropaguloides* Hale.

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Introduction

The Parmeliaceae (excluding the Usneaceae) is the largest foliose family among the lichenized fungi, with over 1200 species. *Xanthoparmelia*, one of the major genera in the family, now has 406 species. By comparison, *Parmotrema* Massalongo has about 250 species and *Hypotrachyna* (Vainio) Hale about 165.

The remaining parmelioid genera (*Almbornia* Esslinger, *Arctoparmelia* Hale, *Asahinea* Culberson and Culberson, *Bulbothrix* Hale, *Canomaculina* Elix and Hale, *Canoparmelia* Elix and Hale, *Cetrariastrum* Sipman, *Cetrelia* Culberson and Culberson, *Concamerella* Culberson, *Everniastrum* Sipman, *Flavoparmelia* Hale, *Flavopunctelia* (Krog) Hale, *Karoowia* Hale, *Melanelia* Esslinger, *Myelochroa* Elix and Hale, *Namakwa* Hale, *Neofuscelia* Esslinger, *Paraparmelia* Elix and Johnston, *Parmelaria* Awasthi, *Parmelia* Ach., *Parmelina* Hale, *Parmelinella* Elix and Hale, *Parmelinopsis* Elix and Hale, *Parmotremopsis* Elix and Hale, *Platismatia* Culberson and Culberson, *Pleurosticta* Petrak, *Pseudoparmelia* Lynge, *Psiloparmelia* Hale, *Punctelia* Krog, *Relicina* (Hale and Kurokawa) Hale, *Relicinopsis* Elix and Verdon, and *Xanthomaculina* Hale), have less—usually considerably less—than 80 species each.

The cetrarioid genera, *Ahtiana* Goward, *Cetraria* Acharius, *Cetrariopsis* Kurokawa, *Esslingeriana* Hale and Lai, *Masonhalea* Kärnefelt, *Nephromopsis* Müller Argoviensis, and *Tuckermannopsis* Gyelnik, comprise 80–100 species, although much work remains to be done in this group.

When I began my first studies of *Xanthoparmelia* in 1955, I soon realized that a world monograph could not be completed with the materials then at hand. The genus appeared to have the greatest number of species in Australia and South Africa, the very countries where lichenological research was least active historically and collections the fewest.

In retrospect another serious obstacle to monographing *Xanthoparmelia* at that time was our imperfect knowledge of the chemistry and the primitive methods then available for identifying lichen substances. Chemistry was destined to be a crucial character in the taxonomy of this genus, but Asahina's microcrystal tests were no match for the rich chemical diversity since uncovered. It was not until the late 1960s and early 1970s that thin layer chromatography (TLC) was introduced and put into practice sufficiently for lichen taxonomists to benefit fully.

Although for these and other reasons I postponed the goal of a world monograph, I did examine almost all of the approximately 280 type specimens of species and subspecific taxa published in the genus before 1960. Since then many more collections have become available and many new species have been published, filling in gaps that had earlier prevented a coherent treatment. Dr. J.A. Elix has made especially important contributions to the Australian species. He has not only used his profound knowledge of phytochemistry to unravel the complex chemistry of *Xanthoparmelia* and place it on a firm footing, but has carried out critical taxonomic studies of the 145 Australian species, culminating in a revision (Elix, Johnston, and Armstrong, 1986) that forms an indispensable base for studying the genus.

I myself have had the opportunity to conduct extensive field studies in Australia and southern Africa. All type specimens have been re-examined and literature citations re-checked against the originals. The chemical data have been updated with TLC. I have been able to study and identify many additional specimens in major herbaria and revise older identifications.

Using these data, I feel that now is an appropriate time to present a synopsis of the accepted species and their synonymies with full citation of literature and type specimens, chemistry,

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brief synoptic descriptions, and world distributions. This information should provide the groundwork for more intensive local studies that will be needed to achieve a better understanding of this huge genus.

It should be noted that Figures 12–21 and 24–75 have been reduced to 96 percent.

ACKNOWLEDGMENTS.—Special thanks are due Dr. Z. Černohorský, who arranged for loans of Gyelnik's collections while I was visiting Prague in 1961 early in my studies. Dr. Ove Almborn has very kindly checked much of the literature and given advice on some difficult nomenclatural problems. I have benefited immensely from discussions and exchanges of data on problematic species with Dr. J.A. Elix, who also determined the chemistry of many critical species with Dr. G.A. Jenkins and Jen Johnston. Dr. Chicita Culberson, and Anita Johnson have also helped with chemical identifications on many occasions. Mr. Dirk Wessels has given assistance during field work in South Africa and SWA/Namibia, and Dr. J.A. Elix and Dr. Nell Stevens have helped me in Australia. Ellen Farr has developed programs used in building a computerized data base for the genus.

Financial assistance over the years has come from the National Science Foundation, the National Geographic Society, and the Smithsonian Institution Scholarly Studies Program.

Lastly, curators of the many museums where type collections of *Xanthoparmeliae* are preserved have given invaluable help in arranging loans; their cooperation and patience are gratefully acknowledged: AD, ASU, B, BM, BOL, BP, CBG, DUKE, FH, G, GB, H, HO, HBG, KW, L, LD, LISU, M, MEL, MSC, MVM, NY, PC, PE, PRE, PRM, S, TNS, TUR, UPS, VER, W, WU, ZT, and private herbaria of K. Kalb and R. Rosentreter.

History of *Xanthoparmelia* Research

Approximately 45 lichenologists have described one or more species of *Xanthoparmelia* (all as *Parmelia* before 1974), and some 406 species are tabulated in this synopsis. Adding in 195 synonymous names at all ranks as well as 80 dubious or rejected names, we have a total of about 675 published names in the genus.

Linnaeus (1753) did not describe any species now recognized in *Xanthoparmelia*. Acharius described three: *Parmelia camtschadalis, P. conspersa* (with a β *stenophylla* and γ *georgina*), and *P. molliuscula*. By 1925, the end of the classical period in lichenology, 72 species recognized as valid in this synopsis had been described, with half of them, as one might expect, published by Müller Argoviensis (14), Nylander (11), Stirton (6), and Vainio (4). None of these workers, however, can be said to have specialized in *Xanthoparmelia*, and if anything they described proportionately fewer species here than in other parmelioid groups.

Since 1925, there has been an explosion of names unparalleled in any other lichen genus. It began with V. Gyelnik, a Hungarian lichenologist whose main interest had been the genus *Peltigera*. He alone proposed 128 names, 63 at species rank, in *Xanthoparmelia*. He accomplished all of this—in addition to proposing hundreds of names in other genera—in just nine years, from 1930 to 1938. Gyelnik published hastily in numerous fragmented and poorly organized articles, sometimes forgetting what he had published earlier. He had a truly desperate need for an index to his own work, such as the one later compiled by Sjödin (1954)!

We know relatively few details about Gyelnik's career. According to Verseghy (1963), he was born in Budapest in 1906. Before receiving his Dr. Phil. degree in 1929, he spent nearly a year in Cairo helping to organize a botanical museum. He returned to Budapest in 1930 to become curator of the lichen collections at the Natural History Museum, where he remained until 1944. He also held a post at the University in Debrecen. Gyelnik published his first scientific article in 1926, at the age of only 20 and the bulk of his research was accomplished between the ages of 24 and 34 (1930–1940) during a period of great political and economic upheaval throughout Europe, including Hungary.

One source of my information about Gyelnik comes from his correspondence from 1930–1933 with the American amateur lichenologist C.C. Plitt (archived in BPI), written in English and German. In one of the earliest letters dated 10 June 1930, Plitt wrote to Gyelnik that he wanted to visit him in Hungary before attending the International Botanical Congress held in England that summer. Plitt did in fact visit Gyelnik in August 1930 and was taken on a field trip with Szatala, Kummerle, and others. Gyelnik married Theresa Hofflinger on 30 May 1931, sending Plitt a wedding invitation. After a six-week honeymoon, Gyelnik returned to his office to find that he had been awarded a travel stipend for lichen studies, but the trip had to be postponed because of an operation for appendicitis. Returning to work again, he found the grant rescinded as a result of economic steps taken by the Gombos administration to counter a bank crisis. In December Gyelnik had another operation for a growth on his forehead.

By the summer of 1932 Gyelnik had found a house and his wife gave birth to a son. Correspondence with Plitt continued with requests for copies of lichen books, including Tuckerman's *Synopsis*, duplicate specimens for his newly issued *Lichenotheca Parva*, and foreign stamps for his personal stamp collection. This warm exchange of letters ended in early 1933 with Plitt's death.

In 1935, when "Hungarianism" reached a peak in the fascist Gombos administration, it was common for Hungarians with non-Hungarian family names (Gyelnik has a Slavic ring) to change or modify them, especially if they wanted political appointments. Gyelnik prefixed "Köfaragó" to his last name, perhaps facetiously, since this means stone cutter in Hungarian—an occupation in which every lichen collector soon becomes an expert! In any event he was eventually appointed to the post of Head of the Botanical Department at the National Museum in 1942, ending his career as a productive scientist at the age of only 36.

In October 1944, with the Russian army already entering the suburbs of Budapest, Ferenc Szalasi assumed the post of Prime Minister (Nagy-Talavera, 1970). He replaced virtually everyone in the previous Kallay regime, and it was thus that Gyelnik was appointed Minister of Culture and Education (E. Friedmann, personal communication). Szalasi visited Hitler in December 1944 and, still believing that the Nazis would triumph, set up a provisional capital at Sopron, 3 km from the Austrian border for protection. At the same time the Russians installed an anti-fascist government in Debrecen as Budapest was destroyed by fascists and Russians alike. The new government's first act was to condemn to death all members of the Szalasi regime. Some were executed, some escaped to Austria. Verseghy (1963) says that Gyelnik died at the end of 1944 or early 1945, but Grummann (1974) reported that Gyelnik was killed in an air raid on a railway station in Austria on 15 March 1945. Perhaps his actual fate may never be known.

Gyelnik was a controversial individual who infuriated or at least antagonized virtually every contemporary lichenologist. Yet his correspondence with Plitt reveals a warm and generous person beset by many problems. In 1940 Gyelnik published a "Chronica Botanica Hungarica 1940: I–VI" in *Borbasia Nova,* a journal he himself founded. In this article his colleague and co-editor of *Borbasia,* Z. Kárpati, paints a humorous picture of Gyelnik with a caricature in "Monographiae botanicorum hungaricum prodromus I." Gyelnik is described as "*Homo botanicus* var. *cryptogamus* f. *lichenologus* lus. *fajfaragoensis* [species splitter!]. Diagnosis: Corpus verticaliter valde elongatus, horizontaliter semicrassus. Pedes recti, longi, sat dense setosi (= capreaepedati), cum braccis diu tecti, noctu non obducti, capitibus vulgo exodoratis. Truncus validus, sat latus, rectus, in parte dorsali cum spina (!). Caput ovoideum, in parte apicali hieme villoso-tomentosum fuscumque, aestate toto glabrescens billiardgolyobiformeque vel interdum brevisetosum, auriculatum, auribus subrectangularibus, sat robustis, benissime auditis, naso bono et lingua acuta instructum. Consistentia dura, tenax, non esculenta. Habitat vulgo in museo botanico budapestinensi, rariter in instituto botanico universitatis debreceniensi."

Gyelnik's scientific work matured in definite stages. Starting out in the late 1920s on a strictly local basis, he described many forms and varieties of well-known species. After visiting the Acharian and Nylander collections in Helsinki in 1927, he began to describe more exotic species, especially from Australia and South Africa. He even studied briefly with both Vainio and Räsänen (Grummann, 1974). Later he examined many more type collections, primarily those of Krempelhuber, Müller Argoviensis, and Nylander, and received on loan Stirton's GLAM collections (Gyelnik, 1938a) and general collections for identification from Bouly de Lesdain, Evans, Hosseus, and Nádvorník. The result of these wide-ranging investigations was the realization that many of his own species were synonymous with earlier names. He then proceeded to synonymize many of them or transfer them to older names with almost clinical care, first under one but often later under another as new discoveries were made.

Sjödin (1954) catalogs many examples of Gyelnik's nomenclatural jungle. A typical one is the nomenclatural history of *Parmelia ioannis-simae* (now considered to be a synonym of *Xanthoparmelia taractica*). It was first described as a species, *P. ioannis-simae,* in 1931, but after establishing the identity of *Parmelia imitans* (Müller Argoviensis) Gyelnik (now recognized as a synonym of *X. somloensis*), he transferred it there in 1934 as *P. imitans* var. *ioannis-simae.* Still later he examined the type of *P. phaeophana* and created *P. phaeophana* f. *ioannis-simae* (Gyelnik) Gyelnik in 1938. By 1938, the last year that he published in *Xanthoparmelia,* Gyelnik had reduced many of his own and other species in this way to varieties or forms in a regular progression.

Although Gyelnik published 25 more scientific articles from 1939 to 1942, he never again dealt with *Xanthoparmelia.* The reason for this abrupt loss of interest in a genus that had been his primary field of research for nine years will never be known.

When Gyelnik's contributions are put into perspective, we realize that he had a far deeper, though sometimes garbled, understanding of *Xanthoparmelia*—and other genera—than any other lichenologist of his day and was clearly far ahead of his time. For example, he was the first lichenologist after Nylander to use chemistry as a species character on a large scale, although some may not consider that to his credit. For the most part he employed the well-known but uncritical color tests with KOH and calcium hypochlorite, even though he must have been aware of the microcrystal tests for salazinic acid and other compounds described by Zopf (1903) and Lettau (1914). After Asahina (1934) introduced *para*-phenylenediamine, Gyelnik retested many specimens with this new color reagent but never published the results. His annotation labels for P tests on his own material in BP are undated but were probably prepared after 1936.

Asahina (1936) also published procedures for microcrystal tests that were far more sophisticated than those of Lettau, providing lichenologists for the first time with a more accurate means of identifying substances responsible for color reactions and ultimately establishing a sounder basis for chemotaxonomy. While Gyelnik acknowledged some help from Asahina in 1938 (Gyelnik, 1938a) for his "im Werden begriffenen *Xanthoparmelia*-Monographie," he did not attempt to use Asahina's tests or to cite full chemistry except for three species analyzed by Asahina (Gyelnik, 1938d). On the contrary, he began to have doubts on the accuracy of color tests (Gyelnik, 1938d). His sincere efforts simply did not coincide with the chemical technologies just beginning to bear fruit.

Even as he worked so frantically, Gyelnik took care to designate type collections and carefully annotated them in his neat handwriting. At the same time he followed logical rules of nomenclature, with a few understandable exceptions, more than did some of his contemporaries. Thus it is comparatively

easy to typify his species and locate type specimens.

Hillmann (1936, 1939), a very careful worker in *Parmelia* in the 1930s, was one of Gyelnik's main critics. He objected to his splitting up species and raising forms to "kleinste Arten" (we would now say microspecies), asserting that his methods were detrimental to science. Hillmann correctly stated that careful studies in nature and examination of large numbers of specimens are important in gaining a full understanding of the species, a most desirable goal which, unfortunately, few taxonomists achieve. It is true that Gyelnik often saw only one specimen when describing exotic species and did not visit any countries outside of Europe, except Egypt. Both Kušan (1932) and Magnusson (1933) also criticized Gyelnik's work as hasty and ill-conceived. Gyelnik (1934b, 1938d, 1939b) responded to his critics methodically, but the animosity between these lichenologists never healed.

After Gyelnik's last publication on the *Xanthoparmeliae* in 1938, there was a hiatus of more than 20 years when very few new species in this group were published. In 1959 Dodge published nine African species alleged to be *Xanthoparmeliae* (eight of these are in fact synonyms of well-known species or belong in other genera). Since 1964 virtually all of the 300 or so additional new species of *Xanthoparmelia* have been described by five principal authors, Elix (81), Kurokawa and Kurokawa and Filson (31), Hale (175), Nash (16), and Knox and Brusse (19). In other words, more than three-quarters of the valid species in the genus have been published in just 20 years, in contrast to the 200 years for the first 72 species!

It would probably be foolhardy to predict how many species remain to be found, even though all major collecting areas have been visited by one or more lichenologists. Certainly the total may reach 500, making *Xanthoparmelia* by far the largest genus in the Parmeliaceae.

Taxonomic Characters

Most species of *Xanthoparmelia* described before 1930 were based on obvious differences in gross external morphology or substrate (rock or soil). At one extreme, Nylander had a narrow species concept, using isidia and soredia, conidia, and chemistry as species characters. By contrast, Müller Argoviensis (1888c:195) categorically rejected chemical species and deemed isidia and soredia to be modifications of "true" species and varieties.

It was not until Gyelnik started publishing so rapidly in the 1930s that lichenologists began to examine the value of these and other characters introduced by him, such as isidial branching and chemical color reactions (Gyelnik, 1931b). Kušan (1932), obviously reacting to Gyelnik's 28 new species published 1930–1931, discussed various characters in considerable detail, particularly for the *Parmelia conspersa* group in Europe. He felt, for example, that thallus color (both upper and lower surfaces) showed all possible nuances and variations. Degree of adnation had no value either in his opinion. Isidia were too frequent to have significance or could be treated as forms when isidiate-nonisidiate parallels were found. Finally, apothecia appeared to be constant with little variation in height of hymenium or spore size and pycnidia had no value. Of course, Kušan was studying only the very few species occurring in Europe.

If we examine more closely the characters actually used by Gyelnik (1931b), a certain degree of consistency is apparent. Chemistry is very basic: "medulla partim alba, partim rubra" (*P. serbica*) or "similis omnino *P. servitianae* sed medulla KC+ rubescens non KC–" (*P. pseudoservitiana* [= *X. conspersa*]). We know now that some of these color tests were spurious but that others reflected significant chemical differences.

The degree of adnation (Gyelnik, 1934c) was also given considerable importance, as in "subcrustaceus" (*P. mougeotii* and *P. novomexicana*) and "typice foliaceus" (*P. subramigera*). Density of rhizines played some role, as in *P. cheelii*, which has very sparse rhizines. The color of the lower surface was carefully noted, as in "similis *P. regis-matthiae* [= *X. conspersa*] sed subtus pallidus" (*P. canariensis* [= *X. subramigera*]). It is interesting to note that long before this Tuckerman (1860) had observed specimens of "*P. conspersa*" with a pale rather than the usual black lower surface, a common trait in American populations and in this instance probably referring to *X. plittii*.

In the same year Nylander (1860:391) also used this character when he described *Parmelia conspersa* var. *hypoclysta* (= *X. sublaevis*).

The presence and branching of isidia (Gyelnik, 1931b) were other species-level characters frequently mentioned by Gyelnik, as "isidiis ramosis" (*P. bohemica*) or "similis *P. isidiatae* (= *X. conspersa*) sed isidiis eramosis" (*P. korosi-csomae* [= *X. tinctina*]).

In my first studies of *Xanthoparmelia* (Hale, 1955) I used the presence of isidia and degree of adnation correlated with chemistry, characters supported later by des Abbayes (1961). My early work, however, was not concerned with taxonomic questions and all isidiate populations were indiscriminately called *Parmelia lusitana*.

In 1959 Dodge denied chemistry as a species character, at least as reflected in color tests, but did use lower surface color. By 1964 I had enhanced my treatment of the North American species with mass field studies and concluded that a combination of pale or black lower surface, chemistry, and to a lesser extent adnation, supported by geographical correlations, seemed to provide a reasonable basis for recognizing seven isidiate species, three of them (*P. mexicana, P. plittii,* and *P. subramigera*) already described by Gyelnik (Hale, 1964).

These basic characters have been tested and used by workers in *Xanthoparmelia* for the last 20 years and provided a

workable basis for recognizing species. Furthermore, as the accuracy of techniques for identification of lichen substances has improved, particularly after the introduction of thin layer (TLC) and high performance liquid (HPLC) chromatography, chemistry has played an ever more important role at the species level.

The most recent studies of *Xanthoparmelia* (Elix, 1981; Elix and Armstrong, 1983; Elix and Johnston, 1987, 1988a, 1988b; Elix, Johnston, and Armstrong, 1986; Hale, 1984, 1985a, 1986b, 1987a, 1987b, 1988a, 1988b, 1989a; Knox and Brusse, 1983; Kurokawa, 1985) contain descriptions of about 300 new Australian, American and South African species. They are based in large part on unique morphologies, especially soredia and more carefully defined isidial types (cylindrical, globose, and pustulate) not appreciated by earlier workers, on lower surface color, and on chemistry.

I have listed below the major characters on which species are or could be based in *Xanthoparmelia*. The frequencies are taken from the 406 species in the synoptic list. I will try to discuss the taxonomic value of most of the characters but our present imperfect knowledge of many aspects of the ontogeny and morphogenesis of lichen structures does not permit us to pass full judgment on them now.

All of the morphological, chemical, and geographical data for the 406 species were entered into a computerized database. This database was searched for any number and combination of characters and used to prepare the keys. Species descriptions were also generated and formed the basis for the final descriptions.

Thallus Color and Texture

Gyelnik (1938a), and before him Kušan (1932), concluded that color tone varied so much as to have little taxonomic value. However, anyone who has done serious field work cannot help but be impressed by the subtle color variations in *Xanthoparmelia*. Some species are consistently light or bright greenish yellow (e.g., *X. colorata, X. hypoprotocetrarica, X. luminosa, X. schenckiana*), whereas others are dark greenish to almost brownish yellow (*X. mougeotii, X. mougeotina, X. springbokensis, X. synestia,* and *X. xanthomelaena*). The great majority are rather dull yellowish green. A few pruinose species, such as *X. equalis, X. pumila, X. serusiauxii,* and some members of the *X. schenckiana* group, have a whitish cast. Although it is difficult to measure and describe these differences, they are useful as auxiliary characters for identifying species.

Thallus texture is another subtle, variable character. Some species are firm, leathery, and easy to collect, such as most terricolous species in the *X. convoluta* group as well as *X. africana, X. austroafricana, X. effigurata, X. hypoprotocetrarica, X. namakwa, X. phaeophana, X. somloensis,* and *X. subpigmentosa*. Others are rather fragile and brittle, even when loosely attached and easily collected, e.g., *X. denudata* and *X. molliuscula*. These characters are species-specific, but as with thallus color are difficult to quantify.

Surface Features

The upper surface of most *Xanthoparmelia* species (347 of the 406 total) appears opaque and uniform without any distinguishing markings when viewed at 10×–20× magnification. I define this as a continuous (or emaculate) surface. It may be shiny, especially toward the tips, to dull and opaque or, in the few pruinose species mentioned above, frosty white (Figure 1*a*). The pruinosity is caused by surface deposits of rather deformed crystals, presumably some form of calcium oxalate (Figure 1*c*). In all these species the underlying cortex is uniformly thickened.

The remaining 59 species have distinctive, irregularly shaped whitish surface markings, so-called maculae (Elix, Johnston, and Armstrong, 1986). One group of 15 species has very marked white maculae just visible to the naked eye (Figure 1*b*). Such maculae were first reported by Nylander (1860) in *X. hypoleia*. This group includes *X. mannumensis, X. notata, X. pantherina,* and *X. yowaensis* from Australia; *X. cedrus-montana, X. dysprosa, X. effigurata, X. karoo, X. leucostigma, X. namakwa,* and *X. protodysprosa* from South Africa; and *X. burmeisteri, X. hypoleia, X. hypoprotocetrarica,* and *X. pseudohypoleia* from both Australia and South Africa. None is known from South America, North America, or Europe. These species may be called effigurate-maculate. The orientation of the maculae is correlated with the underlying vaulted cortical structure described below. Most members of this group are extremely close morphologically. For example, species in the *X. hypoleia* group (*X. burmeisteri, X. cedrus-montana, X. dysprosa, X. hypoleia, X. hypoprotocetrarica, X. mannumensis, X. mollis, X. notata,* and *X. pseudohypoleia*) have rather narrow, elongate lobes, sparse rhizines, and a black lower surface. On the other hand, they are chemically very diverse. Three other species are effigurate-maculate but do not belong to the *X. hypoleia* group: *X. effigurata* and *X. namakwa* have broader lobes and denser rhizines, and *X. leucostigma* has a pale lower surface.

A second group of 44 maculate species has distinct but more subtle whitish markings on the thallus surface that are visible only with a hand lens (Figure 1*d*). I have called these simply white-maculate. These maculae apparently have the same origin as effigurate maculae but with a less well-developed vaulted cortex. The best known examples are the well-known *X. somloensis,* as well as *X. africana, X. camtschadalis, X. phaeophana, X. protomatrae,* and *X. synestia*. They are also characteristic of *X. amphixantha, X. aurifera, X. concomitans, X. pseudoamphixantha, X. pseudohungarica, X. reptans, X.*

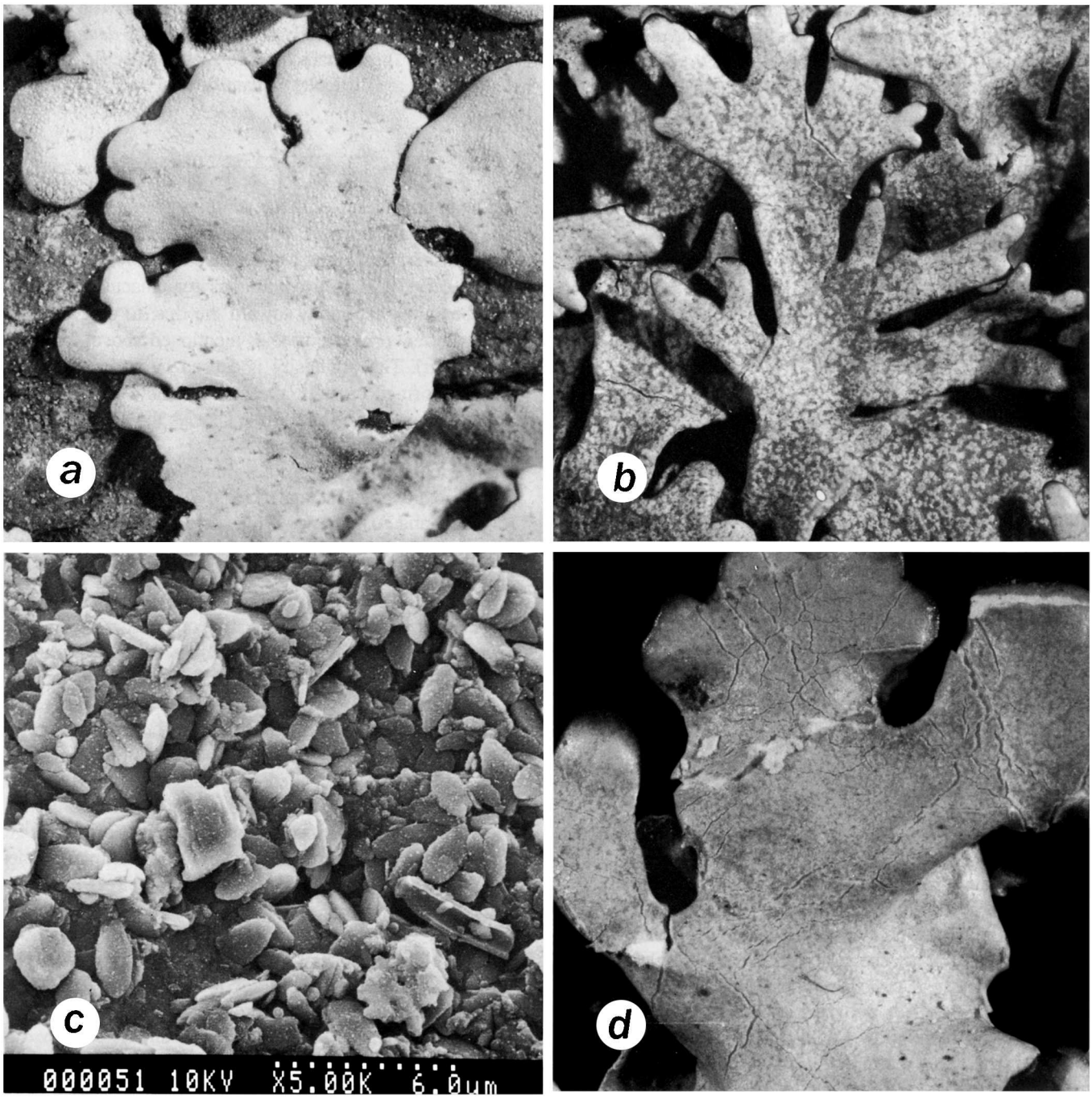


FIGURE 1.—Surface features of *Xanthoparmelia: a*, pruina of *X. colorata* (Hale 74113); *b*, effigurate maculae of *X. hypoleia* (*Hale* 72122); *c*, pruina of *X. evernica* (Hale *75120*); *d*, white-maculate surface of *X. phaeophana* (Almborn 3748) (×10).

subdiffluens, X. substrigosa, X. willisii, and others. Curiously, few species classified as white-maculate or effigurate-maculate have soredia, and only *X. treurensis* and *X. xizangensis* are isidiate.

INTERNAL ANATOMY

The internal anatomy (Figure 2*a*) and ultrastructure of *Xanthoparmelia* species appear to be rather uniform, judging from the available descriptions. There are three aspects which have potential as specific characters, epicortical structure, upper cortex, and lower cortex.

EPICORTICAL STRUCTURE.—All species of *Xanthoparmelia* studied so far have a pored epicortex (Hale, 1973) (Figure 2*b*. There is a great range in pore size and shape (Figures 3–4) with some consistency at the species level. In one case, for

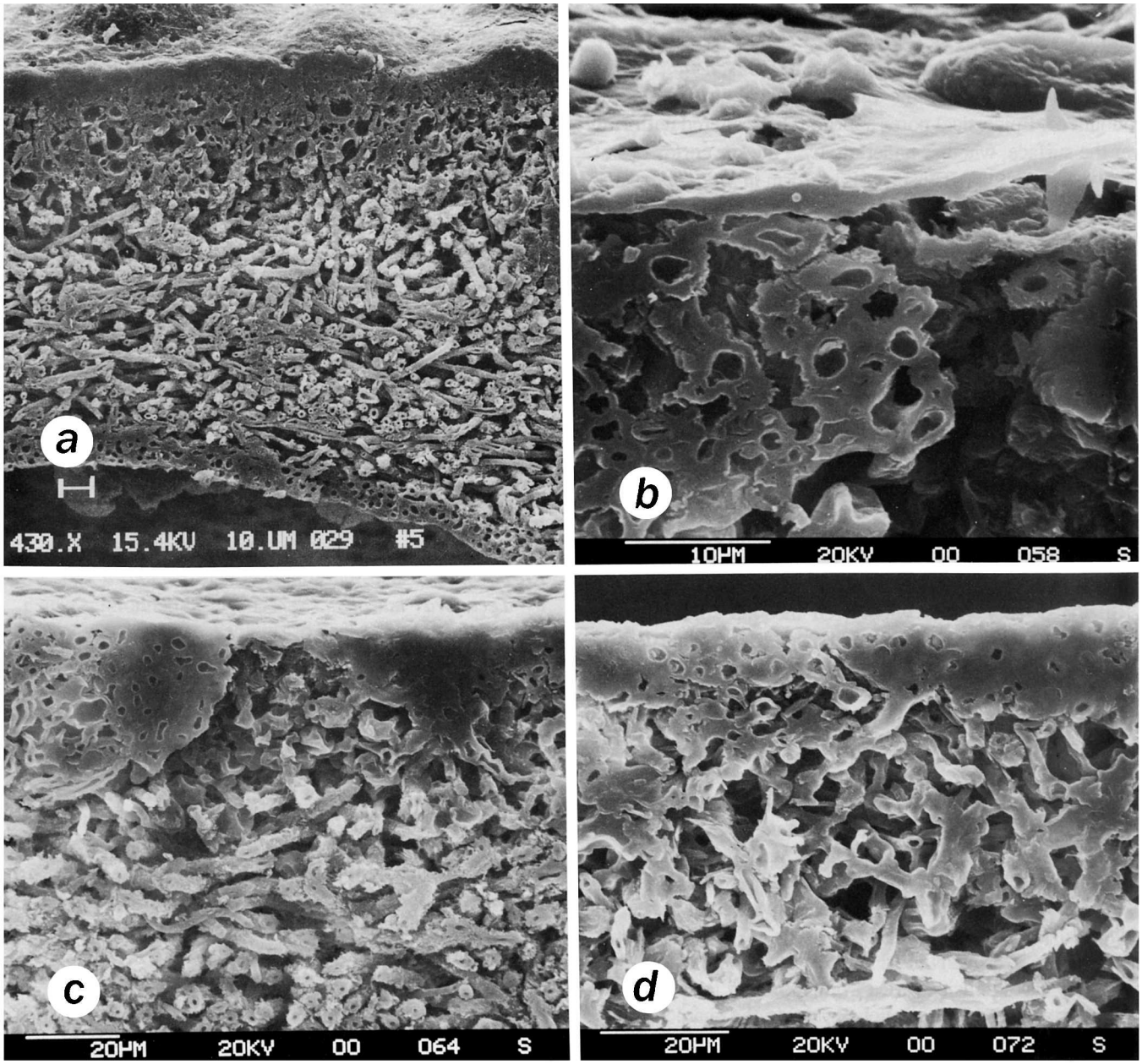


FIGURE 2.—Upper cortex of *Xanthoparmelia: a*, cross section of thallus of *X. cumberlandia* (*Brodo* 13590); *b*, epicortex of *X. phaeophana* (*Almborn* 650); *c*, vaulted cortex of *X. notata* (*Hale* 58271); *d*, weakly vaulted cortex of *X. somloensis* (*Santesson* 12198).

example, two closely related species, *X. austroafricana* and *X. phaeophana*, may have similar, unusual elongated pores (Figure 4*b*). On the other hand, other specimens of both of these species show normal orbicular pores. However, many more than the 150 specimens I have examined should be studied before we can determine if this character has any taxonomic value; present indications are that it does not.

UPPER CORTEX.—Being epicorticate, *Xanthoparmelia* species usually have a fairly thin cortex with more or less loosely arranged paraplectenchymatous to palisade-oriented cell tissue 10–18 μm thick (Figure 2*b*). This is uniformly the case with species having a continuous surface, the vast majority of the genus.

Species with an effigurate-maculate surface have a unique vaulted structure, similar to (but not as strongly developed as) that in *Xanthomaculina hottentotta* (Hale, 1985b). Dense intrusions of cortical tissue, as in *X. notata* (Figure 2*c*), form the darker greenish parts which contrast with the white effigurate maculae and have on their surface few if any epicortical pores. The intervening chambers are capped with a

thin epicorticate cortex and lie below the actual white markings.

In white-maculate species, such as *X. camtschadalis* and *X. somloensis* (Figure 2*d*), this vaulted cortical structure is less pronounced. Epicortical pores appear to be scattered uniformly over the surface, whether underlain by a thicker cortex or not.

LOWER CORTEX.—This layer is uniform in *Xanthoparmelia*, and consists of a compact paraplectenchymatous layer 3–4 cells thick (Figure 5*a*).

RHIZINES.—Most *Xanthoparmelia* species have moderately coarse, unbranched solid rhizines, 0.2–2 mm long and 0.2–0.8 mm in diameter. Long rhizines may become sparsely furcate, as in *X. africana* (Figure 5*b*) and *X. substrigosa*, or splayed at the tips. As a rule they are concolorous with the lower surface, although there are some exceptions, especially among canaliculate species, such as *X. amphixantha*, *X. concomitans*, *X. reptans*, and *X. willisii*. In these species the long sparse rhizines are dark brown to black, contrasting strongly with the very pale yellowish brown lower surface (Figure 10). An interesting feature of *Xanthoparmelia* is that all species appear to lack oil bodies in the rhizines, whereas other major genera of the Parmeliaceae have them (Ralph Common, unpublished data).

Rhizine density varies widely. Of the 406 species in this synopsis, 246 are described as having moderate rhizine density, including familiar *X. camtschadalis*, *X. conspersa*, and *X. somloensis*. Another 144 species have sparse rhizines, many of them in species with a black, sometimes rugose lower surface, e.g., *X. cheelii*, the *X. hypoleia* group, *X. constrictans*, *X. hyporhytida*, and *X. rubrireagens*. At the other extreme, *X. africana*, *X. peruviensis*, *X. substrigosa*, and *X. sulcifera* are characterized by long dense rhizines, and five other mostly Australian species (e.g., *X. barbellata* and *X. metastrigosa*) have comparatively dense but shorter rhizines.

Rhizines are essentially lacking in seven species, *X. lobulifera*, *X. mollis*, *X. norchlorochroa*, *X. pachyclada*, *X. suberadicata*, *X. subruginosa*, and *X. treurensis*.

In many cases density varies from specimen to specimen in the same species and descriptions bridging the character states such as "sparsely to moderately rhizinate" are required. Some species with sublinear lobes may even have rhizines concentrated toward the lobe tips, leaving the center almost bare, as in *X. phaeophana* or *X. subcolorata*. Obviously we need better guidelines on how to quantify rhizine density in order to compare species more accurately. In any event rhizine density alone is probably not acceptable now as a species character in the absence of other correlating characters.

THALLUS ADNATION

Thallus adnation is a measure of how closely a lichen is attached to the rock or soil substrate. No other genus in the Parmeliaceae has the broad range found in *Xanthoparmelia*, excepting perhaps *Neofuscelia* and to a much lesser extent *Paraparmelia*. Along with other workers in the field I have used five broad categories as follows:

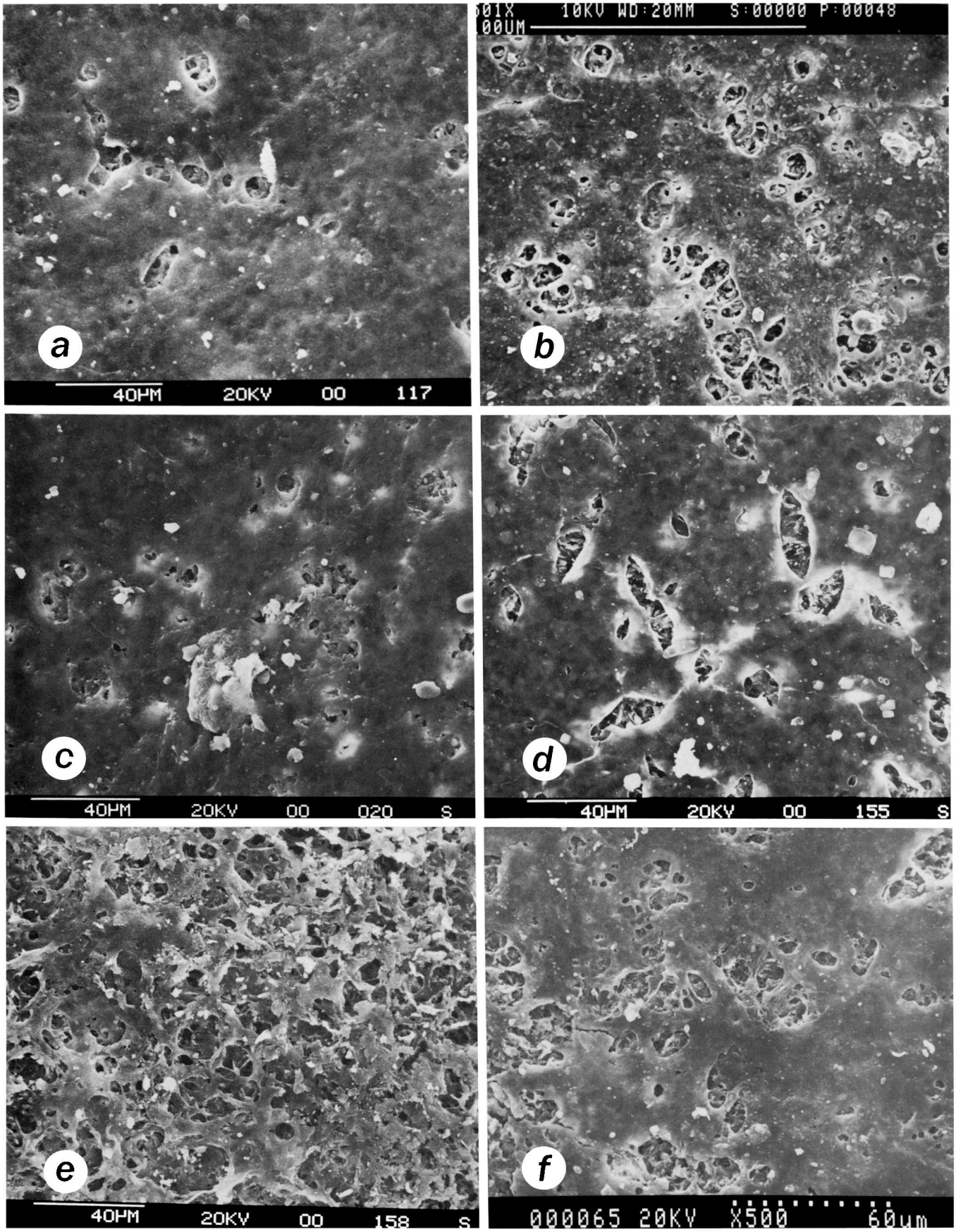
1. Very tightly adnate: Thallus very tightly appressed to the rock substrate, often appearing areolate at the center. I have used this description for 34 species, the majority of which occur in Australia or South Africa. Some better known ones are *X. alectoronica* (Figure 25*a*), *X. brunnthaleri* (Figure 29*b*), *X. conspersula* (Figure 33*d*), *X. exillima* (Figure 40*b*), *X. keralensis*, *X. mougeotii* (Figure 6), *X. neorimalis*, *X. worcesteri* (Figure 74*d*), and *X. xanthomelaena* (Figure 74*f*). This category includes most of the species called "subcrustose" by Elix, Johnston, and Armstrong (1986). I prefer not to use the term subcrustose because of confusion with the closely related, truly subcrustose species of *Karoowia* (Hale, 1989c) (previously classified as *Xanthoparmelia*).

The thallus of these often inconspicuous species ranges from 0.5 to 10 cm in diameter (usually 2–4 cm). They cannot be removed from the rock without considerable damage and fragmentation. Minimum lobe width varies from 0.2 mm in *X. mougeotii* (Figure 6) to 0.7 mm in *X. applicata*. The average for the group is 0.3 mm. Maximum width is 0.5–1.5 mm. In this respect the very tightly adnate species mimic not only *Karoowia* but also marginally lobate *Lecanora* species such as *Lecanora muralis* (Schreber) Rabenhorst, which are differentiated by the lack of rhizines.

2. Tightly adnate: Thallus tightly adnate or appressed on the substrate. The thallus is 1–10 cm broad and the center remains clearly lobate with the lobes varying from 0.2 to 1.0 mm in width. The average lobe width for this group is 0.6 mm and the lobes vary from sublinear to subirregular. Maximum width is 0.6–2.5 mm. Portions of the thallus may be scraped off with a knife, especially when wet, but dry specimens must be collected with the rock substrate to obtain a good specimen. There are 70 species described as tightly adnate, including, for example, *X. lineola* (Figure 48*d*), *X. novomexicana*, *X. oleosa*, and *X. parvoincerta* (Figure 58*b*), with most being rather rare Australian or southern African endemics.

3. Adnate: Thallus fairly closely attached to the substrate but with broader, generally sublinear to subirregular lobes that are contiguous and overlapping and with obtuse to more or less rotund tips. Minimum lobe width varies from 0.3 to 3.0 mm, averaging 0.9 mm, the maximum range being 1–7 mm. The thallus, 2–12 cm broad, can often be removed intact from the substrate, at least in part, especially when wet, but herbarium specimens often come attached to rock, depending on how much care the collector has used. This type of adnation is used to describe 146 species of *Xanthoparmelia*, including most of the familiar ones in temperate zones such as *X. conspersa* (Figure 33*c*), *X. cumberlandia* (Figure 8), *X. filarszkyana* (Figure 40*e*), *X. plittii*, *X. subdecipiens* (Figure

FIGURE 3 (right).—Surface features of *Xanthoparmelia* with SEM: *a*, *X. applicata* (Hale 77664); *b*, *X. barbellata* (*Hale* 63228); *c*, *X. camtschadalis* (*Savicz* 46a); *d*, *X. cumberlandia* (*Schroeder* 1478); *e*, *X. effigurata* (*Hale* 78468); *f*, *X. microlobulata* (*Hale* 76859, holotype).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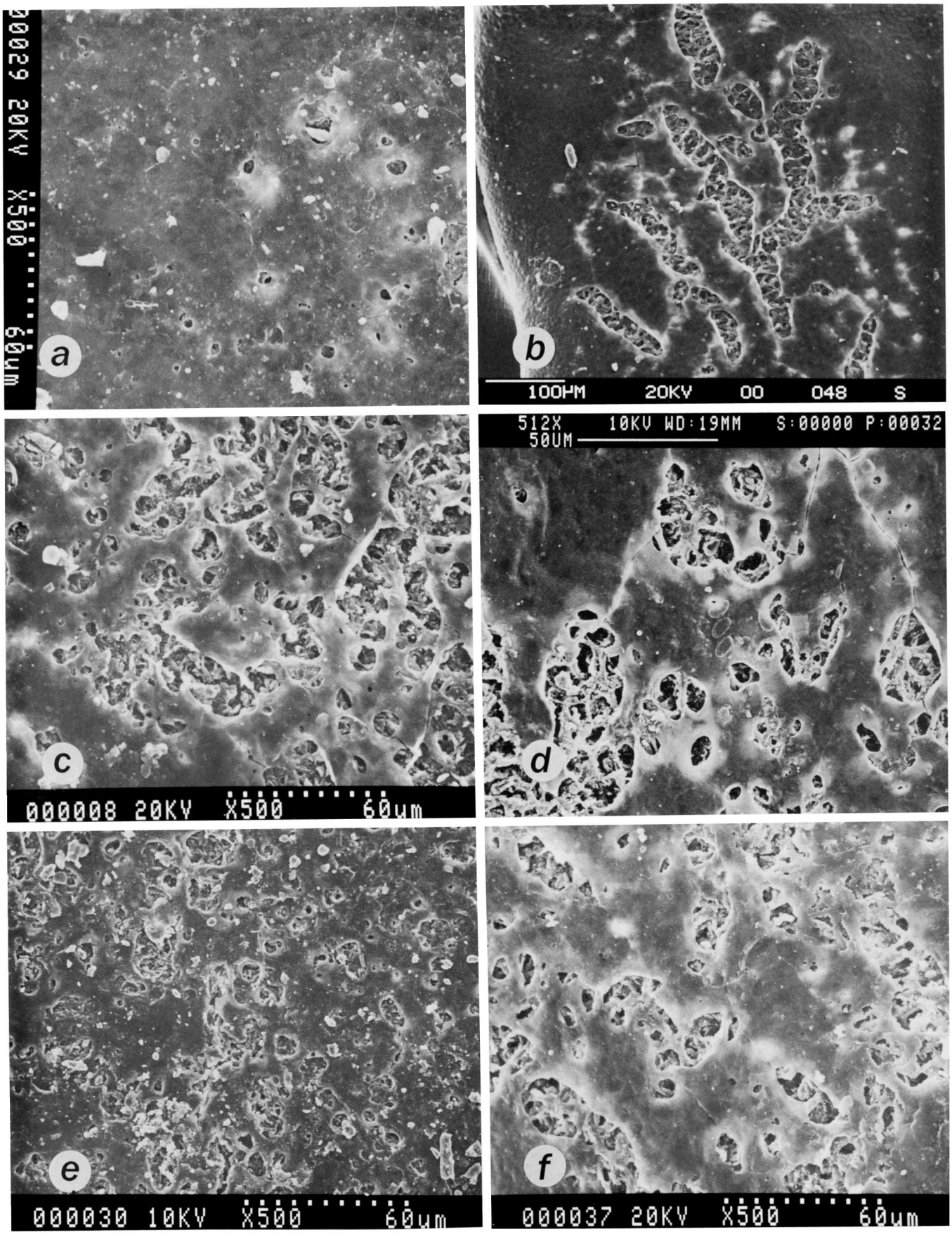
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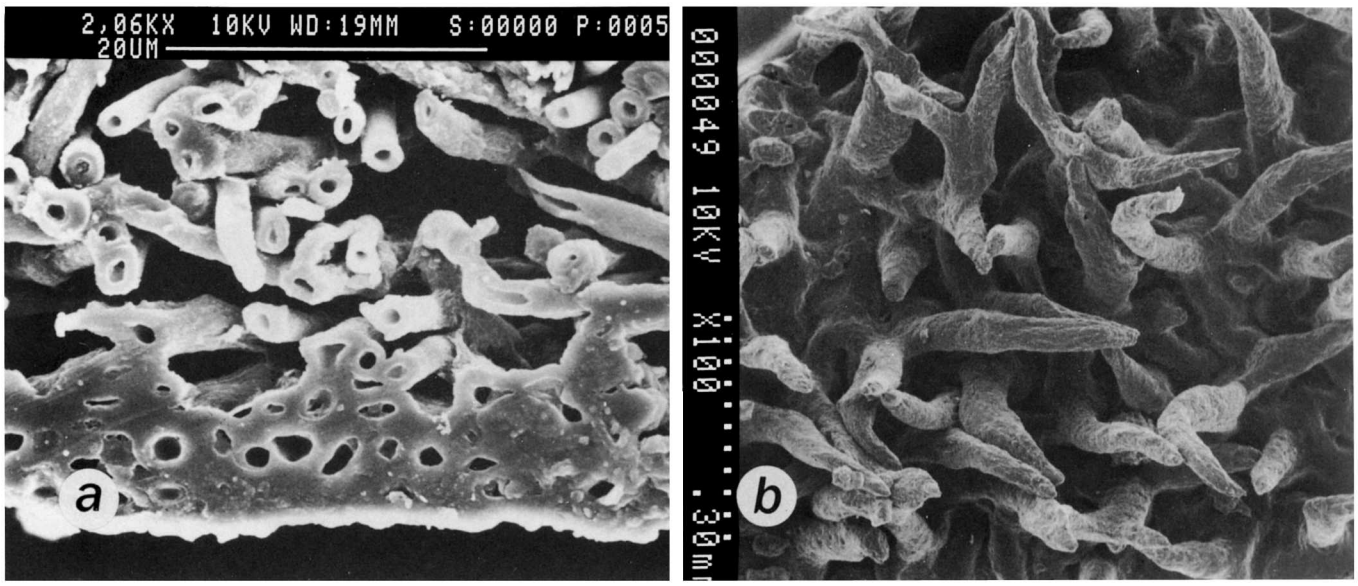


FIGURE 5.—Lower cortex and surface features of *Xanthoparmelia*: *a*, lower cortex of *X. lineola* (*Hale* 52046); *b*, rhizines of *X. africana* (*Hedberg* 1393 in UPS).

66*e*), and *X. tinctina* (Figure 71*a*).

4. Loosely attached: Thallus moderately adnate to nearly free growing but with at least some basal attachment (as in the *X. hypoleia* group or in *X. walteri*). The whole thallus, often attaining a diameter of 10–20 cm or more, is easily peeled from the substrate with a knife or even by hand and specimens for herbaria are rarely collected with the rock substrate. The lobes are usually sublinear, separate and sometimes divaricately branched, subascending in some species, and with sparsely to moderately developed, rarely furcate rhizines. Lobe width is extremely variable and reaches 6–10 mm in larger species such as *X. maxima* (Figure 49*f*), *X. phaeophana* (Figure 58*f*), and *X. substrigosa* (Figure 68*f*) but may be quite narrow (0.1–0.6 mm wide) and stringy in other species (e.g., *X. benyovszkyana* (Figure 28*c*), *X. eradicata* (Figure 39*b*), *X. esterhuyseniae* (Figure 39*d*), *X. metamorphosa* (Figure 50*c*), *X. planilobata* (Figure 59*c*), *X. rubrireagens* (Figure 62*e*), and *X. tenuiloba* (Figure 70*b*)). Excluding these seven stringy species with lobes less than 0.5 mm wide, the average minimum lobe width is 1.0 mm. Among the more common of the 131 species classified here are *X. australasica* (Figure 27*a*), *X. furcata* (Figure 41*d*), *X. protomatrae* (Figure 60*a*), *X. somloensis* (Figure 65*c*), *X. taractica* (Figure 69*e*), and *X. tasmanica* (Figure 69*f*).

5. Free growing: Thallus vagrant, growing free on soil and lacking any attachment, the lobes plain to moderately or strongly convoluted. The leathery thalli may be intact or fragmented into lobe-sized parts as in *X. camtschadalis* (Figure 30*c*), *X. chlorochroa* (Figure 31*e*), and *X. convoluta* (Figure 34*b*). Elenkin (1901b) graphically described desert forms of *X. desertorum* which are blown about by the wind. Lobe width is quite variable, from 0.5 mm in *X. concomitans* to 3 mm in *X. norconvoluta*, although some species have lobes at least 10 mm wide when unrolled. The lobes are convoluted, canaliculate, or channelled, and the thalli tend to curl up when dry. This very distinctive group includes 25 species: *X. amphixantha* (Figure 25*e*), *X. aurifera*, *X. australiensis* (Figure 27*b*), *X. beatricea* (Figure 28*a*), *X. bellatula* (Figure 28*b*), *X. camtschadalis* (Figure 30*c*), *X. chlorochroa* (Figure 31*e*), *X. concomitans*, *X. convoluta* (Figure 34*b*), *X. desertorum* (Figure 35*d*), *X. epigaea* (Figure 38*f*), *X. erosa*, *X. idahoensis* (Figure 44*d*), *X. kasachstania* (Figure 46*d*), *X. kotisephola* (Figure 46*f*), *X. lipochlorochroa* (Figure 48*e*), *X. neochlorochroa* (Figure 53*b*), *X. norchlorochroa* (Figure 55*c*), *X. norconvoluta*, *X. pachyclada* (Figure 57*e*), *X. reptans* (Figure 62*d*), *X. subdiffluens* (Figure 66*f*), *X. subflabellata*, *X. vagans* (Figure 72*e*), and *X. willisii* (Figure 74*b*).

The five categories of adnation outlined above obviously intergrade broadly and not every specimen can be rigidly assigned to one. Some might be called tightly adnate by one lichenologist, adnate by another. However, few would disagree on the "typical" species. For many species, however, overlapping descriptions are necessary, as "thallus tightly adnate to adnate," reflecting modifications imposed in extreme habitats. On the other hand, embracing too wide a range, as "thallus very tightly adnate to adnate," may indicate that two closely related species are being lumped.

One can find series of populations with identical chemistry and morphology which can be, and usually are, separated into

FIGURE 4 (left).—Surface features of *Xanthoparmelia* with SEM: *a*, *X. phaeophana* (Almborn 650); *b*, *X. namaquensis* (*Hale* 73018, holotype); *c*, *X. pseudohypoleia* (*Hale* 59911); *d*, *X. proximata* (*Hale* 76052, holotype); *e*, *X. subflabellata* (*Kärnefelt* 8448-9); *f*, *X. xanthomelaena* (*Hale* 77601).

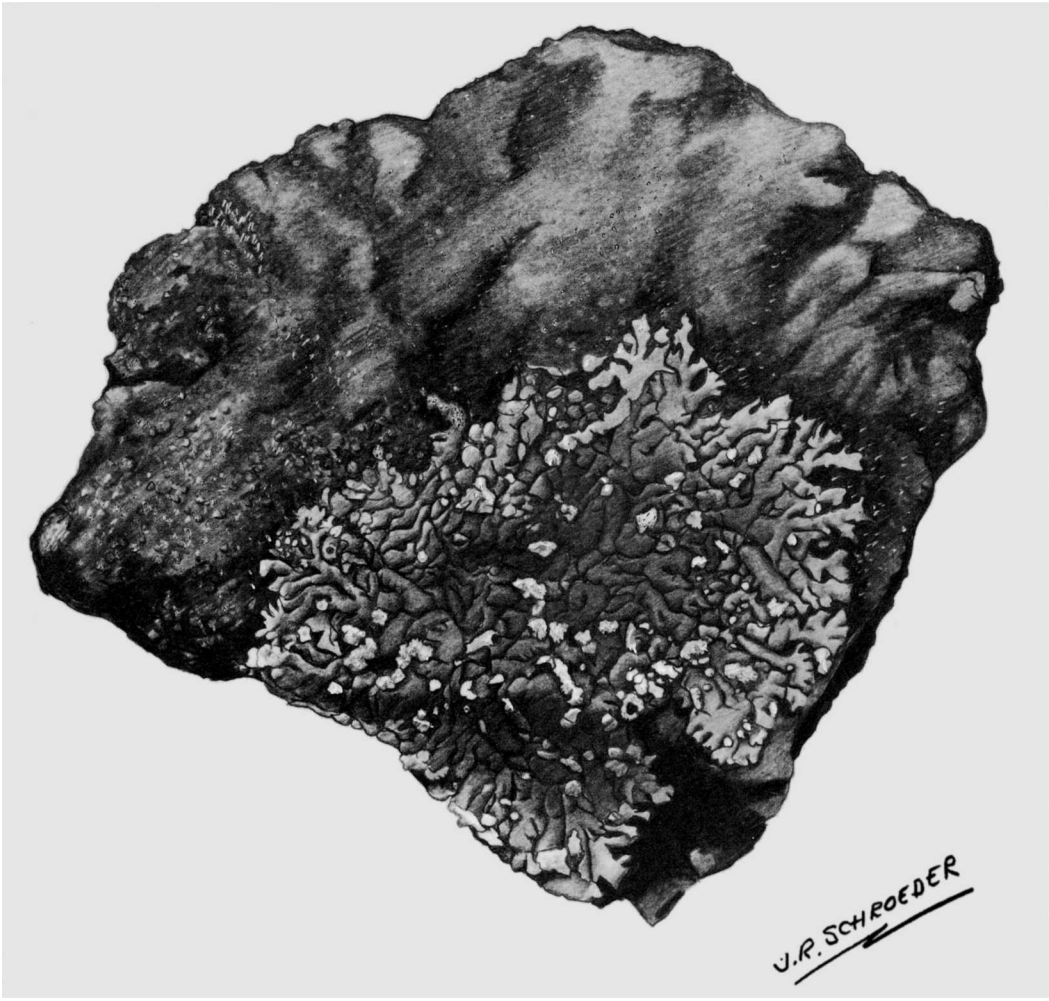


FIGURE 6.—Very tightly adnate thallus adnation of *X. mougeotii* (×3).

two or more distinct, adnation-based species. For example, in North America we have salazinic acid-containing *X. lineola* (adnate), *X. coloradoensis* (loosely adnate), *X. wyomingica* (loosely attached and convoluted), and *X. chlorochroa* (free growing), with a few troublesome intermediates which defy exact identification. We could fill in the series with Australian *X. neorimalis* (very tightly adnate). Other examples are the stictic acid-containing group of *X. substenophylloides* (tightly adnate)—*X. conspersa* (adnate)—*X. isidiascens* (loosely attached) and the hypoprotocetraric acid-containing group, *X. endochrysea* (tightly adnate)—*X. weberi* (adnate). Other African examples are *X. subamplexuloides* (tightly adnate)—*X. amplexuloides* (adnate); and *X. karoo* (adnate)—*X. hypoprotocetrarica* (loosely adnate). However, adnation is not always the only character used to separate these species.

LOBATION

Lobation is used to describe the width, branching, and orientation of thallus lobes. Of these only width can be quantified. It is fairly easy to measure the width of linear and sublinear lobes, which tend to have a uniform width throughout the length of the branches. There is greater variation in subirregular lobes, which tend to be rotund and wider at the tips. In these species I tried to select an axillary point where branching begins, not the point where the lobe broadens out to the maximum.

Actual measurements were calculated from photographs of specimens (often types) enlarged two to ten times and placed on a digitizing tablet linked to a computer. Ten randomly selected mature lobes from a single specimen were used to compute minimum, maximum, and average lobe width. The level of accuracy is about 0.1 mm, far better than can be obtained with a millimeter ruler under a binocular microscope. The final measurements of lobe width given in the species descriptions represent the computerized values enhanced where necessary with direct measurements from many different thalli.

Relatively long, narrow, little-branched lobes of uniform width are usually called linear or sublinear. The apices tend to be blunt and the lobes separate to divaricately branched. Many

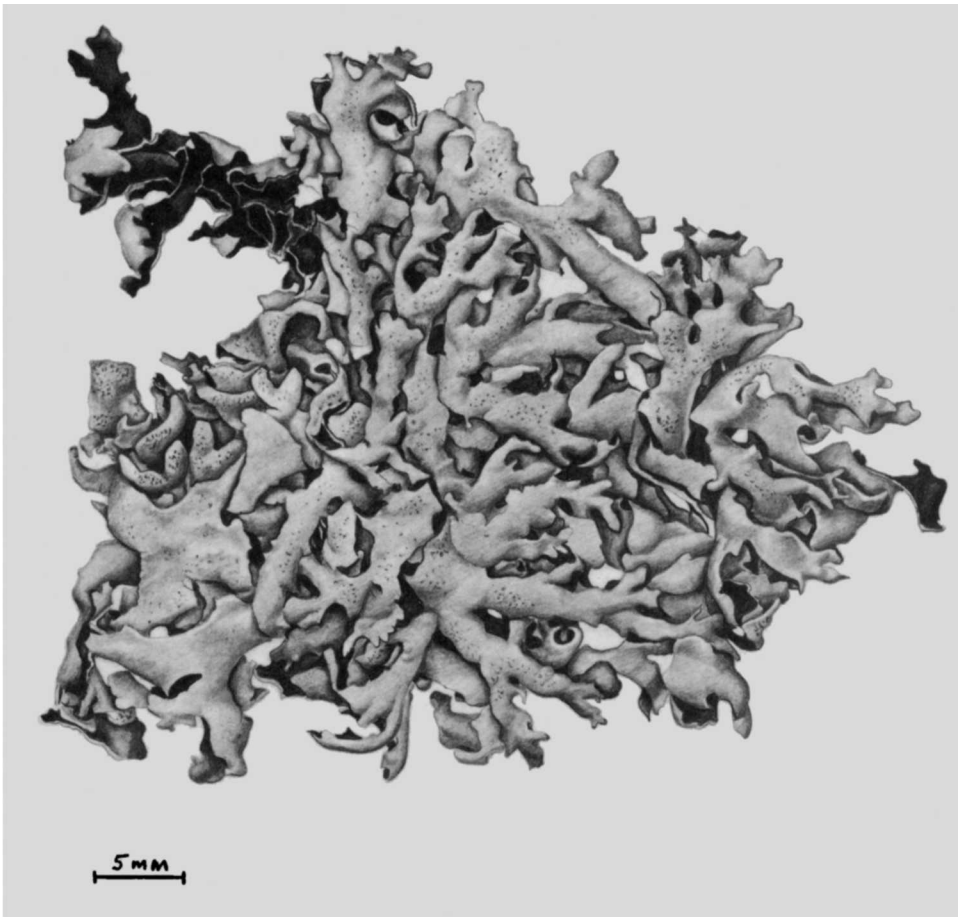


FIGURE 7.—Loosely adnate thallus adnation of *X. isidiascens*.

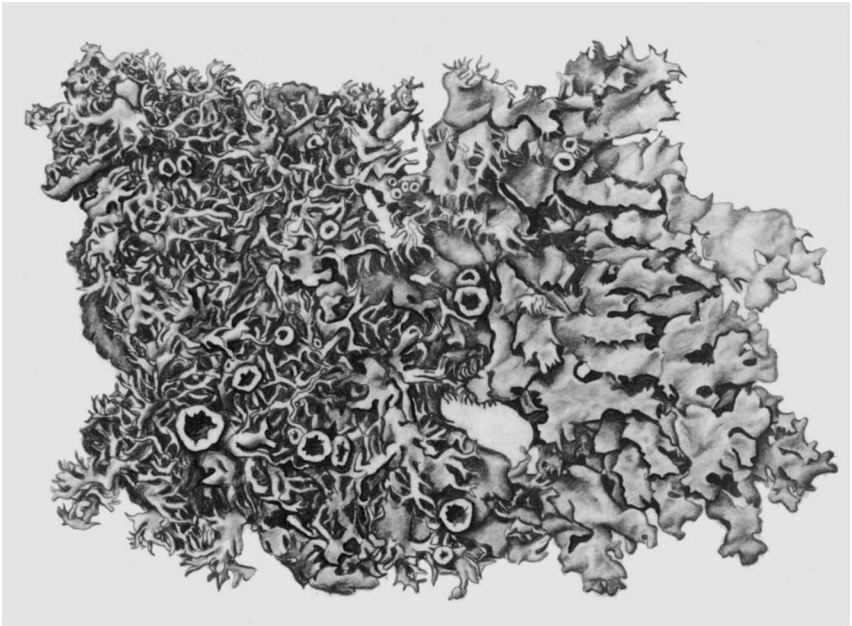


FIGURE 8.—Laciniate thallus of *X. cumberlandia* (×2).

soil-inhabiting and loosely adnate species have this configuration. I have described 21 species as having linear lobes. All of these are loosely adnate and vary in width from 0.1–0.3 mm (*X. esterhuyseniae*, Figure 39*d*)) to 1–2 mm (*X. subnuda*, Figure 67*e*), with most being 0.5–1 mm wide. Other examples are the *X. hypoleia* group, *X. metamorphosa* (Figure 50*c*), *X. neoreptans* (Figure 53*f*), *X. suberadicata*, and *X. tenuiloba* (Figure 70*b*).

The majority of the species (238), are called sublinear (see Figure 8). They have relatively elongate lobes which are more frequently branched and irregular in outline than the linear species. This category includes a large group of 40 species classified as very tightly adnate or tightly adnate, such as *X. exillima* (Figure 40*b*), *X. minuta*, and *X. mougeotii* (Figure 6), where minimum lobe width is less than 0.5 mm. The remaining species are usually adnate or loosely adnate and have a minimum lobe width of 0.5–3 mm, as in *X. angustiphylla* (Figure 26*b*), *X. camtschadalis* (Figure 30*c*), *X. somloensis* (Figure 65*c*), and *X. tasmanica* (Figure 69*f*).

The third category, subirregular, describes 147 species in the genus, including, for example, *X. conspersa* (Figure 33*c*), *X. cumberlandia* (Figure 8), *X. mexicana* (Figure 50*d*), *X. tinctina* (Figure 71*a*), and *X. ulcerosa* (Figure 72*b*). Minimum lobe width is 0.4–3 mm, most species falling in the range 1–3 mm with a maximum width of 3–9 mm in *X. maxima* (Figure 49*f*). The lobes are more irregularly branched and widened, contiguous to imbricate and more rotund in outline apically than those called linear or sublinear. The thalli are usually tightly adnate or adnate.

As with thallus adnation, there is considerable overlap in lobe configuration and I often use overlapping character states, such as subirregular to sublinear, in the descriptions.

Lobe margins are usually smooth and entire, as opposed to crenate, and sometimes black-rimmed. Gyelnik (1938a) eventually disregarded a black rim as a diagnostic character, but it can be a useful and stable character to separate some species, such as black-rimmed *X. pseudocongensis* and concolorous-rimmed *X. substenophylloides*.

As in most foliose lichen groups, small lobes (secondary laciniae) may regenerate from the margins of main lobes, especially towards the center of the thallus with age. Although secondary laciniae may be found in almost any species of *Xanthoparmelia*, relatively few species regularly produce them. A good example is *X. cumberlandia* (Figure 8) as well as about 40 other species, such as *X. angustiphylla* (Figure 26*b*) and Australian *X. digitiformis*, and *X. glareosa*. Several Australian species, *X. examplaris* (Figure 40*a*) and *X. incrustata*, terricolous *X. bellatula* (Figure 28*b*), *X. eilifii*, and *X. terrestris* (Figure 70*d*), have laciniae with a convoluted lower surface. The South African *X. microlobulata* (Figure 50*e*) is covered with tiny lobules.

Another interesting group of 10 terricolous species has suberect secondary laciniae which become subterete or terete in cross section with no dorsiventrality, almost seeming like monstrously developed isidia. This group includes *X. aggregata* (Figure 24*d*), *X. alternata*, *X. amphixanthoides* (Figure 25*f*), *X. durietzii* (Figure 37*d*), *X. molliuscula* (Figure 51*b*), *X. neowyomingica* (Figure 55*a*). *X. norpumila*, *X. pumila* (Figure 61*c*), and *X. tolucensis* (Figure 71*b*). The extreme example of this is *X. cylindriloba* (Figure 35*a*), a curious high elevation species in Kenya which consists almost entirely of terete lobes.

Other lobe characters are used to describe species. *Xanthoparmelia constrictans* (Figure 33*f*) and *X. endochromatica* (Figure 38*b*), among a few others, have irregularly constricted lobes. Other species have a strongly convex rather than plane lobe surface, such as *X. effigurata* (Figure 37*f*), *X. inflata* (Figure 45*b*), *X. namakwa* (52*b*), *X. serusiauxii* (Figure 64*e*), and *X. tumidosa* (Figure 72*a*). An extreme case is inflated-bullate *X. toninioides* (Figure 71*c*). Most species have a smooth surface, but some, such as *X. granulata* (Figure 42*c*), *X. paradoxa* (Figure 57*f*), *X. perrugosa* (Figure 58*d*), and *X. springbokensis* (Figure 65*d*), are conspicuously rugose at maturity. Finally, the majority of the species develop transverse cracks on the older parts of the thallus.

Lower Surface

There are three main characters of the lower surface that are used to delimit species: planeness, color, and nature of rhizines.

Lower Surface Planeness.—Of the 406 species of *Xanthoparmelia*, the great majority, some 361, almost all saxicolous, have a plane or flat lower surface more or less uniformly vested with rhizines. Familiar species are *X. conspersa*, *X. cumberlandia*, *X. somloensis*, and *X. tasmanica*. A few, such as *X. denudata*, *X. hyporhytida*, *X. planilobata*, *X. rubrireagens*, *X. subcolorata*, and *X. walteri*, are conspicuously rugose at maturity. The lower surface is most often shiny but becomes dull in some species with a black lower surface, as the *X. schenckiana* group and the *X. walteri* group. In *X. denudata*, *X. hyporhytida*, *X. subcolorata*, and even *X. phaeophana*, the lower surface appears to disintegrate with age, leaving a whitish erhizinate area of exposed hyphae at the center, or in the case of pigmented species such as *X. denudata* and *X. subcolorata* an orange or ochre colored area.

Twenty-five species have a convoluted lower surface; that is, the lobe edges turn downward and roll inward (Figure 9). Of this conspicuous group, the following species are rather weakly convoluted in that the rhizines are more or less visible on the incompletely inrolled lower surface: *X. duplicata* (Figure 37*c*), *X. eilifii*, *X. epigaea* (Figure 38*f*), *X. leonora* (Figure 48*b*), *X. neowyomingica* (Figure 55*a*), *X. standaertii* (Figure 65*e*), *X. subdistorta* (Figure 67*a*), *X. sulcifera*, *X. terrestris* (Figure 70*d*), and *X. wyomingica* (Figures 9, 74*e*). Another group of species has rather strongly convoluted lobes but still not forming tubes: *X. camtschadalis* (Figure 30*c*), *X. chlorochroa* (Figure 31*e*), *X. erosa*, *X. kasachstania* (Figure 46*d*), *X. kotisephola* (Figure 46*f*), *X. lipichlorochroa* (Figure 48e), *X. neochlorochroa* (Figure 53*b*), *X. norconvoluta*, and *X.*

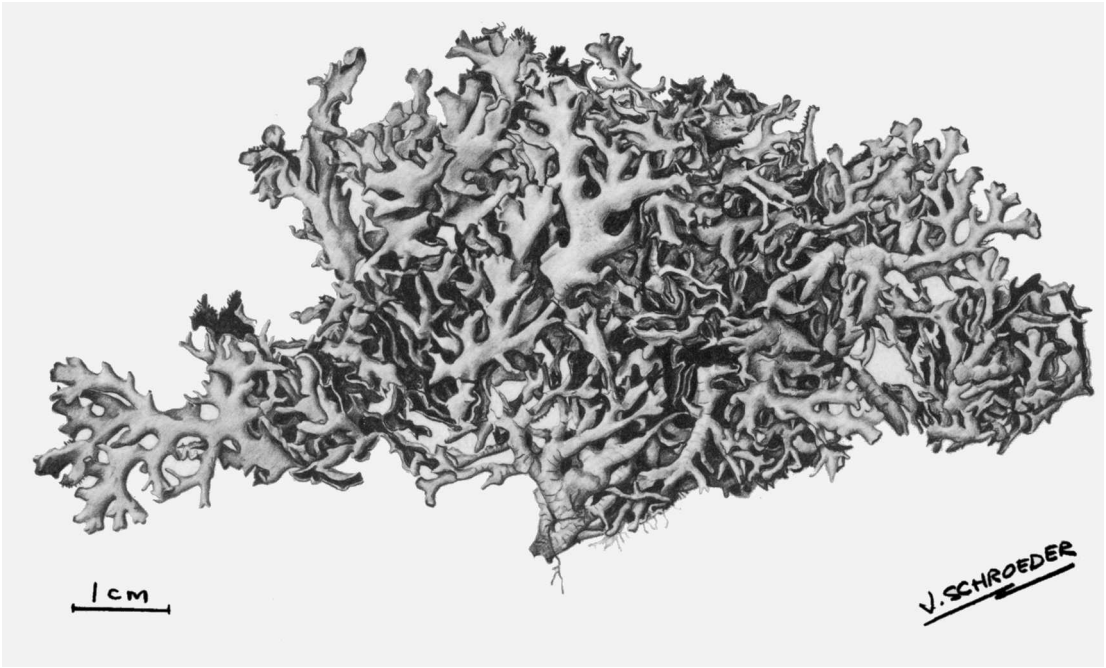


FIGURE 9.—Convoluted lobes of *X. wyomingica*.

vagans (Figure 72*e*). The remaining species have more strongly convoluted lobes that form tubes which, when turned over, seem to lack dorsiventrality: *X. beatricea* (Figure 28*a*), *X. convoluta* (Figure 34*b*), *X. desertorum* (Figure 35*d*), *X. norchlorochroa* (Figure 55*c*), *X. norconvoluta*, and *X. pachyclada* (Figure 57*e*). Of course the variation in one species may span moderately to strongly convoluted.

A final small group of 20 rather closely related species have a canaliculate lower surface which is barely or not at all convoluted and with the margins being somewhat raised and lighter colored than the rest of the surface (Figure 10). Rhizines are usually only very sparsely produced and are often much darker than the lower surface. Included here are *X. aggregata* (Figure 24*d*), *X. alternata*, *X. amphixantha* (Figure 25*e*), *X. amphixanthoides* (Figure 25*f*), *X. aurifera*, *X. bellatula* (Figure 28*b*), *X. benyovszkyana* (Figure 28*c*), *X. callifolioides* (Figure 30*a*), *X. concomitans*, *X. idahoensis* (Figure 44*d*), *X. molliuscula* (Figure 51*b*), *X. neoreptans*, *X. norpumila*, *X. peruviensis* (Figure 58*e*), *X. pseudoamphixantha* (Figure 60*d*), *X. pumila* (Figure 61*c*), *X. reptans* (Figure 62*d*), *X. salamphixantha* (Figure 63*c*), *X. subflabellata*, and *X. willisii* (Figure 74*b*). Most of these are terricolous, but, unlike the convoluted species, generally remain flat or curl upward when dry.

LOWER SURFACE COLOR.—Color of the lower surface has been used in many foliose lichen genera as a species character (Elix, Johnston, and Armstrong, 1986; Filson, 1982) although, as with many other lichen characters, we know nothing of the origin and morphogenetic or adaptive significance of this trait. As a general rule there are two character states: black (carbonized, with a nonextractable black pigment) and pale (noncarbonized), varying from nearly ivory white to pale or darker brown. A few species with dense concentrations of skyrin (especially *X. denudata*, *X. luminosa*, *X. subcolorata*, *X. subdomokosii*, and *X. subpigmentosa*) appear to have an orange or mottled brown-orange lower surface.

Some 162 species of *Xanthoparmelia*, including widespread *X. conspersa* and *X. tasmanica*, have a constantly black lower surface. There may be a marginal dark brown zone but the

FIGURE 10.—Canaliculate lower surface of *X. pseudoamphixantha* (*Hale* 68538) (×10).

center is always jet black and the rhizines dark brown to black. All, except for convoluted *X. norchlorochroa,* have a plane lower surface.

At the other extreme are 244 species, more than half of the genus, which have a pale to moderately brown lower surface and concolorous rhizines. Often the marginal zone is darker than the center. Representative species here are *X. camtschadalis, X. cumberlandia, X. filarszkyana, X. flavescentireagens, X. lineola, X. mexicana, X. phaeophana, X. plittii, X. protomatrae, X. somloensis,* and *X. ulcerosa.* Fifty-five of these species have a consistently darker brown but not blackening lower surface. The best examples are *X. furcata* and *X. scabrosa.*

The importance of lower surface color as a species character has not been challenged. There is a group of at least 14 species pairs, one with a pale lower surface and one with a black one. The species are otherwise identical in chemistry and morphology.

Pale Below	Black Below
X. amplexula	*X. thamnoides*
X. barklyensis	*X. aliphatica*
X. cumberlandia	*X. angustiphylla*
X. furcata	*X. dichotoma*
X. namakwa	*X. effigurata*
X. neopropaguloides	*X. substenophylloides*
X. neosynestia	*X. synestia*
X. oleosa	*X. nigraoleosa*
X. plittii	*X. conspersa*
X. psoromifera	*X. nigropsoromifera*
X. scabrosa	*X. verdonii*
X. subramigera	*X. mbabanensis*
X. subsorediata	*X. wrightiana*
X. ulcerosa	*X. microspora*

ISIDIA

Isidia occur in 118 species, about 29% of the total 406 *Xanthoparmeliae.* This is of the same order of magnitude as most other parmelioid genera. With only two exceptions (*X. treurensis* and *X. xizangensis*) they are absent in species with a maculate or effigurate-maculate cortex as well as the free-growing soil species. There is no apparent correlation between the presence of isidia and either chemistry or color of the lower surface.

Although Gyelnik (1931a:157) carefully distinguished the cylindrical isidia of *Parmelia isidiata* (= *X. conspersa*) from the barrel-shaped ("kugelig") isidia of *P. korosi-csomae* (= *X. tinctina*), variations in isidial structure were not fully appreciated until Kurokawa and Filson (1975) and Elix (1981) began to distinguish between cylindrical, globose, and pustular types, many of which were first described from Australian species. These isidial types are relatively easy to recognize but the total range of variation has not yet been established. There are two basic shapes, cylindrical and globose. The diameter of isidia given in the species descriptions were determined from SEM photographs taken at 150× for all the species, most of which are illustrated in Figures 11–23. Isidial height was determined under a binocular.

Cylindrical isidia are more or less uniformly thickened and entirely corticate. The tips are entire and syncorticate and may be quite shiny or blackened (Figures 11*a, b*). These isidia are identical with those found in other typically isidiate foliose genera. In *Xanthoparmelia* there are 73 isidiate species of this isidial form, among them *X. amplexula* (Figure 12*g*), *X. australasica* (Figure 13*b*), *X. conspersa* (Figure 14*a*), *X. mexicana* (Figure 17*b*), *X. mougeotina* (Figure 17*e*), *X. plittii* (Figure 18*g*), and *X. subramigera* (Figure 20*b*). The isidia may remain simple, commonly 0.02–0.2 mm in diameter and up to 2 mm high. They may also branch and even form dense coralloid masses, as in *X. antleriformis* (Figure 12*i*), *X. conspersa,* and *X. neotinctina.* Gyelnik's emphasis on branching density was misplaced, according to our present knowledge. On the other hand, diameter of the isidia appears to be a useful character for separating *X. australasica* (Figure 13*b*) and *X. isidiigera* (Figure 15*i*). As a rule, the smaller the thallus and lobes, the smaller the isidia, with a rough correlation between lobe width and isidial diameter. Naturally there are a few exceptions, as narrow lobed *X. phillipsiana,* which has abnormally large isidia (Figures 18*e,* 59*a*).

The second type of isidium, the globose form, is generally short and inflated or basally constricted, 0.07–0.2 mm in diameter and usually less than 0.2–0.3 mm high with little if any branching. Except for *X. tinctina,* which remains syncorticate, they often appear to be hollow or dactyliform or at least break open very easily. At maturity they erode but usually do not become sorediate, a condition which Elix, Johnston, and Armstrong, (1986) call erumpent. Viewed under SEM, the isidial tip of the majority of species appears to be loosely epicorticate with the epicortex finally breaking down (Figures 11*c, d*). Here we find a distinctive group of 33 species, almost all in Australia and South Africa, with typical examples being *X. centralis* (Figure 13*g*), *X. congensis, X. flindersiana, X. globulifera* (Figure 11*c*), *X. isidiosa* (Figure 16*a*), *X. kalbii* (Figure 16*c*), *X. praegnans* (Figure 18*h*), and *X. tenacea* (Figure 20*f*).

In a few species with cylindrical isidia the apical portion breaks down and becomes pustulate or pustulate-sorediate. Species with these so-called pustulate isidia include the mostly Australian species *X. alexandrensis* (Figure 12*e*), *X. constipata, X. cordillerana* (Figure 14*b*), *X. pustuliza* (Figure 19*b*), *X. scabrosa* (Figure 19*e*), and *X. verdonii* (Figure 21*c*). As a group these species are probably not distinct from globose isidiate species, and there is the expected variation in isidial shape from globose to cylindrical.

There are two sets of species which have identical chemistry (norlobaridone) and morphology except that one has normal

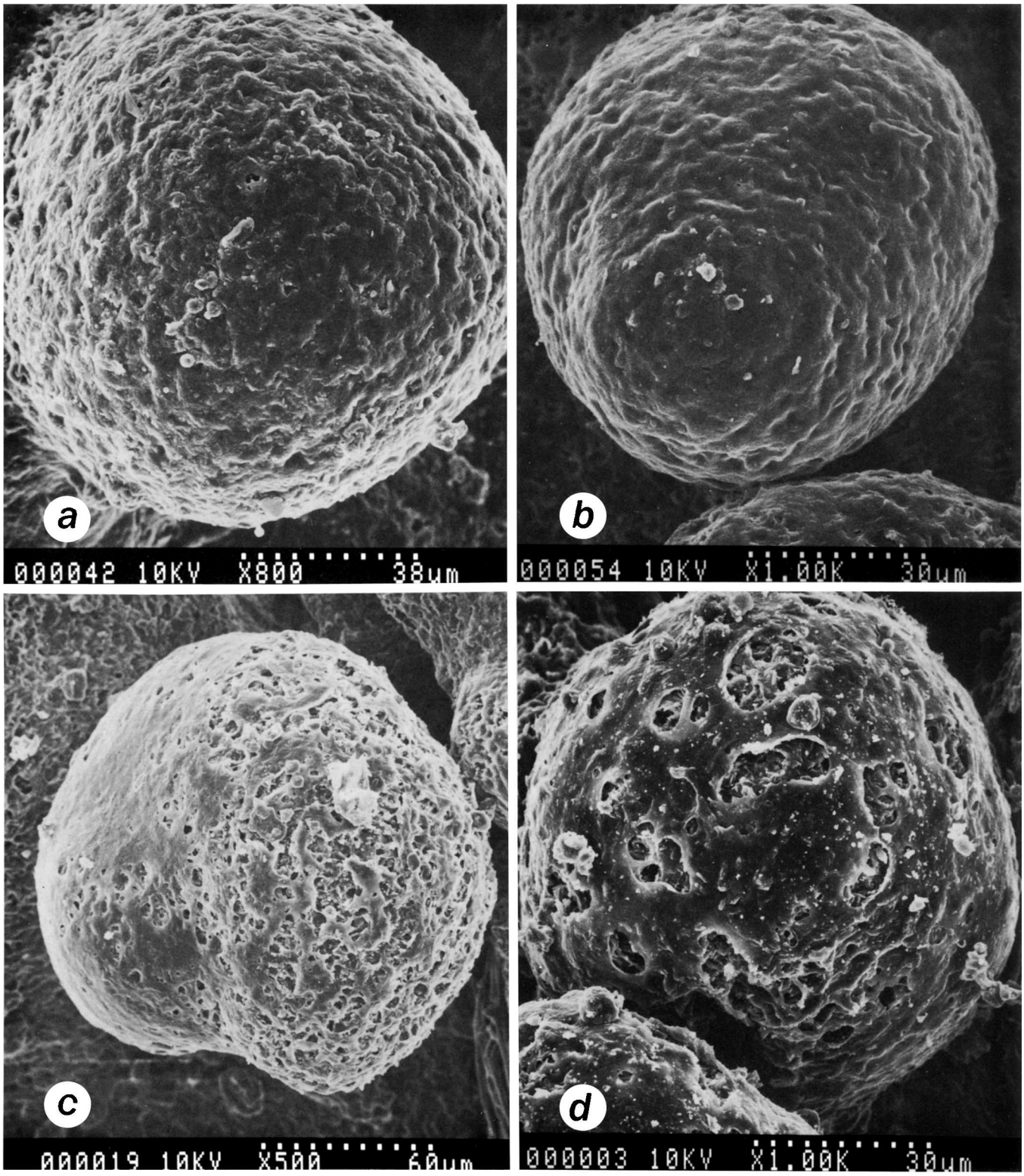


FIGURE 11.—Closeup of isidial tips with SEM: *a*, *X. catarinae* (Poeschmann-Hájková 761)(syncorticate); *b*, *X. consociata* (*Hale* 59409) (syncorticate); *c*, *X. globulifera* (*Day* 10848 in CBG)(epicorticate); *d*, *X. lavicola* (*Amable* 600, lectotype in BP) (epicorticate).

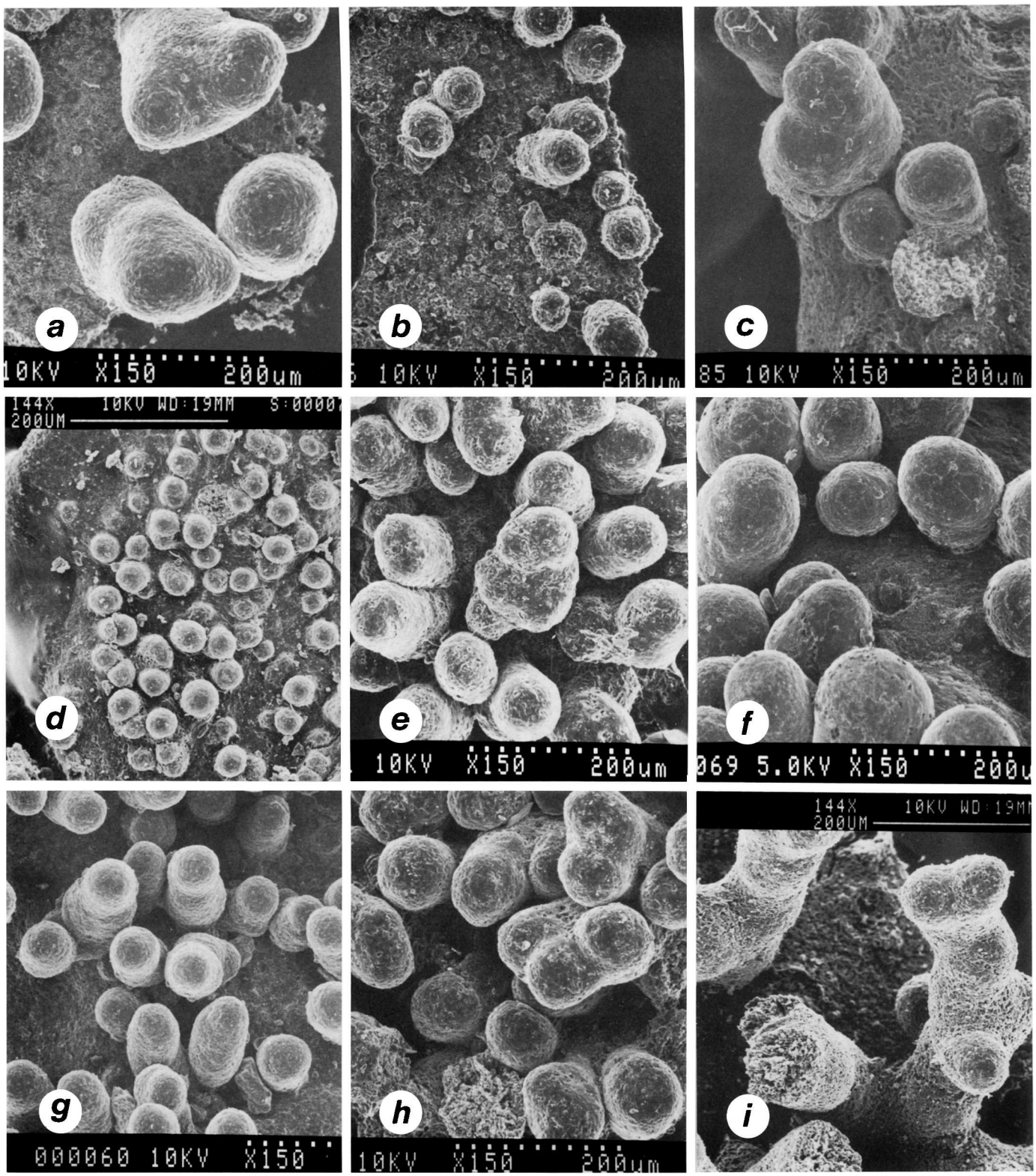


FIGURE 12.—Isidia of *Xanthoparmelia* species with SEM: *a*, *X. adleri* (*Adler* s.n.); *b*, *X. afrolavicola* (*Hale* 74104, holotype in US); *c*, *X. ajoensis* (Egan 7123); *d*, *X. alectoronica* (*López and Smith* 21216A, isotype in US); *e*, *X. alexandrensis* (*Elix* 11541); *f*, *X. amableana* (*Amable* 653, lectotype in BP); *g*, *X. amplexula* (*Hale* 58498); *h*, *X. amplexuloides* (*Hale* 78874); *i*, *X. antleriformis* (*Hale* 59552).

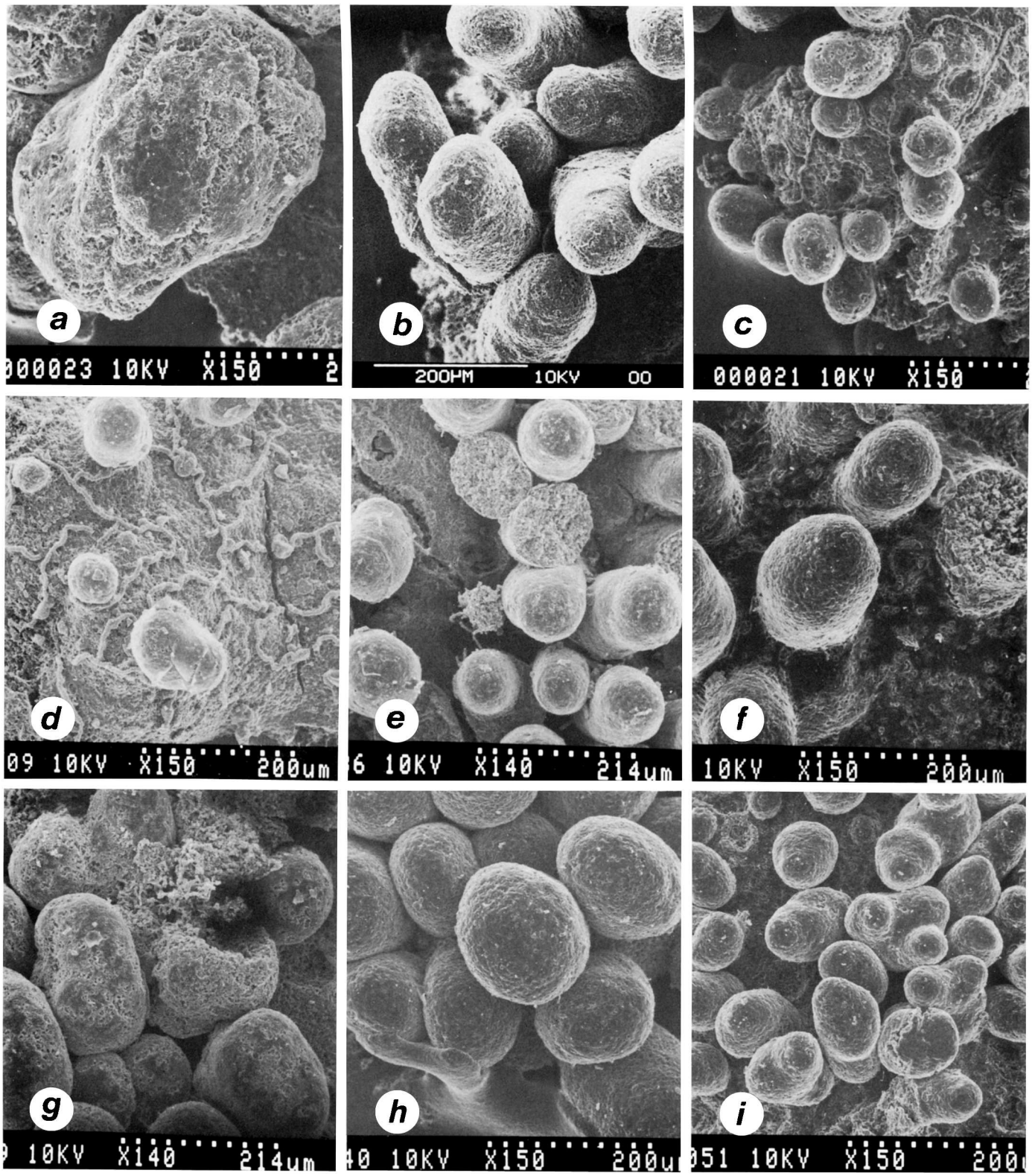


FIGURE 13.—Isidia of *Xanthoparmelia* species with SEM: *a*, *X. areolata* (Hale 76267, holotype in US); *b*, *X. australasica* (*Bartlett* s.n., isotype in BM); *c*, *X. ballingalliana* (*Elix* 20490, holotype in CBG); *d*, *X. blackdownensis* (*Verdon* 5234, holotype in CBG); *e*, *X. capensis* (*Hale* 74046, holotype in US); *f*, *X. catarinae* (*Poeschmann-Hájková* 761, holotype in US); *g*, *X. centralis* (*Elix* 11172, holotype in CBG); *h*, *X. clivorum* (*Brusse* 3069, holotype in PRE); *i*, *X. consociata* (*Hale* 59409).

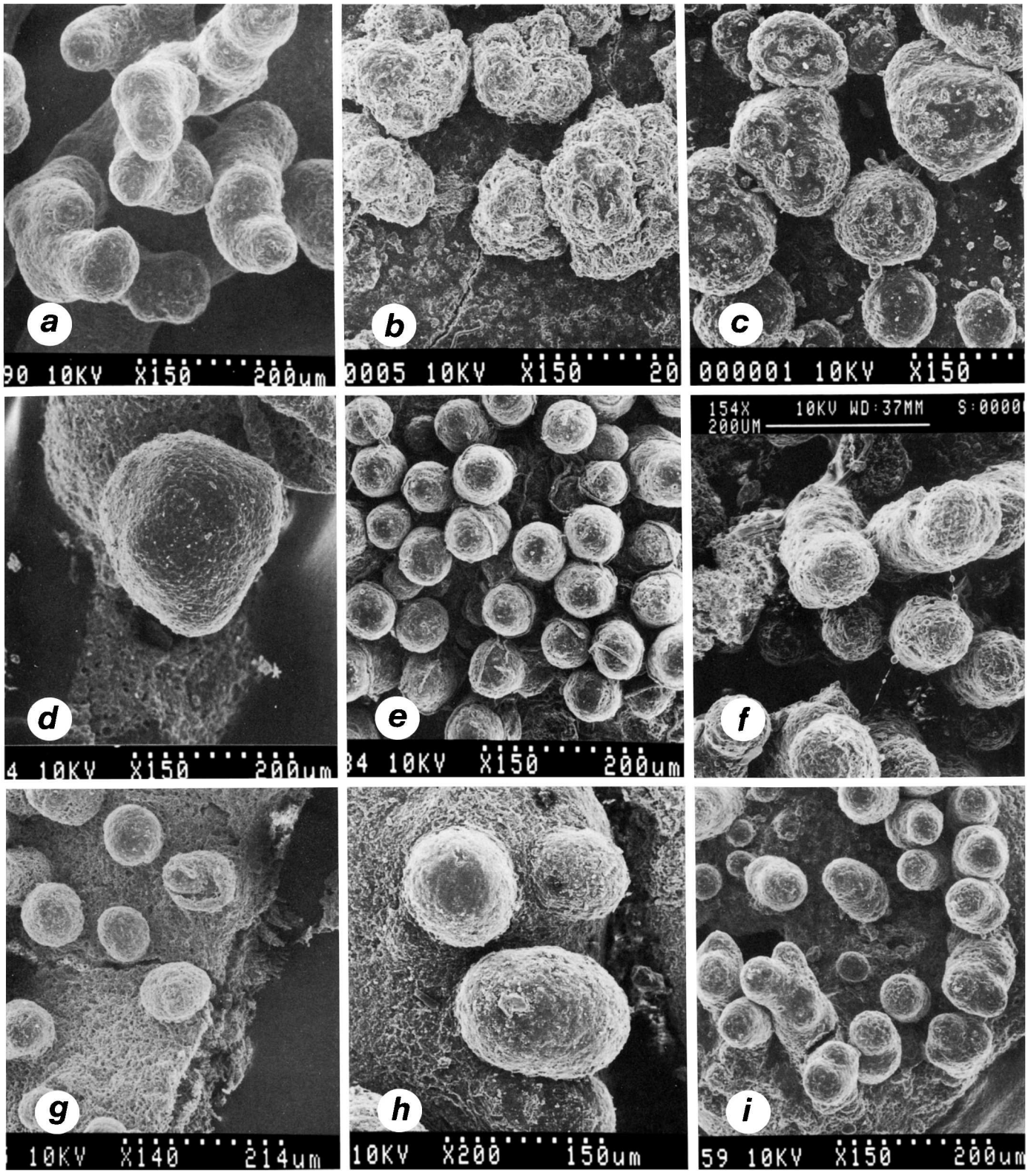


FIGURE 14.—Isidia of *Xanthoparmelia* species with SEM: *a*, *X. conspersa* (Plitt 10608); *b*, *X. cordilleriana* (*Hale* 66597); *c*, *X. coreana* (*Hale* 29444); *d*, *X. dayiana* (*Hale* 68892); *e*, *X. diadeta* (*Hale* 81219); *f*, *X. dierythra* (*Hale* 23628); *g*, *X. endochrysea* (*Schweinfurth* s.n., lectotype in G); *h*, *X. evernica* (*Hale* 75120); *i*, *X. exillima* (*Hale* 58495).

cylindrical isidia and one pustulate isidia: *X. amplexula* and *X. scabrosa*, both with a brown lower surface; and *X. thamnoides* and *X. verdonii*, both with a black lower surface.

A third type of isidium may be called bullate or pustulate. These are consistently larger than either cylindrical or globose isidia, at least 0.2–0.3 mm in diameter. In a few cases such as *X. granulata*, they are close to the true pustules of lichens such as *Flavoparmelia baltimorensis* (Gyelnik) Hale, where the pustules erupt into coarse soredia. In *Xanthoparmelia* they may burst open and become granular-sorediate or remain entire. Species which I include here are *X. coneruptens*, *X. eruptens* (Figure 39*c*), *X. granulata* (Figure 42*c*), *X. glomerulata*, *X. pustulifera* (Figure 61*d*), *X. pustulosorediata* (Figure 61*f*), *X. saleruptens* (Figure 63*d*), *X. saniensis* (Figures 19*d*, 63*f*), and *X. subbullata* (Figure 66*b*), all confined to Africa.

Isidia have had considerable importance as a species character since the days of Nylander. Most lichenologists have used them consistently in recognizing species, except for Müller Argoviensis (1888c:195) and a few modern workers (Tehler, 1982). There are, however, not as many isidiate-nonisidiate species pairs in *Xanthoparmelia* as one might imagine, considering the large number of isidiate species. Few have been adequately studied in the field:

Nonisidiate	Isidiate
X. albomaculata	*X. treurensis*
X. angustiphylla	*X. conspersa*
X. arida	*X. joranadia*
X. californica	*X. dierythra*
X. cumberlandia	*X. plittii*
X. dissitifolia	*X. filsonii*
X. elaeodes	*X. thamnoides*
X. luminosa	*X. subluminosa*
X. proximata	*X. minuta*
X. psoromifera	*X. lavicola*
X. stenosporonica	*X. keralensis*
X. subnigra	*X. transvaalensis*
X. tucsonensis	*X. ajoensis*

The remaining isidiate species of *Xanthoparmelia* appear to have no extant parent morphs although some will undoubtedly be found with more intensive field collecting.

SOREDIA

Soredia occur in only 13 species of *Xanthoparmelia: X. aurifera*, *X. concomitans*, *X. cotopaxiensis*, *X. erosa*, *X. farinosa* (Figure 40*c*), *X. ferraroiana*, *X. microspora* (Figure 50*f*), *X. mougeotii* (Figure 51*e*), *X. submougeotii* (Figure 67*d*), *X. ulcerosa* (Figure 72*b*), *X. wildeae* (Figure 74a), and *X. xanthosorediata* (Figure 75*b*). This is far fewer species than one would predict in a typical foliose genus where 30% or more may be sorediate. The soralia are all laminal and orbicular. The greatest number of sorediate species occurs in South America and Australia, but there are no species in common between these two continents. The only one in the northern hemisphere is pantemperate *X. mougeotii*. Sorediate-nonsorediate morphs are clearly developed in *X. amphixantha-X. aurifera*, *X. convoluta-X. erosa* and perhaps *X. reptans-X. concomitans*.

Reproductive Structures

APOTHECIA

Apothecia have been found in 254 of the 406 species in the genus. Usually they are adnate to sessile in very tightly adnate or tightly adnate species, and adnate to substipitate in loosely attached species. The disc is chestnut brown or lighter and plane to somewhat concave. The diameter varies from 0.3–1 mm in very tightly adnate species to 10–15 mm in large, loosely attached species. As one would expect, they occur more frequently in nonisidiate species (80%) than in the isidiate species (55%). Apothecia are known for four of 13 sorediate species.

The ontogeny of apothecia in the Parmeliaceae has been given relatively little attention compared to the crustose families. According to Henssen (1981), the Parmeliaceae are separated from other families in the suborder Lecanorineae by the formation of a meristematic cupular exciple and a complicated differentiation of the centrum. There is a hyaline layer below the hypothecium, interspersed by connecting hyphae, a unique feature among lichenized ascomycetes. The genera in the family agree fairly well in the main steps of development.

The only detailed study of a *Xanthoparmelia*, *X. conspersa*, was published by Letrouit-Galinou (1970), who considers it to have essentially the same developmental pattern as *Parmelia acetabulum*. Henssen (1981) discusses the development of ascocarps in *Parmelia exasperata* and emphasizes the uniqueness of a hyaline layer below the hypothecium. Bellemère and Letrouit-Galinou (1981) speak of a *Parmelia*-type ascus, which has an apical dome developed into a plug with three concentric regions, lacks a subapical pad, and lacks or has an extremely reduced pendant organ. These observations were based on *P. acetabulum*, now recognized in the genus *Pleurosticta* Petrak (Lumbsch, Kothe, and Elix, 1988).

While Hawksworth (1988) states that excipular structure in the parmelioid genera shows considerable variation (without citing any specific examples) and that some of the species of *Xanthoparmelia* will ultimately be recognized under other excipular-based generic names, no one so far has discovered any significant differences in structure and development of apothecia in the Parmeliaceae (sensu stricto).

SPORES.—While apothecia may be quite well developed, spores are sometimes immature or absent. Where good data are available (in 219 of the 233 species with apothecia), spore size is extremely uniform, as previous workers have often noted (Kušan, 1932; Elix, Johnston, and Armstrong, 1986). Width varies from 4–8 µm and length from 6–13 µm. Data on maximum spore size distribution for 218 fertile species is summarized in Figure 22.

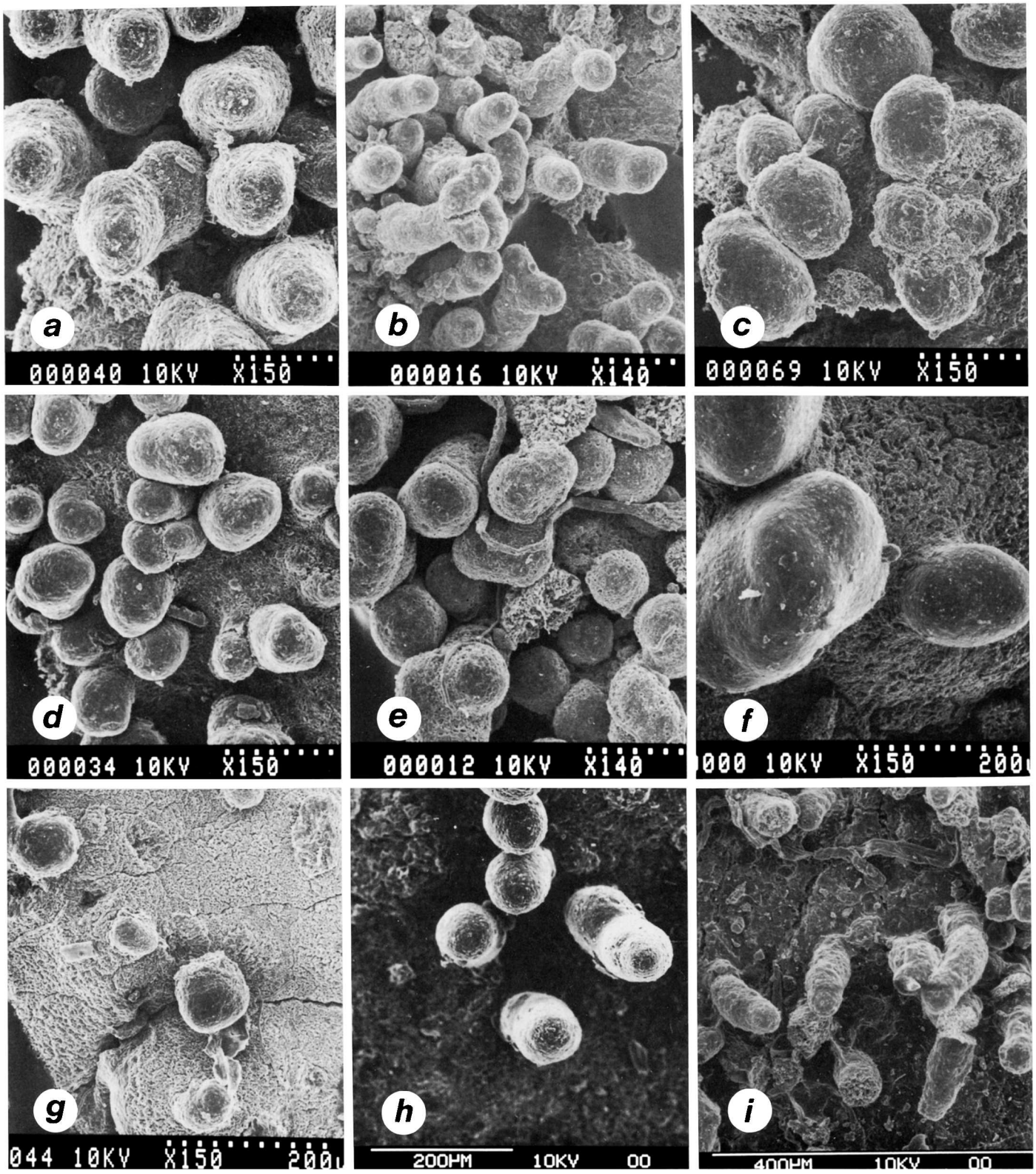


FIGURE 15.—Isidia of *Xanthoparmelia* species with SEM: *a, X. exuviata* (Hale 66632); *b, X. filsonii* (*Elix* 16639); *c, X. geesterani* (*Degelius* SA-451); *d, X. globisidiosa* (*Hale* 72030, holotype in US); *e, X. gongylodes* (*Elix* 18008, holotype in CBG); *f, X. harrisii* (*Hale* 81203, holotype in US); *g, X. immutata* (*Hale* 66633); *h, X. isidiascens* (*McVaugh* 4588, holotype in US); *i, X. isidiigera* (*Harris* 52, lectotype in G).

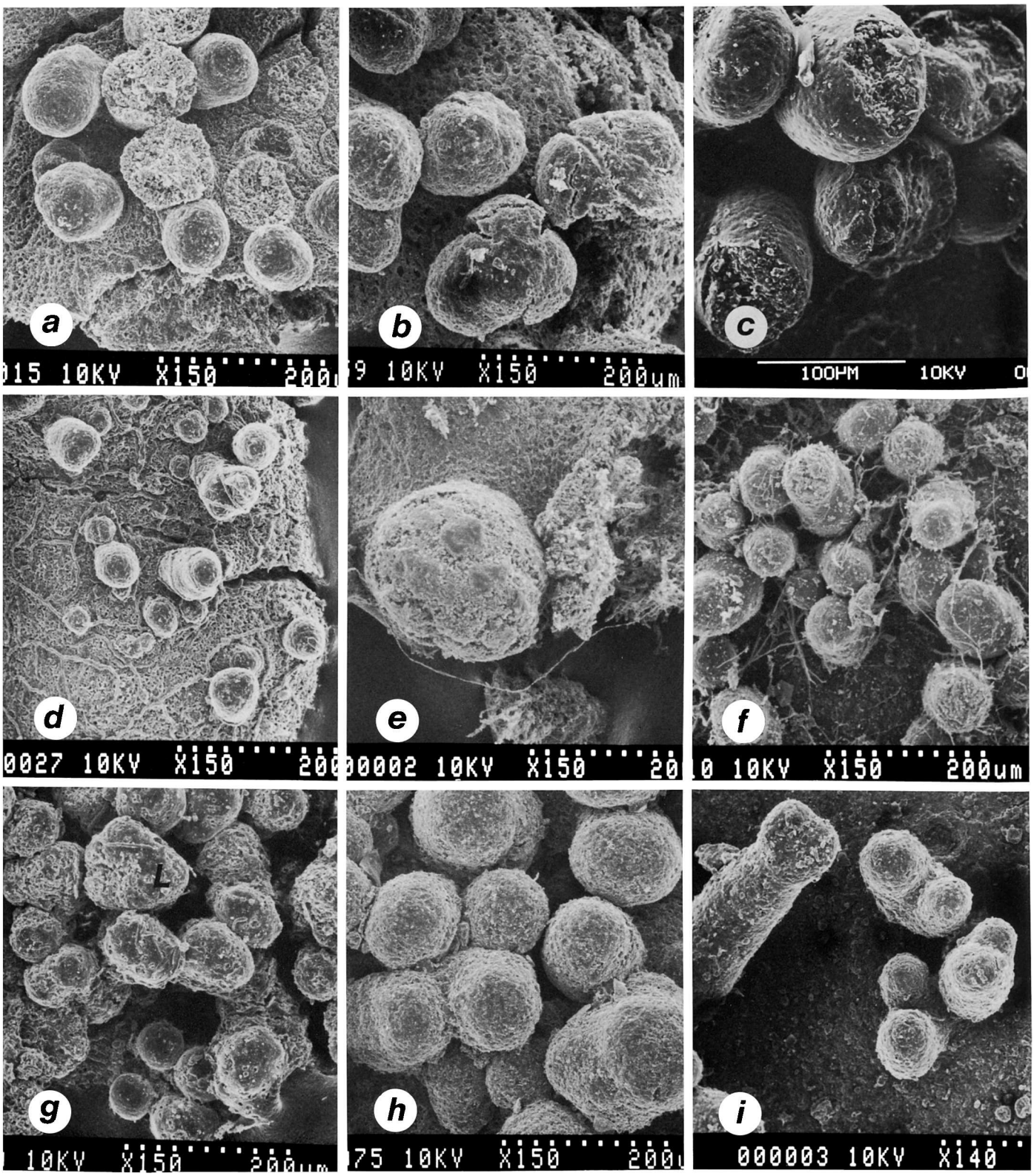


FIGURE 16.—Isidia of *Xanthoparmelia* species with SEM: *a*, *X. isidiosa* (Hale 75722); *b*, *X. joranadia* (*Nash* 7897, isotype in US); *c*, *X. kalbii* (Xavier 754, holotype in US); *d*, *X . keralensis* (*Hale* 76562); *e*, *X. khomasiana* (*Hale* 80955, holotype in US); *f*, *X. krogiae* (*Hildenbrandt* 1962 p.p., lectotype in G); *g*, *X. lavicola* (*Arvidsson* 4532); *h*, *X. maricopensis* (*Nash* 8520); *i*, *X. mbabanensis* (*Hale* 79071, holotype in US).

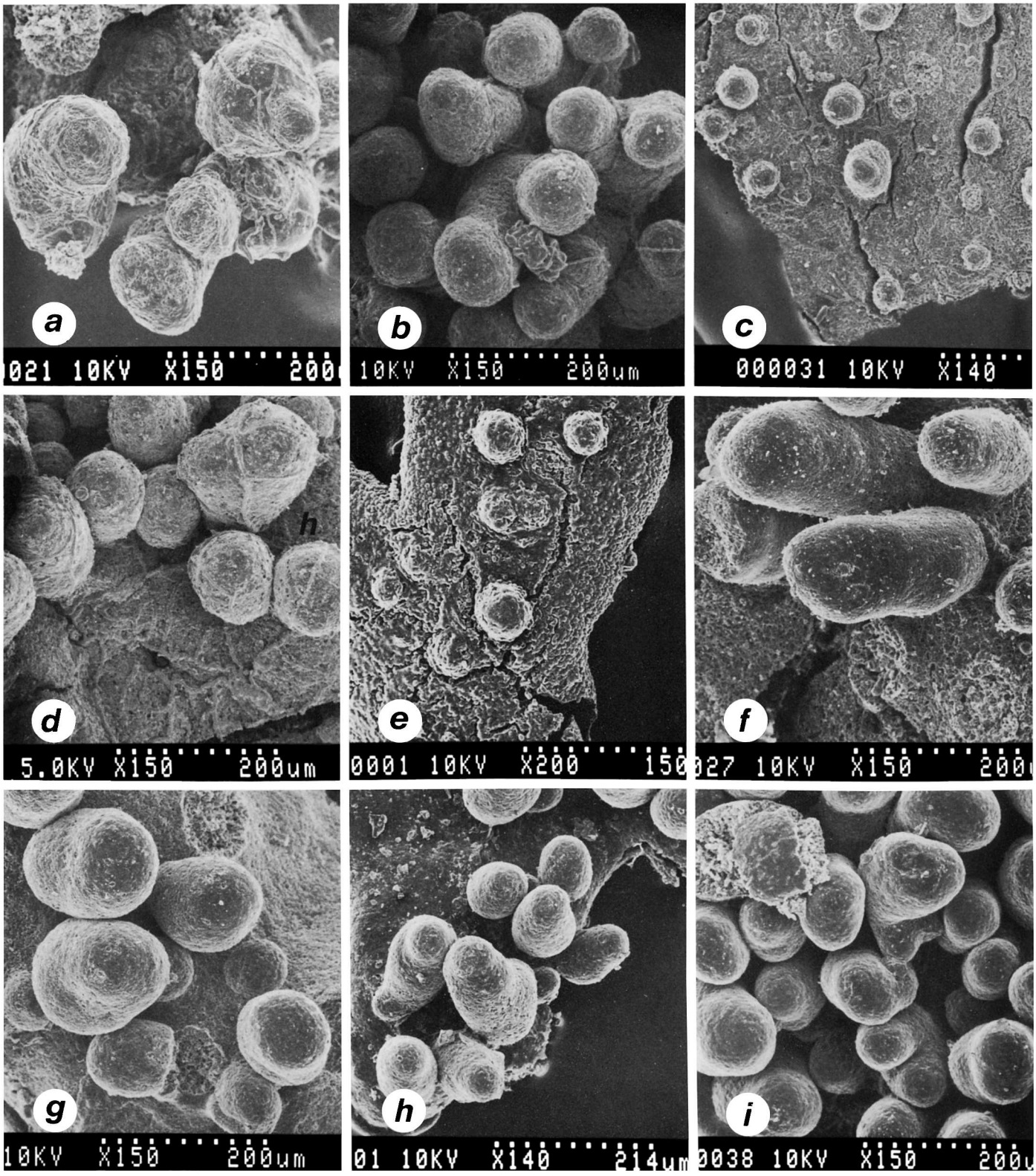


FIGURE 17.—Isidia of *Xanthoparmelia* species with SEM: *a*, *X. meruensis* (Krog and Swinscow, holotype in O); *b*, *X. mexicana* (*Nash* 7602); *c*, *X. minuta* (*Hale* 72108, holotype in US); *d*, *X. moctezumensis* (*Nash* 11974); *e*, *X. mougeotina* (*Hale* 65266); *f*, *X. nashii* (*Nash* 20392, holotype in ASU); *g*, *X. neocongensis* (*Hale* 79288); *h*, *X. neopropaguloides* (*Hale* 76741); *i*, *X. neotinctina* (*Hale* 65223).

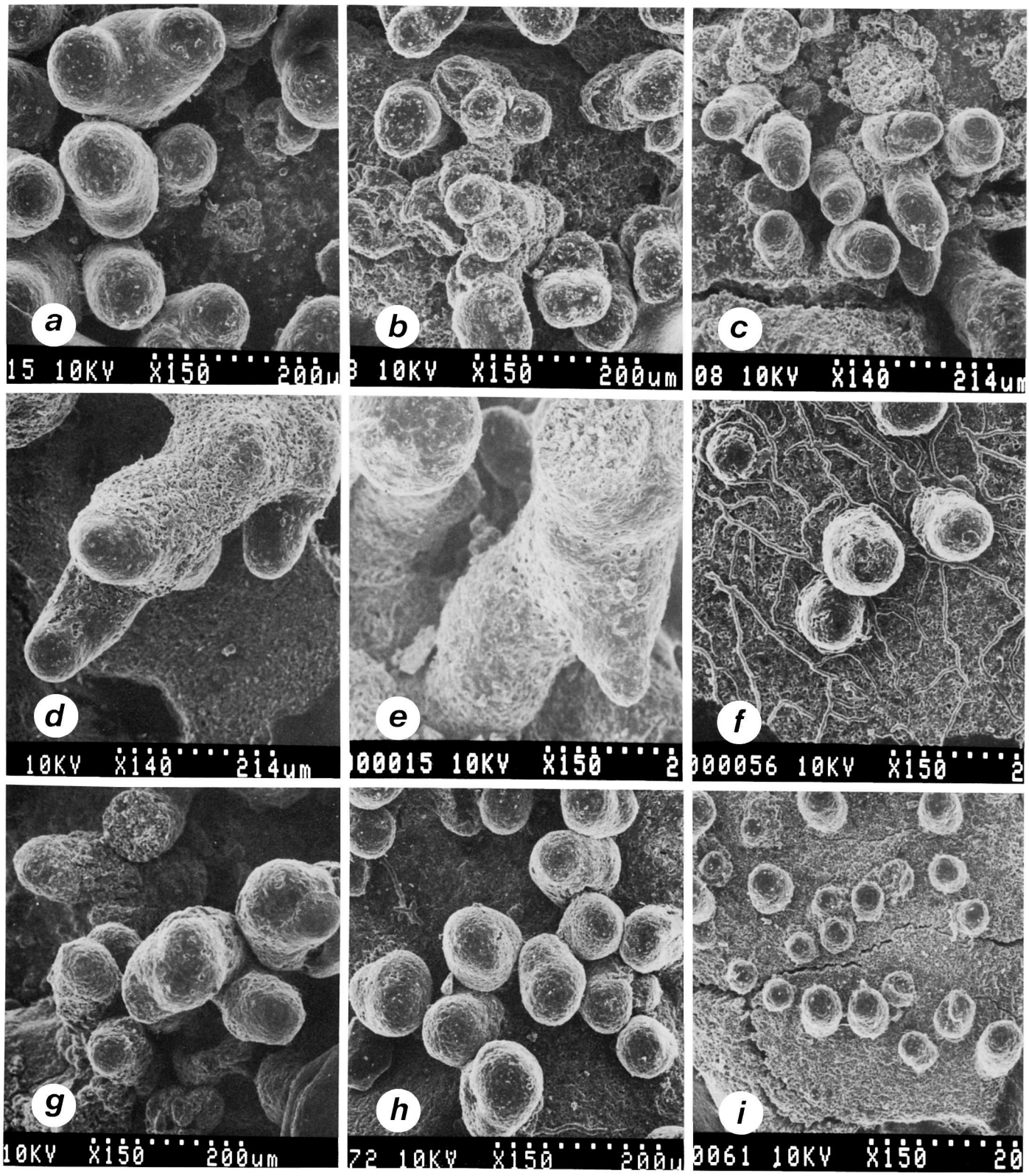


FIGURE 18.—Isidia of *Xanthoparmelia* species with SEM: *a*, *X. neoweberi* (Hale 76884); *b*, *X. nonreagens* (*Elix* 20550); *c*, *X. norhypopsila* (*Hale* 23106, holotype in US); *d*, *X. oribensis* (*Hale* 74041); *e*, *X. phillipsiana* (Filson 5904, holotype in MEL); *f*, *X. piedmontensis* (*Hale* 24016, holotype in US); *g*, *X. plittii* (*Hale* 14408); *h*, *X. praegnans* (*Hale* 68838); *i*, *X. pseudocongensis* (*Hale* 78993, holotype in US).

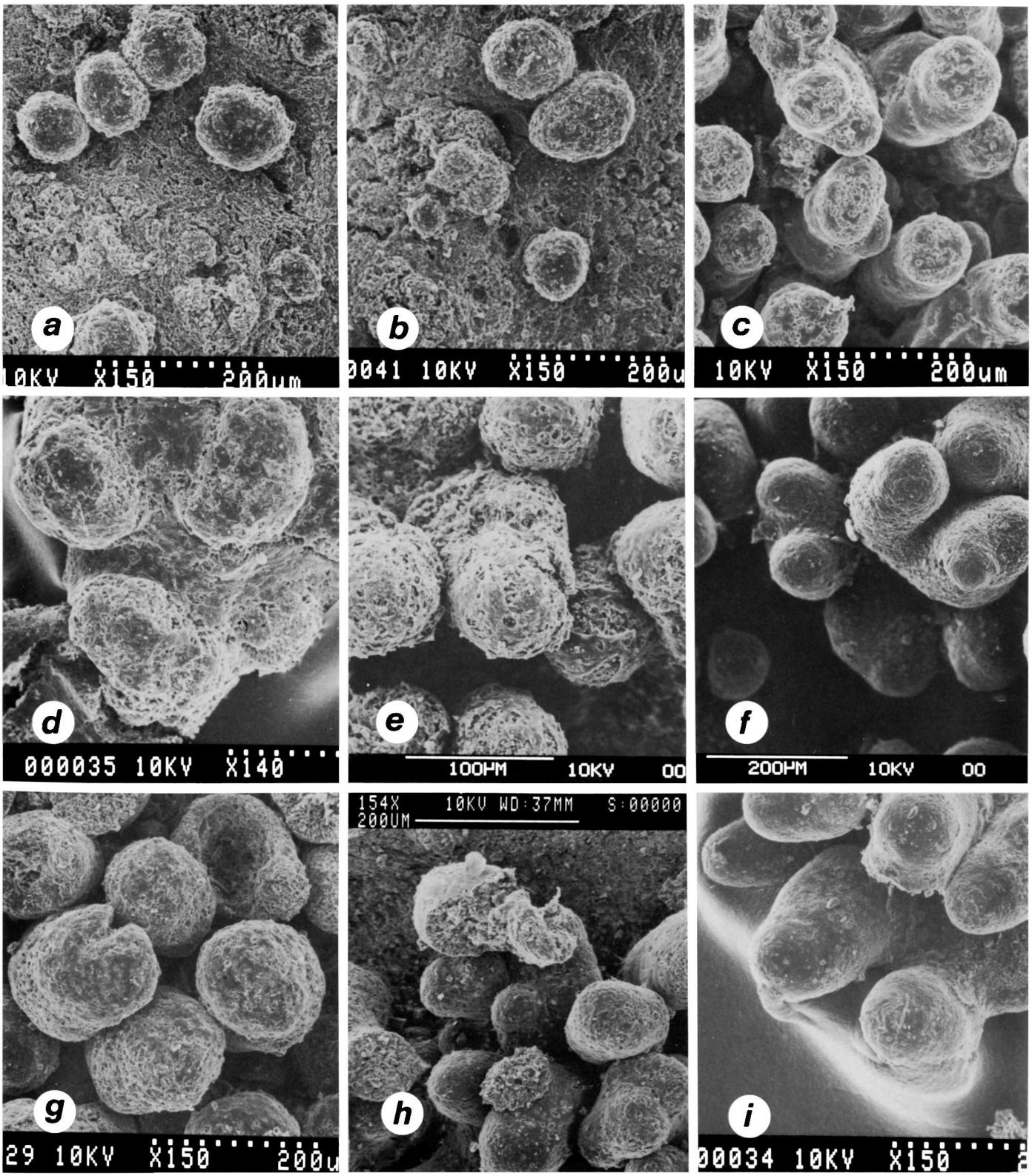


FIGURE 19.—Isidia of *Xanthoparmelia* species with SEM: *a*, *X. punctulata* (Nash 23915, isotype of *X. argentinensis* in US); *b*, *X. pustuliza* (*Hale* 59964); *c*, *X. remanens* (*Elix* 1522, holotype in MEL); *d*, *X. saniensis* (*Hale* 74031); *e*, *X. scabrosa* (*Elix* 5497); *f*, *X. schmidtii* (*Hale* 56679); *g*, *X. spargens* (*Hale* 76093); *h*, *X. streimannii* (*Hale* 58511); *i*, *X. subluminosa* (Hale 58524, holotype in US).

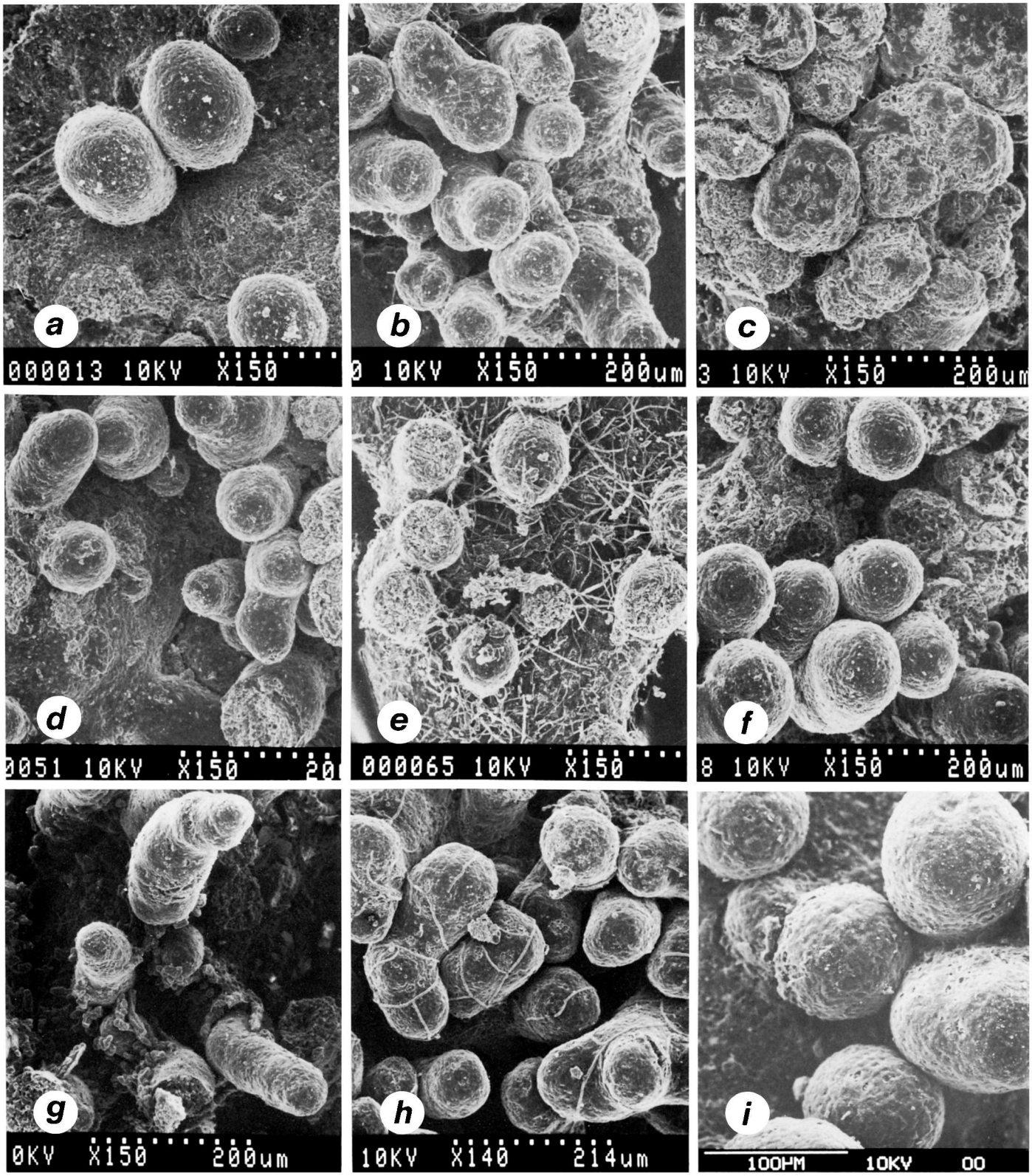


FIGURE 20.—Isidia of *Xanthoparmelia* species with SEM: *a*, *X. subplittii* (Nee and Mori 3925); *b*, *X. subramigera* (*Faurie* 856, lectotype in BP); *c*, *X. subsorediata* (*Arvidsson* 919); *d*, *X. substenophylloides* (*Hale* 79148, holotype in US); *e*, *X. succedans* (*Glaziou* 3842, lectotype in M); *f*, *X. tenacea* (*Walter* 5107); *g*, *X. thamnoides* (*Hale* 65798); *h*, *X. thamnolica* (Hale 72034, holotype in US); *i*, *X. tinctina* (*Kjellmert* s.n.).

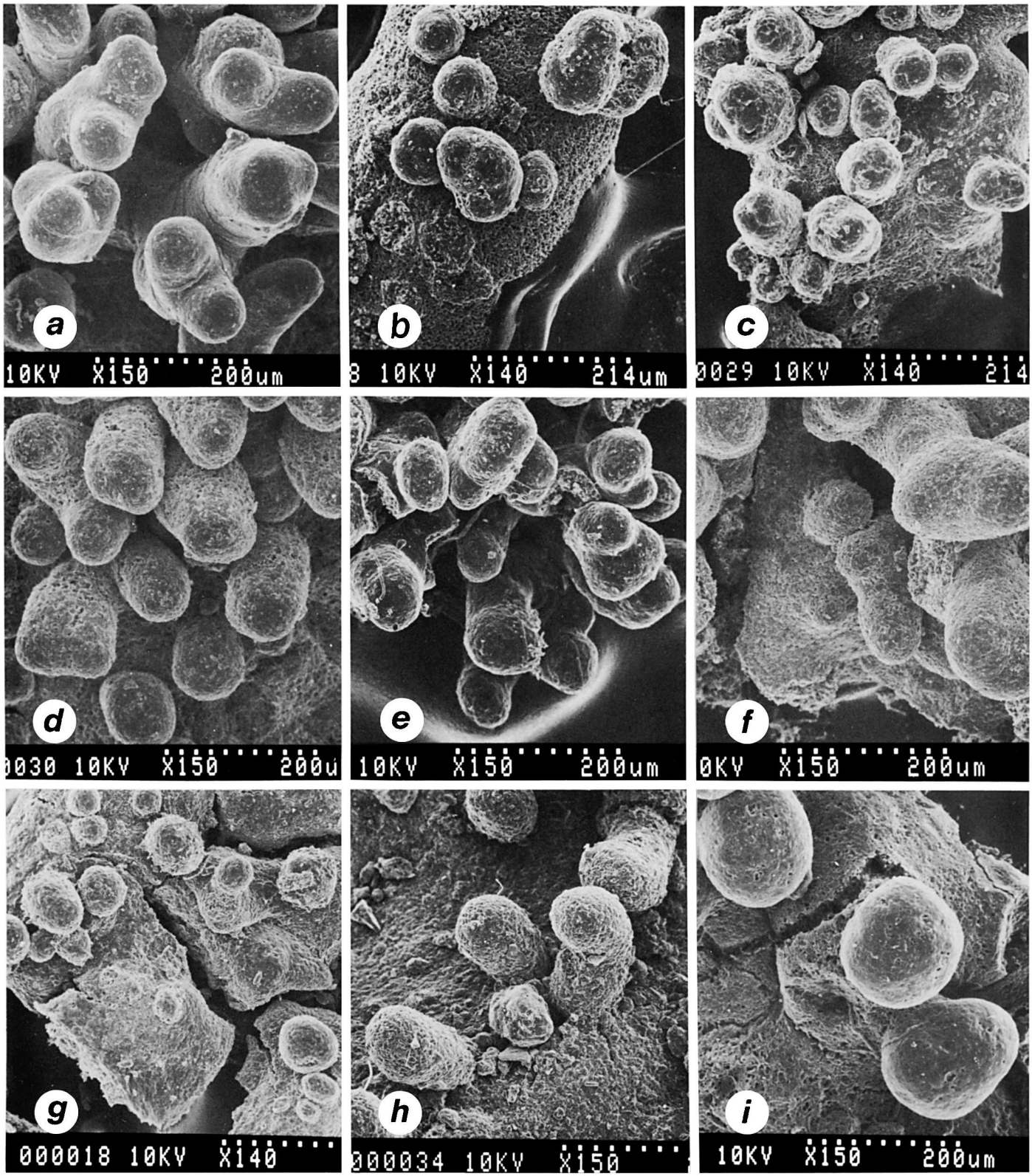


FIGURE 21.—Isidia of *Xanthoparmelia* species with SEM: *a*, *X. treurensis* (Hale 76315); *b*, *X. umtamvuna* (*Hale* 76731, holotype in US); *c*, *X. verdonii* (*Elix* 11443); *d*, *X. verrucigera* (*Aptroot* 20591); *e*, *X. vicaria* (*Cutliffe* s.n., holotype in HO); *f*, *X. weberi* (*Weber* 33663); *g*, *X. xerophila* (*Elix* 17752, holotype in CBG); *h*, *X. xizangensis* (*Zong* 218-1, holotype in HMAS); *i*, *X. zonata* (*Ballingall* 1764A, holotype in CBG).

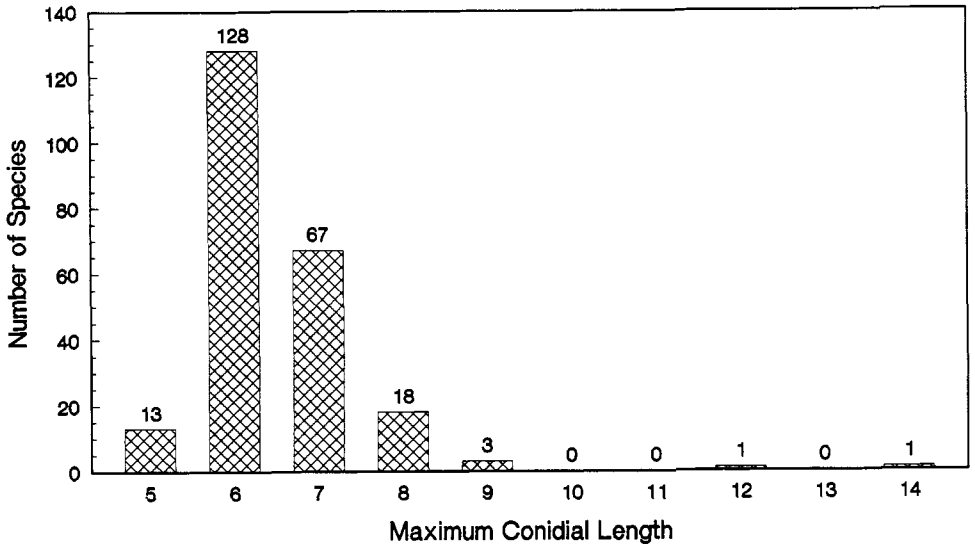


FIGURE 22.—Distribution of maximum conidial length in micrometers for species of *Xanthoparmelia*.

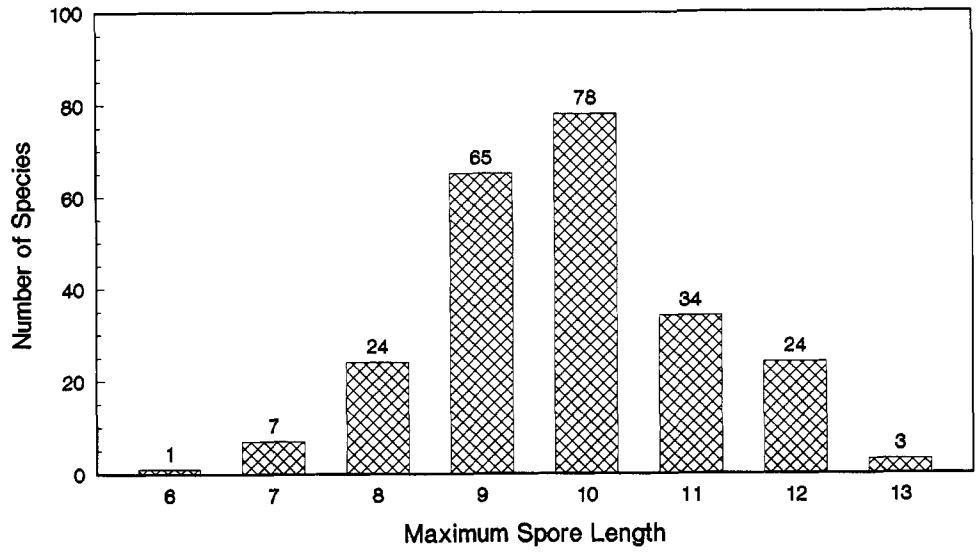


FIGURE 23.—Distribution of maximum spore length in micrometers for species of *Xanthoparmelia*.

PYCNIDIA

Pycnidia have been found in 233 of the 406 species of *Xanthoparmelia*. They appear to belong to the *Umbilicaria*-type (Vobis, 1980), although no ontogenetic studies have been made specifically for *Xanthoparmelia*. All are immersed in the thallus and 90–130 µm in diameter.

Conidia are extremely uniform in size, ranging from 5–14 µm long, the vast majority of the species (228) being 5–8 µm (Figure 23). The shape varies from weakly to strongly bifusiform, cylindrical with subapical bulges, or rod-shaped. Glück (1899) investigated *X. conspersa* in Europe and found a great range of shapes in a single specimen. Several species, however, have unusually long cylindrical conidia: *X. mougeotina*, *X. xanthomelaena*, and *X. xanthomelanoides* (all 7–9 µm long), *X. beatricea* (9–12 µm), and *X. heterodoxa* (11–14 µm). So far conidial shape and size have not played a role in the taxonomy of *Xanthoparmelia*.

Chemistry

Early studies on the chemistry of *Xanthoparmelia* using microcrystal tests indicated a very limited range of lichen substances (Dahl, 1952; Krog, 1951). In fact, the main medullary components seemed to be only fumarprotocetraric, norstictic, salazinic, and stictic acids. This number has increased dramatically for two reasons. For a start, improved techniques for identification with thin layer chromatography (TLC) (C. Culberson, 1972a; C. Culberson and Johnson, 1976) and high performance liquid chromatography (HPLC) (C. Culberson, 1972b) have overcome the limits of sensitivity and accuracy imposed by the imperfect crystal tests. Secondly, analyses of many more specimens from previously poorly collected areas such as southwestern United States, Australia, and South Africa have revealed in full the true chemical diversity of the genus.

According to the most recent work, mostly by C.F. Culberson and J.A. Elix, there are at least 38 major metabolites (not counting usnic acid, rarely accompanied by atranorin in the cortex), defined here in a strictly taxonomic sense as diagnostic components at the species level (they usually occur with one or more minor metabolites):

alectoronic acid
anthraquinone pigment ("endomiltoides unknowns" in *X. ianthina*)
barbatic acid
colensoic acid
constictic acid
constipatic acid
4-*O*-demethyldiffractaic acid
4-*O*-methylhypoprotocetraric acid (Kurokawa et al., 1971)
diffractaic acid
evernic acid
exuviatic acid
fatty unknown (in *X. atroventralis*)
fatty unknown (in *X. lipochlorochroa*)
fatty unknown (in *X. nebulosa*) (Elix, Johnston, and Armstrong, 1986)
fatty unknown (in *X. spargens*)
fatty unknown (in *X. subdecipiens*) (Elix, Johnston, and Armstrong, 1986)
fumarprotocetraric acid
gyrophoric acid
3-α-hydroxybarbatic acid (C. Culberson, Nash, and Johnson, 1979)
hypoprotocetraric acid
hypostictic acid (Keogh, 1978)
hypothamnolic acid
lecanoric acid
lichesterinic acid
lobaric acid
microphyllinic acid
norlobaridone (Gream and Riggs, 1960)
norstictic acid
notatic acid (Kurokawa et al., 1971)
olivetoric acid
protocetraric acid
psoromic acid
salazinic acid
scabrosin derivatives (Begg, Elix, and Jones, 1978)
stenosporonic acid (Elix, Jenie, and Parker, 1987)
stictic acid
succinprotocetraric acid
thamnolic acid

There are in addition at least 53 secondary or minor metabolites, a few not yet identified structurally, which accompany the major metabolites:

baeomycesic acid
caperatic acid
chalybaeizans unknown
conechinocarpic acid
conloxodin (Begg, Chester, and Elix, 1979)
conorlobaridone (Begg, Chester, and Elix, 1979)
connorstictic acid
conprotocetraric acid
consalazinic acid
cryptostictic acid
dehydroconstipatic acid
divaronic acid (Elix, Jenie, and Parker, 1987)
4-*O*-demethylbarbatic acid
4-*O*-demethylmicrophyllinic acid
4-*O*-demethylnotatic acid (C. Culberson and Hale, 1973) ("nornotatic acid")
2′-*O*-demethylpsoromic acid ("norpsoromic acid")
echinocarpic acid
endocrocin
hypoconstictic acid
hyposalazinic acid
isonorlobaridone
isonorlobariol
isonotatic acid
loxodin (Komiya and Kurokawa, 1970)
lusitana unknown (in *X. verrucigera*)
menegazziaic acid
2,4-di-*O*-methylgyrophoric/4,5-di-methylhiascic acid
4-*O*-methylhiascic acid
2-*O*-methylobtusatic acid (Chester and Elix, 1979a)
4-*O*-methylolivetoric acid
norcolensoic acid
norlobariol
norlobariol methyl ester
obtusatic acid
oxyskyrin
pertusaric acid
physodalic acid
physodic acid
protoconstipatic acid
pseudostictic acid
scabrosin 4,4′-diacetate (Begg, Elix, and Jones, 1978)
scabrosin 4-acetate-4′-butyrate (Begg, Elix, and Jones, 1978)
scabrosin 4,4′-dibutyrate (Begg, Elix, and Jones, 1978)
scabrosin 4-acetate-4′-hexanoate (Begg, Elix, and Jones, 1978)
scabrosin unknown R_{fc} 12 (in *X. amplexuloides*)
schenckiana unknown (pigment)
skyrin
skyrinol
squamatic acid
subnotatic acid (Elix and Lajide, 1984)
umbilicaric acid
ursolic acid
virensic acid
zeorin

This number is still growing as new analyses are made and new structures determined. Details on the structure and classification of these substances can be found in Elix, Whitton, and Sargent (1984) and Elix, Johnston, and Armstrong (1986). One may predict that the genus will be found to produce well

over 100 different substances.

My first chemical tests in the 1950s were done with Asahina's microcrystal tests, which I had learned from the *Cladonia* specialist Dr. A.W. Evans. Over the years I progressed from primitive paper chromatography to silica gel TLC as the new techniques became available. For the purposes of this synopsis I have determined the chemistry of all species with TLC, using at least 2 or more solvent systems in common use (C. Culberson, 1969; Culberson, Culberson, and Johnson, 1981). Fumarprotocetraric, protocetraric, and succinprotocetraric acids were usually confirmed in *n*-butanol-acetone.

In the main species list the chemistry given for each species is an amalgam of my own tests, those done for me by other workers, and unpublished notes taken from specimens annotated for chemistry, most by Culberson or Elix. It can be assumed that the chemistry listed holds for type specimens unless stated otherwise. A number of type specimens are so fragmentary that their full chemistry cannot be investigated with modern techniques without destroying the specimens. In truth, no analysis can ever be considered final and definitive.

A complete list of the occurrence of the major lichen substances by species follows. Minor metabolites are not listed here but may be determined from entries under "Chemistry" in the main synoptic list. If two major metabolites occur together (as protocetraric acid and 4-*O*-demethyldiffractaic acid in *X. duplicata*), one is selected as the major metabolite (perhaps arbitrarily!) and the other one listed in parentheses. Pigments are listed separately.

alectoronic acid: *X. alectoronica*.

anthraquinone (in *X. endomiltoides* series): *X. ianthina*.

barbatic acid (usually with 4-*O*-demethylbarbatic acid): *X. applicata, X. areolata, X. barbatica, X. boonahensis, X. burmeisteri, X. centralis, X. donneri* (norstictic acid), *X. louisii, X. vicaria, X. xerophila*.

colensoic acid: *X. ballingalliana, X. colensoica* (stenosporonic acid).

constictic acid: *X. gerhardii*.

constipatic acid (usually accompanied by protoconstipatic and dehydroconstipatic acids): *X. condaminensis* (scabrosin derivatives), *X. globulifera, X. nigraoleosa, X. oleosa, X. ustulata*.

4-*O*-demethyldiffractaic acid: *X. duplicata* (protocetraric acid), *X. neotumidosa* (protocetraric acid), *X. ochropulchra*.

4-*O*-methylhypoprotocetraric: *X. calvinia, X. competita*.

diffractaic acid (often accompanied by traces of barbatic acid, 4-*O*-demethylbarbatic acid, and squamatic acid): *X. ajoensis, X. blackdownensis, X. conjuncta, X. diffractaica* (salazinic acid), *X. everardensis, X. lesothoensis* (salazinic acid), *X. luderitziana, X. mannumensis, X. nana* (salazinic acid), *X. nashii, X. rugulosa, X. tucsonensis*.

echinocarpic acid: *X. putsoa* (gyrophoric acid).

evernic acid (sometimes with traces of lecanoric acid): *X. aggregata, X. dysprosa, X. equalis, X. eruptens, X. evernica, X. sigillata*.

exuviatic acid: *X. exuviata, X. spargenosa*.

fumarprotocetraric acid (often with succinprotocetraric and/or protocetraric acid): *X. almbornii, X. ceresina, X.concomitans, X. dayiana, X. fumigata, X. granulata, X. hypomelaena, X. hypomelaenoides, X. iniquita, X. leonora, X. mbabanensis, X. monticola, X. mutabilis, X. natalensis* (diffractaic acid), *X.neoreptans, X. X. novomexicana, X. paradoxa* (hypostictic acid), *X. pertinax, X. phaeophana, X. piedmontensis, X. protomatrae, X. pseudohypoleia, X. reptans, X. rogersii, X. subramigera, X. swartbergensis, X. vendensis, X. viridis, X. willisii, X. yowaensis*.

gyrophoric acid: *X. endochromatica, X. gyrophorica, X. leucostigma, X. olivetorica*.

3-α-Hydroxybarbatic acid: *X. moctezumensis*.

hypoprotocetraric acid (almost always accompanied by 4-*O*-demethylnotatic acid): *X. contrasta, X. dissensa, X. domokosii, X. endochrysea, X. hypoprotocetrarica, X. inflata, X. karoo, X. karooensis, X. khomasiana, X. laxencrustans, X. neocongensis, X. neocongruens, X. neoweberi, X. oribensis, X. pachyclada, X. perrugosa, X. prodomokosii, X. subdomokosii, X. tablensis, X. toninioides, X. weberi*.

hypostictic acid (usually accompanied by hyposalazinic acid): *X. brevilobata, X. gongylodes, X. harrisii, X. inconspicua, X. kalbii, X. metastrigosa, X. multipartita, X. protoquintaria, X. quintaria, X. saniensis, X. subcrustacea, X. sulcifera*.

hypothamnolic acid: *X. thamnolica*.

lecanoric acid: *X. arida, X. clivorum, X. coneruptens, X. joranadia, X. lecanorica, X. namaquensis, X. protodysprosa, X. serusiauxii, X. worcesteri*.

lichesterinic acid: *X. montanensis*.

lobaric acid: *X. zonata*.

microphyllinic acid: *X. ceresensis*.

norlobaridone (often with loxodin): *X. amplexula, X. amplexuloides, X. australiensis, X. calida* (scabrosins), *X. constipata* (constipatic acid), *X. dichotoma, X. dubitata, X. eilifii, X. elaeodes, X. exillima, X. filarszkyana, X. flavescentireagens, X. furcata, X. incrustata, X. lynii, X. metamorphosa, X. microlobulata, X. norlobaronica, X. obscurata, X. scabrosa, X. subamplexuloides, X. subdistorta, X. tenuiloba, X. thamnoides, X. verdonii, X. xanthosorediata*.

norstictic acid (often accompanied by connorstictic acid; when listed as an accompanying metabolite, salazinic occurs in approximately equal concentration): *X. alexandrensis, X. arapilensis, X. ausiana* (salazinic acid), *X. barbellata* (salazinic acid), *X. californica, X. colorata* (salazinic acid), *X. congesta* (salazinic acid), *X. dierythra, X. dissitifolia, X. elixii, X. filsonii, X. flindersiana, X. glareosa* (salazinic acid), *X. heinari, X. kasachstania, X. kiboensis, X. maricopensis, X. maxima* (salazinic acid), *X. metaclystoides* (salazinic acid), *X. minuta* (salazinic acid), *X. neochlorochroa, X. neotinctina* (salazinic acid), *X. norchlorochroa, X. norcolorata, X. norconvoluta, X. norhypopsila, X. norpraegnans, X. norpumila, X. norwalteri, X. olifantensis* (salazinic acid), *X. pantherina* (salazinic acid), *X. parvoclystoides, X. probarbellata* (salazinic acid), *X. pseudoamphixantha, X. pustuliza, X. schmidtii* (salazinic acid, barbatic acid), *X. subnuda* (salazinic acid), *X. substrigosa* (salazinic acid), *X. terrestris* (salazinic acid), *X. wisangerensis* (salazinic acid).

notatic acid: *X. notata*.

olivetoric acid: *X. heterodoxa*.

protocetraric acid: *X. austroafricana, X. beatricea, X. dichromatica, X. fucina, X. hybrida* (pseudostictic), *X. hypoleia, X. lagunebergensis, X. marroninipuncta, X. mollis, X. schenckiana, X. skyrinifera, X. stuartensis, X. subcolorata, X. subochracea, X. tumidosa, X. verruciformis*.

psoromic acid (usually with 2′-*O*-demethylpsoromic acid): *X. afrolavicola, X. diacida* (protocetraric acid), *X. ferraroiana, X. huachucensis, X. lavicola, X. nigropsoromifera, X. psornorstictica* (norstictic acid), *X. psoromica, X. psoromifera*.

salazinic acid (usually accompanied by consalazinic acid, more rarely by traces of norstictic acid): *X. adleri* (norlobaridone), *X. affinis, X. africana, X. alternata, X. amphixanthoides* (chalybaeizans unknown), *X. antleriformis, X. australasica, X. bellatula, X. bibax* (chalybaeizans unknown), *X. camtschadalis, X. capensis* (chalybaeizans unknown), *X. chalybaeizans* (chalybaeizans unknown), *X. cheelii, X. chlorochroa, X. cirrhomedullosa, X. coloradoensis, X. concolor* (chalybaeizans unknown), *X. consociata, X. conspersula, X. constrictans, X. convoluta, X. cordilleriana, X. coreana, X. cotopaxiensis, X. crassilobata, X. cylindriloba, X. denudata, X. desertorum, X. diadeta, X. digitiformis, X. durietzii, X. effigurata, X. endomiltoides, X. enteroxantha, X. eradicata, X. erosa, X. examplaris, X. felkaensis, X. ferruma, X. geesterani, X. hybridiza* (barbatic acid), *X. hyporhytida, X. idahoensis, X. incerta, X. isidiigera, X. isidiosa, X. kotisephola, X. latiloba, X. lineola, X. luminosa, X. mapholanengensis* (norstictic and protocetraric acids), *X. mexicana, X. microspora, X.*

namakwa, X. neorimalis, X. neosynestia, X. neotasmanica, X. parvoincerta, X. perplexa (chalybaeizans), *X. praegnans, X. proximata* (norstictic), *X. pseudohungarica, X. pumila, X. punctulata, X. rubriragens, X. rubromedulla, X. rubropustulata, X. salamphixantha, X. saleruptens, X. salkiboensis, X. somloensis, X. springbokensis* (chalybaeizans), *X. subbullata, X. subconvoluta, X. subdiffluens, X. sublaevis, X. subluminosa, X. subpigmentosa, X. surrogata, X. synestia, X. taractica, X. tasmanica, X. tenacea, X. terricola, X. tinctina, X. ulcerosa* (gyrophoric acid), *X. versicolor, X. walteri, X. wesselsii, X. wildeae, X. wyomingica, X. xizangensis.*

scabrosin derivatives: *X. brunnthaleri, X. bungendorensis, X. cravenii, X. immutata, X. nonreagens, X. remanens, X. rupestris.*

stenosporonic acid (often accompanied by colensoic acid): *X. keralensis, X. naudesnekia* (hypostictic acid), *X. peruviensis, X. shebaiensis, X. stenosporonica, X. tsekensis* (salazinic acid).

stictic acid: (usually accompanied by constictic acid, cryptostictic acid, norstictic acid, menegazziaic acid, and related compounds): *X. albomaculata, X. ambleana, X. amphixantha, X. angustiphylla, X. aurifera, X. austrocapensis, X. benyovszkyana, X. bicontinens, X. catarinae, X. congensis, X. conspersa, X. convexula, X. cumberlandia, X. darlingensis* (barbatic acid), *X. esterhuyseniae, X. farinosa, X. globisidiosa, X. glomerulata, X. greytonensis, X. hypopsila, X. indumenica* (diffractaic acid), *X. isidiascens, X. lobulifera, X. molliuscula, X. mougeotii, X. mougeotina, X. neoconspersa, X. neopropaguloides, X. neotaractica, X. neowyomingica, X. oblisata, X. phillipsiana, X. planilobata, X. plittii, X. protolusitana* (lusitana unknown), *X. pseudocongensis, X. pustulifera, X. pustulosorediata, X. simulans, X. standaertii, X. suberadicata, X. subflabellata, X. submougeotii, X. subpallida, X. subplittii, X. subruginosa, X. subsorediata, X. substenophylloides, X. succedans* (salazinic acid), *X. tegeta, X. tolucensis, X. treurensis, X. umtamvana* (barbatic acid), *X. vagans, X. verrucigera* (lusitana unknown), *X. victoriana, X. villamiliana, X. wrightiana, X. xanthomelaena, X. xanthomelanoides.*

succinprotocetraric acid: *X. krogiae.*

thamnolic acid (often with squamatic acid): *X. cedrus-montana.*

unknown fatty acid: *X. atroventralis.*

unknown fatty acid: *X. nebulosa, X. spargens.*

unknown fatty acid: *X. lipochlorochroa.*

unknown fatty acid: *X. aliphatica, X. barklyensis, X. coriacea, X. epigaea, X. imbricata, X. inuncta, X. laciniata, X. meruensis, X. subdecipiens, X. subnigra, X. transvaalensis, X. unctula*

In terms of sheer frequency, salazinic acid remains the most characteristic lichen substance in *Xanthoparmelia*. Some 138 species contain this easily identified, K+ red acid as a major (92) or minor (46) metabolite. The next most common, closely related stictic acid, occurs as a major component in 60 species.

Beyond salazinic and stictic acids, the remaining ones are not only less frequent but often occur in species with more restricted distributions. Norlobaridone (in 27 species) is almost exclusively centered in Australia. Fumarprotocetraric acid (in 29 species) is most common in North America and South Africa but is also produced by the Eurasian species *X. protomatrae*, pan-subtropical *X. subramigera*, and several Australian species. Norstictic acid as a major component (43 species) has wide occurrence but is especially common in Australia. Hypoprotocetraric acid (21 species) is most common in South Africa with a few occurrences in the southwestern USA and in Australia, and protocetraric acid occurs in 18 species, all but three endemic to southern Africa. Psoromic acid (9 species) is absent from Australasia but occurs in the New World and several common species in South Africa. Constipatic acid occurs in 5 Australasian species, but comparable species in South Africa and the New World have evolved with a more complex series of compounds related to constipatic acid.

PIGMENTS

Pigments occur in 47 species. The most frequent one, the orange-red bisanthraquinone skyrin in 28 species, is deposited in a continuous to patchy layer near the lower medulla. It is by far most common in South Africa (21 species). The dull rusty reddish schenckiana unknown, also produced in the lower medulla and known only in South Africa, forms a brilliantly longwave UV+ yellow fluorescent spot and a lower streak probably representing secalonic acid derivatives.

The anthraquinone pigments, a group of at least four major compounds fully represented only in *X. endomiltoides*, are still mostly undetermined and confined to South Africa. They form a series of discrete reddish to purple spots on TLC plates. A pale yellowish pigment streak tentatively identified as a secalonic acid compound has been found in *X. krogiae* and *X. mutabilis* and in schenckiana pigment-containing species.

endocrocin: *X. ochropulchra.*

endomiltoides anthraquinones: *X. dichromatica, X. endomiltoides, X. ianthina, X. inconspicua, X. marroninipuncta, X. rubropustulata.*

oxyskyrin: *X. enteroxantha.*

schenckiana pigments: *X. colorata, X. diacida, X. endochromatica, X. laciniata, X. psoromica, X. schenckiana, X. verecunda.*

secalonic acid group: *X. endochromatica, X. krogiae, X. mutabilis, X. verecunda.*

skyrin: *X. barbellata, X. boonahensis, X. brevilobata, X. cirrhomedullosa, X. contrasta, X. coriacea, X. denudata, X. duplicata, X. enteroxantha, X. ferruma, X. karooensis, X. luminosa, X. naudesnekia, X. neocongruens, X. neoweberi, X. oribensis, X. probarbellata, X. rubromedulla, X. saniensis, X. skyrinifera, X. springbokensis, X. subcolorata, X. subdomokosii, X. subluminosa, X. subochracea, X. subpigmentosa, X. surrogata, X. zonata.*

skyrinol: *X. enteroxantha.*

unknown pigments: *X. brevilobata, X. constrictans, X. enteroxantha, X. namaquensis, X. ochropulchra, X. tsekensis.*

CHEMISTRY AS A SPECIES CHARACTER

Every lichen taxonomist is aware that most lichens produce unique secondary metabolites, often called lichen acids or lichen substances. Some of these are pigments, such as usnic acid, but the majority are colorless and identifiable only with microchemical tests. There is no longer any argument over the biological uniqueness of these substances, only their use as taxonomic characters.

William Nylander, the "father" of lichen chemotaxonomy, applied rather few color tests to *Xanthoparmelia* (Nylander, 1869a) and created no "chemical species." Vainio (1900) made careful color tests of the species he studied. Lettau (1914)

wrote a long, sympathetic discussion on the use of chemistry in lichen taxonomy, utilizing crude microcrystal tests for salazinic acid. Kušan (1932) categorized three groups of taxonomists, one which rejected the use of lichen chemistry, one which recognized the importance of chemistry but not as a taxonomic character, and one which enthusiastically used chemistry as a species character (e.g., Zopf, 1903). Gyelnik was included in the latter group since from the first he made deliberate use of chemical color tests as species characters. For example he recognized *Parmelia protomatrae* as follows: "a *P. conspersa* differt medulla K+ primum nulla." We know now that *X. protomatrae* contains K- fumarprotocetraric acid and that *P. conspersa* (= *X. angustiphylla* in Gyelnik's sense) has K+ yellow stictic acid. Many of Gyelnik's species were based on KOH reactions and medullary color.

In 1964 I described *Parmelia dierythra* as a chemotype of *P. plittii*. Since then most workers in *Xanthoparmelia* have used chemistry as a species character. For example, Krog (1978) concluded that in the absence of a variety of morphological characters "chemical constituents have...proved to be of greater taxonomic value in [Xanthoparmelias] than in many other lichen groups." Elix (1982), Elix and Johnston (1987), and Elix, Johnston, and Armstrong (1986) make detailed references to biogenetic pathways and correlations with geographic distribution to support chemical species in the Australian flora.

The kinds and patterns of chemical variation in lichens have been discussed by many authors (Culberson, 1969; Hale, 1983; Elix, 1982; Hawksworth, 1976) and need no further elaboration here. *Xanthoparmelia* has a wide range of variation but generally follows replacement patterns. A good example of this is the *X. mexicana* group in North America. The 9 chemotypes share a common morphology: Thallus isidiate with cylindrical isidia, adnate to loosely attached, and pale brown below. If geography is ignored, the species cannot be identified without TLC tests. These species, with their major metabolites, are:

Species	Chemistry
X. ajoensis	diffractaic acid
X. dierythra	norstictic acid
X. joranadia	lecanoric acid
X. maricopensis	norstictic and hyposalazinic acids
X. mexicana	salazinic acid
X. moctezumensis	3-α-hydroxybarbatic acid
X. plittii	stictic acid
X. schmidtii	barbatic, norstictic, and salazinic acids
X. subramigera	fumarprotocetraric acid
X. weberi	hypoprotocetraric acid

The North American distributions of these species are now rather well known. The three most common ones are roughly allopatric: *X. plittii* is the main species in northeastern USA—Great Lakes region, *X. subramigera* extends from New Jersey to Texas in the Piedmont (south of the maximum extent of Wisconsin glaciation) and in the western states, and *X. mexicana* is strictly western (Hale, 1964). They fall in well-defined phytogeographic patterns with sharp separation at convergence points (Hale, 1956). Rare *X. dierythra* was described from Minnesota and occurs sporadically in neighboring states. The remaining species are confined mostly to arid southwestern USA and Mexico.

In Australia a good example of a replacement series is *X. amphixantha* (stictic acid), *X. pseudoamphixantha* (norstictic acid), and *X. reptans* (fumarprotocetraric acid).

Other examples can be found in the discussions of *X. conspersa, X. dichotoma, X. exillima, X. hypoleia, X. lineola, X. somloensis, X. tasmanica,* and *X. worcesteri.*

The addition pattern is represented by *X. brevilobata* (hypostictic acid) and *X. naudesnekia* (hypostictic and stenosporonic acids), *X. dierythra* (norstictic acid) and *X. maricopensis* (norstictic and hyposalazinic acids), *X. schenckiana* (protocetraric acid) and *X. diacida* (protocetraric and psoromic acids), *X. subramigera* (fumarprotocetraric acid) and *X. natalensis* (fumarprotocetraric and diffractaic acids), and *X. tumidosa* (protocetraric acid) and *X. neotumidosa* (protocetraric and 4-*O*-demethyldiffractaic acids).

Chemosyndromy is a rare chemical pattern in *Xanthoparmelia,* found mostly in species containing the barbatic—diffractaic acid or colensoic—stenosporonic acid series. The best studied example is *X. ajoensis—X. moctezumensis* (C. Culberson, Nash, and Johnson, 1979) in southwestern USA and Mexico. Another is *X. colensoica—X. shebaiensis* in South Africa.

It is difficult to estimate how many of the 406 species in *Xanthoparmelia* can be considered to be "chemical species." About 60 species (13 "parents" and 47 chemotypes) are involved in the patterns described above. This total could be increased but some of the pairs would be contrived since subtle morphological and chemical differences will often be found on closer study. Ever more refined studies of morphology often show that presumed chemical species differ in previously undetected morphological characters or in ecology and distribution. Nash and Zavada (1977) conducted an intensive survey of the *X. mexicana* chemotypes in Arizona and discovered statistically significant correlations between species distribution and type of rock substrate. Adding other data on lobe width and adnation, they concluded that the chemotypes should be recognized as species. A comparably thorough study of other presumed chemotypes in *Xanthoparmelia* will require herbarium and field studies on a large scale, as well as a better understanding of morphological characters.

Phytogeography

The geographical distributions of *Xanthoparmelia* species were poorly known as recently as 15 years ago, when I listed 94 species at the world level (Hale, 1974b). We had fairly extensive collections from eastern North America and Europe, but relatively little from Australia, southwestern USA, and

South Africa. Since then almost 300 species have been described from these areas, and the results have profoundly altered our views on the geography and evolution of the genus. I had, for example, presumed South Africa to be the major center of speciation and while this has proved to be correct, Australia has emerged to be not far behind (Elix, Johnston, and Armstrong, 1986).

In truth, any statements we make on lichen phytogeography are bound to be modified, sometimes embarrassingly so, as new collections are made, and the ranges of many species are extended. As is so often the case, the richness of a lichen flora in most regions is usually a reflection of collecting intensity. I believe, however, that major collecting efforts have been made and most continents are relatively well known.

The 406 species of *Xanthoparmelia* are widely distributed in boreal, temperate, and subtropical regions. As a general rule, however, the species are photophilic and most abundant in semi-arid to arid regions with extensive exposures of granite and sandstone, such as Australia, southern Africa, and southwestern USA. Rainfall, usually in the range of 100 to 500 mm annually, limits the development of forests in these semi-arid regions, and open xerophytic shrub communities dominate (Rogers, 1977). On the other hand, few *Xanthoparmelia* species can survive where there is less than 50 mm a year, except along coastlines where there is significant moisture input from fog and mist, as the Namib coast (Büdel and Wessels, 1986).

Heavily forested Europe, eastern North America, and parts of Asia have rainfall in excess of 1000 mm a year, fewer exposed habitats, and a poor *Xanthoparmelia* flora. At the same time, South America has a relatively poor flora for its size, although it is the center of speciation for the few sorediate species. The poorest areas are the humid lowland tropics, where few species have been collected. Antarctica and the high arctic have no *Xanthoparmeliae*, although *X. somloensis* extends northward into Alaska. The genus is replaced by *Arctoparmelia* in arctic regions.

A few places in the world have unusually high numbers of endemic species. For example, the high frosty doleritic highlands of Lesotho in southern Africa have a total flora of 20 species, of which 11 are endemic and most with unusual chemistries: *X. brevilobata, X. conjuncta, X. diffractaica, X. granulata, X. gyrophorica, X. kotisephola, X. mapholanengensis, X. microlobulata, X. naudesnekia, X. putsoa,* and *X. tsekensis.*

The foggy Namib coast has a total flora of 8 species (*X. equalis, X. evernica, X. harrisii, X. lagunebergensis, X. luderitziana, X. norwalteri, X. serusiauxii,* and *X. walteri*), all (except *X. evernica*) endemic there. This uniqueness (and the absence of other species of *Xanthoparmelia*) may be correlated with their salt tolerance.

The small knersvlakte region north of Vanrhynsdorp in southern Namaqualand is covered with a quartzite pavement. It has 6 highly endemic species in a flora of 20 species: *X. aggregata, X. beatricea, X. duplicata, X. epigaea, X. hyporhytida,* and *X. pachyclada.* It is perhaps no coincidence that these are all terricolous species.

Finally, to continue with examples from southern Africa, one cannot fail to be impressed by the Table Mountain lichen flora. This small area receives frequent fog on strong prevailing southwest winds. Twelve of the 50 species here are endemic: *X. almbornii, X. conspersula, X. constrictans, X. contrasta, X. endochromatica, X. enteroxantha, X. eradicata, X. olifantensis, X. olivetorica, X. surrogata, X. tablensis,* and *X. tenuilobata.*

Australia does not have the sharp climatic differences seen in southern Africa. The Murray mallee shrub area in Victoria and South Australia, however, has been the center of evolution for a number of terricolous species: *X. aurifera, X. bellatula, X. convoluta, X. eilifii, X. pumila, X. pseudoamphixantha,* and *X. terrestris.*

The Sonoran desert in southwestern USA/Mexico has several endemic, chemically unusual species: *X. ajoensis, X. dissensa, X. huachucensis, X. joranadia, X. moctezumensis, X. nigropsoromifera, X. psoromifera,* and *X. tucsonensis.*

The total number of species for the major continental areas are as follows:

North America	50
South America	41
Europe	14
Southern Africa	212
Australasia	145
Asia	13

The following lists of species distribution by country are based on specimens I have actually seen in the herbaria listed in the "Acknowledgments." Literature reports are not included unless I have checked them.

North America

Canada: *X. angustiphylla, X. camtschadalis, X. conspersa, X. plittii, X. somloensis, X. wyomingica.*

USA: *X. ajoensis, X. angustiphylla, X. arida, X. australasica, X. barbatica, X. californica, X. camtschadalis, X. chlorochroa, X. coloradoensis, X. conspersa, X. cumberlandia, X. dierythra, X. dissensa, X. huachucensis, X. hypomelaena, X. idahoensis, X. isidiascens, X. joranadia, X. lavicola, X. lineola, X. lipochlorochroa, X. maricopensis, X. mexicana, X. moctezumensis, X. montanensis, X. monticola, X. mougeotii, X. neochlorochroa, X. neoconspersa, X. neorimalis, X. neotaractica, X. neowyomingica, X. nigropsoromifera, X. norchlorochroa, X. norhypopsila, X. novomexicana, X. oleosa, X. piedmontensis, X. planilobata, X. plittii, X. psoromifera, X. schmidtii, X. somloensis, X. subdecipiens, X. subramigera, X. substenophylloides, X. tasmanica, X. tucsonensis, X. vagans, X. weberi, X. wyomingica.*

Hawaii: *X. coloradoensis, X. mougeotii, X. subramigera, X. tasmanica.*

Mexico and Central America

Costa Rica: *X. conspersa, X. subramigera.*

Guatemala: *X. conspersa, X. neopropaguloides, X. plittii.*

Mexico: *X. ajoensis, X. amableana, X. chlorochroa, X. coloradoensis, X. congensis, X. conspersa, X. cumberlandia, X. lavicola, X. lineola, X.*

maricopensis, X. mexicana, X. microspora, X. moctezumensis, X. monticola, X. neorimalis, X. novomexicana, X. oleosa, X. planilobata, X. plittii, X. psoromifera, X. somloensis, X. subramigera, X. substenophylloides, X. taractica, X. tasmanica, X. tolucensis, X. tucsonensis, X. vagans, X. weberi.

Panama: *X. conspersa, X. neopropaguloides.*

West Indies

Cuba: *X.neopropaguloides, X. plittii, X. subramigera.*

Dominica: *X. subramigera.*

Dominican Republic: *X. cumberlandia, X. mexicana, X. mougeotii, X. neopropaguloides, X. plittii, X. subramigera, X. subsorediata.*

Jamaica: *X. subramigera.*

St. Barthelemy: *X. subramigera.*

South America

Argentina: *X. adleri, X. antleriformis, X. australasica, X. callifolioides, X. farinosa, X. ferraroiana, X. huachucensis, X. hypopsila, X. mexicana, X. microspora, X. mougeotii, X. oleosa, X. punctulata, X. scabrosa, X. taractica, X. tasmanica, X. ulcerosa, X. villamiliana, X. wrightiana.*

Bolivia: *X. microspora, X. peruviensis, X. taractica, X. ulcerosa.*

Brazil: *X. catarinae, X. congensis, X. conspersa, X. cumberlandia, X. farinosa, X. hypopsila, X. kalbii, X. mougeotii, X. neopropaguloides, X. oblisata, X. plittii, X. subplittii, X. subramigera, X. substenophylloides, X. succedans, X. tasmanica.*

Chile: *X. conspersa, X. hypopsila, X. microspora, X. submougeotii, X. ulcerosa, X. vagans.*

Colombia: *X. microspora, X. plittii, X. subplittii, X. subramigera, X. taractica, X. ulcerosa.*

Ecuador: *X. cotopaxiensis, X. farinosa, X. lavicola, X. microspora, X. mougeotii, X. standaertii, X. subsorediata, X. ulcerosa, X. vagans.*

Paraguay: *X. plittii, X. subplittii.*

Peru: *X. australasica, X. conspersa, X. cordilleriana, X. farinosa, X. flaviscentireagens, X. microspora, X. mougeotii, X. peruviensis, X. punctulata, X. standaertii, X. tasmanica.*

Uruguay: *X. cumberlandia, X. farinosa, X. hypopsila, X. plittii.*

Venezuela: *X. alectoronica, X. congensis, X. conspersa, X. cumberlandia, X. microspora, X. neopropaguloides, X. plittii, X. standaertii, X. subplittii, X. subramigera, X. subsorediata, X. substenophylloides, X. ulcerosa, X. wrightiana.*

Tristan de Cunha: *X. microspora.*

Europe

Austria: *X. conspersa, X. somloensis.*

Belgium: *X. angustiphylla, X. conspersa, X. mougeotii, X. protomatrae.*

Bulgaria: *X. somloensis, X. tinctina.*

Czechoslovakia: *X. angustiphylla, X. conspersa, X. felkaensis, X. mougeotii, X. protomatrae, X. pseudohungarica, X. somloensis.*

Finland: *X. conspersa, X. mougeotii, X. somloensis.*

France: *X. conspersa, X. mougeotii, X. protomatrae, X. pseudohungarica, X. somloensis, X. subdiffluens, X. sublaevis, X. tinctina, X. verrucigera.*

Germany: *X. angustiphylla, X. conspersa, X. mougeotii, X. somloensis.*

Greece: *X. conspersa, X. somloensis, X. tinctina.*

Hungary: *X. angustiphylla, X. conspersa, X. felkaensis, X. protomatrae, X. pseudohungarica, X. somloensis, X. subdiffluens, X. tinctina, X. verrucigera.*

Italy: *X. conspersa, X. protomatrae, X. somloensis, X. tinctina, X. verrucigera.*

Norway: *X. conspersa, X. mougeotii, X. protomatrae, X. somloensis.*

Poland: *X. conspersa, X. mougeotii.*

Portugal: *X. sublaevis, X. tinctina, X. verrucigera.*

Roumania: *X. somloensis, X. tinctina, X. verrucigera.*

Spain: *X. somloensis, X. subdiffluens, X. sublaevis, X. tinctina, X. verrucigera.*

Switzerland: *X. conspersa, X. mougeotii, X. somloensis.*

Sweden: *X. angustiphylla, X. conspersa, X. mougeotii, X. somloensis, X. tinctina.*

Turkey: *X. conspersa, X. somloensis.*

United Kingdom: *X. conspersa, X. mougeotii, X. somloensis.*

USSR: *X. camtschadalis, X. conspersa, X. desertorum, X. kasachstania, X. mougeotii, X. protomatrae, X. somloensis, X. subdiffluens, X. subramigera, X. tinctina.*

Yugoslavia: *X. conspersa, X. protomatrae, X. pseudohungarica, X. tinctina, X. verrucigera.*

Africa

Algeria: *X. tinctina.*

Angola: *X. plittii, X. subramigera.*

Bourbon: *X. phaeophana.*

Ethiopia: *X. australasica, X. meruensis.*

Gough Island: *X. microspora.*

Ivory Coast: *X. neopropaguloides.*

Kenya: *X. africana, X. australasica, X. cylindriloba, X. endochrysea, X. glomerulata, X. kiboensis, X. krogiae, X. meruensis, mexicana, X. neoweberi, X. phaeophana, X. rogersii, X. salkiboensis, X. subramigera, X. tasmanica, X. treurensis, X. verrucigera, X. weberi.*

Lesotho: *X. applicata, X. atroventralis, X. brevilobata, X . conjuncta, X. dichromatica, X. granulata, X. gyrophorica, X. imbricata, X. inflata, X. kotisephola, X. lesothoensis, X. mapholanengensis, X. microlobulata, X. molliuscula, X. phaeophana, X. protolusitana, X. psoromica, X. putsoa, X. saniensis, X. schenckiana, X. subbullata, X. subdomokosii, X. subpigmentosa, X. subramigera, X. terricola, X. tsekensis, X. verrucigera.*

Madagascar: *X. benyovszkyana, X. phaeophana, X. suberadicata, X. subflabellata, X. subramigera.*

Malawi: *X. phaeophana.*

Mauritius: *X. phaeophana.*

Morocco: *X. tinctina.*

Saudi Arabia: *X. protomatrae, X. subramigera.*

South Africa: *X. affinis, X. afrolavicola, X. aggregata, X. albomaculata, X. aliphatica, X. almbornii, X. amphixanthoides, X. amplexuloides, X. antleriformis, X. applicata, X. areolata, X. arida, X. ausiana, X. australasica, X. austroafricana, X. austrocapensis, X. barklyensis, X. beatricea, X. bibax, X. bicontinens, X. brevilobata, X. brunnthaleri, X. burmeisteri, X. calvinia, X. capensis, X. cedrus-montana, X. ceresensis, X. ceresina, X. chalybaeizans, X. cirrhomedullosa, X. clivorum, X. colensoica, X. colorata, X. competita, X. concolor, X. coneruptens, X. congensis, X. conspersula, X. constrictans, X. contrasta, X. coriacea, X. crassilobata, X. cumberlandia, X. denudata, X. diacida, X. diadeta, X. dichromatica, X. diffractaica, X. domokosii, X. duplicata, X. dysprosa, X. effigurata, X. endochromatica, X. endomiltoides, X. enteroxantha, X. epigaea, X. eradicata, X. eruptens, X. esterhuyseniae, X. fucina, X. geesterani, X. globisidiosa, X. greytonensis, X. gyrophorica, X. heterodoxa, X. hybrida, X. hypoleia, X. hypoprotocetrarica, X. hypopsila, X. hyporhytida, X. ianthina, X. incerta, X. inconspicua, X. indumenica, X. iniquita, X. inuncta, X. isidiigera, X. karoo, X. karooensis, X. keralensis, X. laciniata, X. latilobata, X. laxencrustans, X. lecanorica, X. leonora, X. leucostigma, X. lineola, X. lobulifera, X. luminosa, X. marroninipuncta, X. maxima, X. mbabanensis, X. microlobulata, X. minuta, X. mollis, X. molliuscula, X. mougeotii, X. mutabilis, X. namakwa, X. namaquensis, X. natalensis, X. naudesnekia, X. neocongensis, X. neocongruens, X. neopropaguloides, X. neoreptans, X. neosynestia, X. neotasmanica, X. neotumidosa, X neoweberi, X. norlobaronica, X. obscurata, X. ochropulchra, X. olifantensis, X. olivetorica, X. oribensis, X. pachyclada, X. paradoxa, X. parvoincerta, X. perplexa, X. perrugosa, X. phaeophana, X. plittii, X. probarbellata, X. prodomokosii, X. protodysprosa, X. protoquintaria, X. proximata, X. pseudocongensis, X. pseudohypoleia, X. psornorstictica, X. psoromica, X. psoromifera, X. pustulifera, pustu-*

losorediata, X. quintaria, X. rubromedulla, X. rubropustulata, X. rugulosa, X. salamphixantha, X. saleruptens, X. saniensis, X. schenckiana, X. shebaiensis, X. sigillata, X. simulans, X. skyrinifera, X. spargens, X. springbokensis, X. stenosporonica, X. subbullata, X. subcolorata, X. subconvoluta, X. subdecipiens, X. subdomokosii, X. subflabellata, X. subnigra, X. subochracea, X. subpallida, X. subpigmentosa, X. subramigera, X. subruginosa, X. substenophylloides, X. surrogata, X. swartbergensis, X. synestia, X. tablensis, X. tasmanica, X. tegeta, X. tenuiloba, X. terricola, X. thamnolica, X. toninioides, X. transvaalensis, X. treurensis, X. tumidosa, X. umtamvuna, X. unctula, X. vendensis, X. verruciformis, X. verrucigera, X. victoriana, X. viridis, X. weberi, X. wesselsii, X. worcesteri, X. xanthomelaena.

South West Africa/Namibia: *X. afrolavicola, X. areolata, X. ausiana, X. bunnthaleri, X. colorata, X. equalis, X. evernica, X. fucina, X. harrisii, X. khomasiana, X. lagunebergensis, X. luderitziana, X. neopropaguloides, X. norcolorata, X. norwalteri, X. psoromica, X. pustulosorediata, X. serusiauxii, X. subamplexuloides, X. subramigera, X. tenacea, X. walteri, X. weberi, X. worcesteri.*

St. Helena: *X. wildeae.*

Sudan: *X. subramigera.*

Swaziland: *X. mbabanensis, X. neopropaguloides, X. phaeophana, X. pseudocongensis, X. spargens, X. subramigera.*

Tanzania: *X. africana, X. australasica, X. glomerulata, X. kiboensis, X. meruensis, X. salkiboensis, X. xanthomelaena.*

Uganda: *X. africana, X. congensis, X. convexula, X. diadeta, X. hypoleia, X. phaeophana, X. subramigera, X. weberi.*

Zaïre: *X. congensis, X. endochrysea, X. subramigera, X. xanthomelaena.*

Zimbabwe: *X. austroafricana, X. fucina, X. neocongensis, X. phaeophana, X. subramigera, X. subruginosa, X. terricola.*

AUSTRALASIA

Australia: *X. alexandrensis, X. alternata, X. amphixantha, X. amplexula, X. antleriformis, X. arapilensis, X. aurifera, X. australasica, X. australiensis, X. ballingalliana, X. barbatica, X. barbellata, X. bellatula, X. bicontinens, X. blackdownensis, X. boonahensis, X. brunnthaleri, X. bungendorensis, X. burmeisteri, X. calida, X. centralis, X. cheelii, X. concomitans, X. congensis, X. congesta, X. consociata, X. constipata, X. constrictans, X. convoluta, X. cordillerana, X. cravenii, X. darlingensis, X. dayiana, X. dichotoma, X. digitiformis, X. dissitifolia, X. donneri, X. dubitata, X. eilifii, X. elaeodes, X. elixii, X. erosa, X. everardensis, X. examplaris, X. exillima, X. exuviata, X. ferruma, X. filarszkyana, X. filsonii, X. flaviscentireagens, X. flindersiana, X. fumigata, X. furcata, X. gerhardii, X. glareosa, X. globulifera, X. gongylodes, X. heinari, X. hybridiza, X. hypoleia, X. hypomelaenoides, X. hypoprotocetrarica, X. immutata, X. incerta, X. incrustata, X. iniquita, X. isidiigera, X. isidiosa, X. laxencrustans, X. lineola, X. louisii, X. luminosa, X. lynii, X. mannumensis, X. metaclystoides, X. metamorphosa, X. metastrigosa, X. mexicana, X. molliuscula, X. mougeotina, X. multipartita, X. nana, X. nashii, X. nebulosa, X. neorimalis, X. neotinctina, X. nigraoleosa, X. nonreagens, X. norconvoluta, X. norpraegnans, X. norpumila, X. notata, X. oleosa, X. pantherina, X. parvoclystoides, X. parvoincerta, X. pertinax, X. phillipsiana, X. praegnans, X. prodomokosii, X. pseudoamphixantha, X. pseudohypoleia, X. pumila, X. pustuliza, X. remanens, X. reptans, X. rogersii, X. rubrireagens, X. rupestris, X. scabrosa, X. segregata, X. spargenosa, X. streimannii, X. stuartensis, X. subcrustacea, X. subdistorta, X. suberadicata, X. X. subluminosa, X. subnuda, X. subpigmentosa, X. substrigosa, X. succedans, X. sulcifera, X. taractica, X. tasmanica, X. tegeta, X. terrestris, X. thamnoides, X. tucsonensis, X. ustulata, X. verdonii, X. verruciformis, X. versicolor, X. vicaria, X. victoriana, X. weberi, X. willisii, X. wisangerensis, X. xanthomelaena, X. xanthomelaenoides, X. xanthosorediata, X. xerophila, X. yowaensis, X. zonata.*

New Guinea: *X. incerta, X. isidiigera, X. scabrosa.*

New Zealand: *X. alexandrensis, X. amplexula, X. arapilensis, X. australasica, X. barbellata, X. cheelii, X. concomitans, X. congesta, X. cordillerana, X. dichotoma, X. digitiformis, X. elixii, X. exillima, X. filarszkyana, X. flaviscentireagens, X. flindersiana, X. furcata, X. glareosa, X. incerta, X. isidiigera, X. lineola, X. metaclystoides, X. metamorphosa, X. mexicana, X. molliuscula, X. mougeotina, X. nebulosa, X. neotinctina, X. notata, X. oleosa, X. phillipsiana, X. pustuliza, X. reptans, X. rubrireagens, X. scabrosa, X. spargenosa, X. streimannii, X. suberadicata, X. subnuda, X. substrigosa, X. taractica, X. tasmanica, X. tegeta, X. thamnoides, X. ustulata, X. verdonii, X. xanthomelaena.*

ASIA

China: *X. camtschadalis, X. congensis, X. durietzii, X. mexicana, X. protomatrae, X. somloensis, X. xizangensis.*

India: *X. congensis, X. keralensis, X. somloensis.*

Japan: *X. conspersa, X. coreana, X. mexicana, X. scabrosa, X. somloensis, X. subramigera.*

Korea: *X. coreana, X. mexicana, X. somloensis.*

Mongolia: *X. camtschadalis, X. desertorum, X. somloensis.*

Nepal: *X. mexicana.*

Pakistan: *X. somloensis, X. tinctina.*

Delimitation of *Xanthoparmelia*

The name *Xanthoparmelia* was first proposed by Vainio (1890) in his classic study of the Brazilian lichens. He conceived it as a group within *Parmelia* (section *Xanthoparmelia*) of narrow lobed, yellow species, including both saxicolous and corticolous ones. Taking the European species, Krog (1951) recognized that "*Xanthoparmelia* [sic] constitutes both chemically and morphologically a well circumscribed group." Hale and Kurokawa (1964) later showed that the group so delimited on the world level is heterogeneous, since the corticolous species such as *Parmelia abstrusa* Vainio (= *Relicina abstrusa* (Vainio) Hale) and *P. sinuosa* Smith (= *Hypotrachyna sinuosa* (Smith) Hale) are distinct by reason of rhizines, cilia, and other characters and belong in other genera.

After these discordant elements were removed, *Parmelia* subgenus *Xanthoparmelia* (Vainio) Hale and Kurokawa, or as it is now known at the generic level, *Xanthoparmelia* (Vainio) Hale, was still a somewhat heterogeneous group of species characterized as obligately saxicolous or terricolous, with usnic acid, a pored epicortex (Hale, 1973), simple rhizines, no cilia and small adnate apothecia with very uniform spores 6–13 µm long. The conidia are basically bifusiform, 5–8 µm long.

Since then several other small discordant elements have been recognized in the genus. The most conspicuously anomalous one, *X. centrifuga* (L.) Hale and its relatives (*X. incurva* (Persoon) Hale, *X. separata* (T. Fries) Hale and *X. subcentrifuga* (Oxner) Hale), has recently been removed to a new genus, *Arctoparmelia* Hale (Hale, 1986a). The species group centered around "*Omphalodium hottentottum* (Acharius) Flotow" has also been assigned to another genus, *Xanthomaculina* Hale (Hale, 1985b). A related vaulted-corticate, pseudocyphellate species, *X. exornata* (Zahlbruckner) Knox

and Brusse, has been recognized as the monotypic genus *Namakwa* Hale (Hale, 1988a). A small group of erhizinate, lichenin-negative species, *X. distincta* and *P. arhizinosa*, constitute the genus *Psiloparmelia* Hale (Hale, 1989b). Finally, a primarily South African group of 16 subcrustose species related to *X. adhaerens* is now recognized as a distinct genus, *Karoowia* Hale (Hale, 1989c). With these five small groups removed, *Xanthoparmelia* now appears to be reasonably homogeneous.

The closest relative among the parmelioid genera is *Paraparmelia* Elix and Johnston, a saxicolous group almost exclusively occurring in the South Hemisphere (Elix, Johnston, and Verdon, 1986). It lacks usnic acid and has a different chemical profile with a preponderance of scabrosin derivatives and norlobaridone. Both *Paraparmelia* and *Xanthoparmelia* have speciated most richly in semi-arid regions where their close morphological similarity may have derived from convergent evolution.

Neofuscelia Esslinger (Esslinger, 1978) is another epicorticate group which has very similar morphological development and is also highly developed in semi-arid regions. The generic relationships of *Neofuscelia* to both atranorin-containing *Paraparmelia* and usnic acid-containing *Xanthoparmelia* will have to be examined by lichenologists in the future when other characters used to separate them, including apothecial ontogeny, iodine tests for polysaccharide macromolecules (lichenin being present in these three genera), oil bodies in rhizines, etc., are better known.

Subgeneric Classification

Gyelnik (1931b, 1932a) recognized three subsections under section *Xanthoparmelia*: subsection *Endoleucae* Vainio (= subsection *Xanthoparmelia*), subsection *Endocoerulea* Gyelnik (type species *Parmelia bouly de lesdainii* Gyelnik (= *Psiloparmelia distincta* (Nylander) Hale), and subsection *Endoxanthae* Vainio (type species *Parmelia sphaerospora* Nylander) (= *Pseudoparmelia sphaerospora* (Nylander) Hale (Hale, 1986c:603)). He later emended subsection *Endocoerulea* to read "Thallus subtus nudus rhizinosus," one of the diagnostic characters for *Psiloparmelia distincta*.

Aside from the fact that two of the three subsections are not now considered to belong in *Xanthoparmelia* at all, the unworkability of a subgeneric classification is attested by the fact that Gyelnik himself never tried to apply this in practice except in some numbers of *Lichenotheca Parva*.

This huge sprawling genus cannot be divided into formal nomenclatural units. At best we can recognize a few groups of obviously very closely related species, leaving the great majority of species simply as undefined *Xanthoparmeliae*. The more obvious of these groups, which will be discussed in more detail in the synoptic list, center around *X. amphixantha*, *X. conspersa*, *X. convoluta*, *X. dichotoma*, *X. hypoleia*, *X. mexicana*, *X. microspora*, *X. mougeotina*, and *X. schenckiana*.

Xanthoparmelia

Xanthoparmelia (Vainio) Hale, 1974b:485.

Parmelia section *Xanthoparmelia* **Endoleuca* Vainio, 1890:60. [Type species: *Lichen conspersus* Acharius, 1798:118.]

Everniastrum Hale, 1976c:345. [Type species: *Borrera camtschadalis* Acharius, 1814:223. Illegitimate name on basis of Article 10 of the International Code of Botanical Nomenclature (Voss, 1983).]

DESCRIPTION.—Thallus foliose, very tightly to loosely adnate, saxicolous or free growing on soil, 1–20 cm broad, yellowish green; lobes subirregular to sublinear or linear, 0.1–10 mm wide, plane or convoluted, irregularly to dichotomously branched, the margins sometimes black rimmed, separate to imbricate; upper surface continuous and emaculate, white-maculate, or effigurate-maculate, smooth to transversely cracked and rugose with age; medulla white or partly or wholly pigmented; lower surface plane or canaliculate, pale brown to black, sparsely to densely rhizinate, rarely erhizinate, the rhizines simple to sparingly branched, 0.1–2 mm long. Pycnidia immersed; conidia bifusiform, 4–8 µm long, rarely cylindrical, 5–14 µm long. Apothecia adnate to substipitate, 1–20 mm in diameter, the disc usually plane, imperforate, brown; spores simple, ellipsoid, colorless, 8/ascus, 4–8 × 6–13 µm.

The typification of the genus with *Parmelia conspersa* follows Vainio's intent, *P. conspersa* being listed as the first species in his treatment. Clements and Shear (1931) later used *P. conspersa* to typify the genus *Parmelia* Acharius in their comprehensive tabulation of lichen and fungal genera, a list which I consider to be neither authoritative or final. Indeed the rules which they devised to typify fungal genera would be totally unacceptable today.

Dodge (Dodge and Baker, 1938:589) also tried to typify *Parmelia*, first removing section *Xanthoparmelia* Vainio (typified by *P. conspersa*) and then recommending a name in the *P. saxatilis* group for *Parmelia*. Ahlner (1954) formally conserved *Parmelia* against *Lichen* L. with the type species *P. saxatilis*, and this treatment is followed in *Index Nominum Genericorum* (Farr, Leussink, and Stafleu, 1979:1266) and in my world-level revision of *Parmelia* (Hale, 1987c). At this point I feel that both *Parmelia* and *Xanthoparmelia* are adequately typified under the present rules of nomenclature.

In the main synoptic list which follows, I have enclosed in brackets any pertinent information on the type specimen labels which was not cited in the original description. As in my previous revisions of the Parmeliaceae, I do not holotypify any names published before 1958, when the Code made designation of holotypes mandatory. Lectotypes are selected for pre-1958 names even when it appears that a particular author saw only one specimen in his collection when describing the taxon.

Data on distribution of the species are based on the approximately 8000 collections in the US and secondarily on

my own identifications of specimens deposited in the various herbaria listed above under Acknowledgments. Unverified literature reports are not used. Elix, Johnston, and Armstrong (1986) should be consulted for greater detail on the Australian species.

Keys to the Species of *Xanthoparmelia*

The following keys to the 406 species of *Xanthoparmelia* are divided into six major groups:

1. Key to Sorediate Species
2. Key to Terricolous Species
3. Key to Isidiate Species with a Brown Lower Surface
4. Key to Isidiate Species with a Black Lower Surface
5. Key to Nonisidiate, Nonsorediate Species with a Pale Lower Surface
6. Key to Nonisidiate, Nonsorediate Species with a Black Lower Surface

Terricolous lichens include both obligately, usually free-growing terricolous species (e.g., *X. camtschadalis* and *X. convoluta*), a few such as *X. barbellata* and *X. phaeophana*, which normally grow on rocks but are occasionally found on soil, and a sizeable group which grows loosely attached on soil and pebbles. Some species in the latter group are keyed in both the terricolous and saxicolous keys. Isidiate terricolous species such as *X. adleri*, *X. constipata*, and *X. villamiliana* are keyed out in the isidiate species keys.

Medullary color tests are useful for preliminary study, but the chemistry of most species must eventually be determined with TLC to arrive at an accurate identification. Chemical characters used in the keys refer to the major metabolite (or co-occurring major metabolite) only, unless stated otherwise in a couplet.

The nature of the upper surface, whether maculate or emaculate, should be determined under 10–20× magnification. Color of the lower surface is also an extremely important character seen best under magnification. Lobe width should be determined with a millimeter ruler as accurately as possible.

1. Key to Sorediate Species

1. Thallus free growing on soil 2
   Thallus very tightly adnate to adnate on rocks 4
2(1). Lobes strongly convoluted . . . . . ***X. erosa***
   Lobes canaliculate below, not convoluted 3
3(2). Medulla K+ yellow (stictic acid) . . . . . ***X. aurifera***
   Medulla K– (fumarprotocetraric acid) . . . . . ***X. concomitans***
4(1). Lower surface black 5
   Lower surface pale brown to brown 8
5(4). Thallus very tightly adnate with an areolate center; lobes 0.2–0.5 mm wide . . . . . ***X. mougeotii***
   Thallus tightly to loosely adnate; lobes 0.5–4 mm wide 6
6(5). Salazinic acid present; soredia powdery; South America . . . . ***X. microspora***
   Stictic acid present 7
7(6). Soredia coarse, arising from pustular isidia; South Africa . . . ***X. pustulifera***
   Soredia powdery in capitate soralia; South America . . . . . ***X. submougeotii***
8(4). Medulla K– (fumarprotocetraric or psoromic acids or norlobaridone) 9
   Medulla K+ yellow or yellow turning red (salazinic or stictic acids); South America 11
9(8). Medulla P– (norlobaridone); soredia powdery; Australia . . . . . ***X. xanthosorediata***
   Medulla P+ yellow or red (fumarprotocetraric or psoromic acids) 10
10(9). Medulla P+ red (fumarprotocetraric acid); soredia coarse, arising from pustular isidia; Lesotho . . . . . ***X. granulata***
   Medulla P+ yellow (psoromic acid); soredia farinose in capitate soralia; South America . . . . . ***X. ferraroiana***
11(8). Stictic acid present 12
   Salazinic acid present 13
12(11). Soredia capitate, farinose; South America . . . . . ***X. farinosa***
   Pustulate-sorediate, the soredia coarse; southern Africa . . . . . ***X. pustulosorediata***

13(11). Lobes broad and subirregular, 1–4 mm wide . . . . . *X. ulcerosa*
Lobes narrower, 0.5–1 mm wide, sublinear 14
14(13). Thallus tightly adnate; soredia produced on digitate laciniae; Ecuador . . . . . *X. cotopaxiensis*
Thallus loosely adnate; soredia produced mostly on main lobes; St. Helena . . . . . *X. wildeae*

2. Key to Terricolous Species

1. Thallus free growing, often breaking apart into separate lobes or remaining intact; lobes moderately to strongly convoluted, sometimes forming tubes 2
Thallus forming intact, usually orbicular colonies or rosettes loosely attached on pebbles or compacted soil, in part becoming free-growing; lobes plane below, canaliculate (with a raised yellowish rim below), or weakly convoluted 25
2(1). Medulla K– (evernic, fatty, fumarprotocetraric, hypoprotocetraric, or protocetraric acids, or norlobaridone) 3
Medulla K+ yellow or yellow turning red (hypostictic, norstictic, salazinic, or stictic acids) 10
3(2). Medulla P+ orange-red (fumarprotocetraric or protocetraric acids); South Africa 4
Medulla P– 5
4(3). Lobes strongly convoluted in tubes; surface emaculate; protocetraric acid present . . . . . *X. beatricea*
Lobes weakly convoluted; surface weakly white-maculate; fumarprotocetraric acid present . . . . . *X. leonora*
5(3). Norlobaridone present; Australia 6
Fatty acid or hypoprotocetraric acid present; USA or South Africa 7
6(5). Lobes coarse and broad, 2–5 mm wide . . . . . *X. australiensis*
Lobes narrower, 0.8–1.2 mm wide . . . . . *X. subdistorta*
7(5). Hypoprotocetraric acid present 8
Fatty acids present 9
8(7). Lower medulla orange-red (skyrin); lobes weakly convoluted, open below . . . . . *X. neocongruens*
Lower medulla white; lobes strongly convoluted as tubes . . . . . *X. pachyclada*
9(7). Thallus forming intact colonies; lobes weakly convoluted; South Africa . . . . . *X. epigaea*
Thallus breaking apart into strongly convoluted tubes; USA . . . . . *X. lipochlorochroa*
10(2). Salazinic acid present 11
Hypostictic, norstictic, or stictic acids present 19
11(10). Surface white-maculate 12
Surface emaculate 15
12(11). Thallus forming more or less intact colonies; lobes narrow, 1.3–3 mm wide; Eurasia and North America . . . . . *X. camtschadalis*
Thallus breaking part into separate lobes; lobes broad, 2–10 mm wide . . . 13
13(12). Thallus forming separate strongly convoluted tubes; lobes coarse, rugose, 3–10 mm wide; USSR and Mongolia . . . . . *X. desertorum*
Lobes plane to weakly convoluted, 1.5–7 mm wide, not rugose 14
14(13). Lobes strap-shaped, moderately rhizinate below; Europe . . . *X. subdiffluens*
Lobes weakly convoluted, contorted and twisted, very sparsely rhizinate below; western North America . . . . . *X. idahoensis*

15(11). Thallus free-growing on soil and humus, often scattered; lobes strongly convoluted 16
Thallus mostly loosely attached on soil or pebbles, remaining intact; lobes weakly convoluted 18
16(15). Lobes mostly separate, strongly inrolled; rhizines sparse; Australia . . . . . ***X. convoluta***
Thallus scattered but lobes mostly intact, moderately to strongly convoluted; rhizines moderate to dense 17
17(16). Lower surface pale to dark brown with moderate to dense rhizines; North America . . . . . ***X. chlorochroa***
Lower surface dark brown with dense, long dark rhizines; Lesotho . . . . . ***X. kotisephola***
18(15). Thallus forming compact rosettes; lobes rather short, to 3 mm wide; rhizines moderate to dense, light brown to brown; western North America . . . . . ***X. wyomingica***
Thallus expanded; lobes elongate less than 2 mm wide; rhizines dense, dark brown; South Africa . . . . . ***X. subconvoluta***
19(10). Norstictic acid present 20
Stictic or hypostictic acid present 23
20(19). Lower surface dark brown to nearly black; rhizines lacking; North America . . . . . ***X. norchlorochroa***
Lower surface pale brown to brown; rhizines present 21
21(20). Upper surface white-maculate; USSR . . . . . ***X. kasachstania***
Upper surface emaculate 22
22(21). Lobes strongly inrolled, coarse, 3–8 mm wide; Australia . . ***X. norconvoluta***
Lobes moderately inrolled, finer, 1–2 mm wide; North America . . . . . ***X. neochlorochroa***
23(19). Hypostictic acid present; Australia . . . . . ***X. sulcifera***
Stictic acid present; Americas 24
24(23). Lobes more or less strongly inrolled, breaking apart . . . . . ***X. vagans***
Lobes weakly convoluted; thallus intact, terete-laciniate at the center . . . . . ***X. neowyomingica***
25(1). Lobes canaliculate; lower surface pale yellow to brown (blackening only in *X. salamphixantha*) with sparse long brown to black rhizines 26
Lobes plane, flattened to weakly convoluted; lower surface pale brown to black with sparse to moderate concolorous rhizines 40
26(25). Upper surface white-maculate 27
Upper surface continuous, emaculate 33
27(26). Medulla K– (fumarprotocetraric or stenosporonic acids) 28
Medulla K+ yellow or yellow turning red (norstictic, salazinic, or stictic acids) 31
28(27). Medulla P– (stenosporonic acid); South America . . . . . ***X. peruviensis***
Medulla P+ orange-red (fumarprotocetraric acid) 29
29(28). Lobes with terete laciniae at the center; South Africa . . . . . ***X. neoreptans***
Terete laciniae lacking; Australia 30
30(29). Thallus forming rosettes; lobes dichotomously branched, moderately branched; rhizines moderate to dense . . . . . ***X. reptans***
Thallus breaking apart; lobes more irregularly branched; rhizines very sparse . . . . . ***X. willisii***
31(27). Norstictic acid present; Australia . . . . . ***X. pseudoamphixantha***
Salazinic acid or stictic acid present 32
32(31). Stictic acid present; Australasia . . . . . ***X. amphixantha***
Salazinic acid present; South Africa . . . . . ***X. salamphixantha***
33(26). Medulla K– (evernic acid); South Africa . . . . . ***X. aggregata***
Medulla K+ yellow or yellow turning red (salazinic or stictic acids) 34

34(33). Stictic acid present 35
Salazinic acid present 38
35(34). Lobes becoming terete, narrow, 0.2–0.6 mm wide; Madagascar . . . . . ***X. benyovszkyana***
Main lobes flattened, only the secondary laciniae terete, 1–2 mm wide . . . 36
36(35). Center of thallus becoming densely terete-laciniate . . . . . ***X. molliuscula***
Terete laciniae lacking 37
37(36). Surface emaculate; lower surface mostly dark brown; South Africa and Madagascar . . . . . ***X. subflabellata***
Surface usually white-maculate; lower surface pale yellowish brown or darker; Australia . . . . . ***X. amphixantha***
38(34). Chalybaeizans unknown present; South Africa . . . . . ***X. amphixanthoides***
Chalybaeizans unknown lacking; Australia 39
39(38). Secondary laciniae weakly convoluted; lower surface pale yellowish brown . . . . . ***X. bellatula***
Secondary laciniae terete; lower surface brown . . . . . ***X. alternata***
40(25). Thallus pale brown to brown below 41
Thallus black below 73
41(40). Medulla K– (4-*O*-demethyldiffractaic, fatty, fumarprotocetraric, hypoprotocetraric, protocetraric, or stenosporonic acids or norlobaridone) 42
Medulla K+ yellow or yellow turning red (hypostictic, norstictic, salazinic, or stictic acids) 53
42(41). Medulla P+ orange-red (fumarprotocetraric or protocetraric acids); South Africa 43
Medulla P– 48
43(42). 4-*O*-Methyldiffractaic acid present . . . . . ***X. duplicata***
4-*O*-Methyldiffractaic acid lacking 44
44(43). Surface emaculate 45
Surface white-maculate 46
45(44). Lobes moderately convoluted, to 4 mm wide . . . . . ***X. leonora***
Lobes plane, barely convoluted, to 2 mm wide . . . . . ***X. vendensis***
46(44). Lower medulla orange-red . . . . . ***X. skyrinifera***
Lower medulla white 47
47(46). Surface strongly white-maculate; lobes flat, with large bare areas on the lower surface . . . . . ***X. phaeophana***
Surface weakly to moderately white-maculate; lobes moderately convoluted, uniformly rhizinate below . . . . . ***X. leonora***
48(42). Lower part of medulla orange-red; hypoprotocetraric acid present . . . . . ***X. neocongruens***
Lower part of medulla white 49
49(48). Lower surface canaliculate with a yellow rim; stenosporonic acid present; South America . . . . . ***X. peruviensis***
Lower surface plane to weakly inrolled; stenosporonic acid lacking 50
50(49). Norlobaridone present 51
Fatty acids present 52
51(50). Thallus forming small rosettes; lobes weakly canaliculate, convoluted, dichotomously branched . . . . . ***X. eilifii***
Thallus irregular; lobes barely if at all convoluted, irregular to sublinear . . . . . ***X. flaviscentireagens***
52(50). Lobes flat to barely convoluted; traces of scabrosin derivatives present; Australia . . . . . ***X. condaminensis***
Lobes mostly weakly to moderately convoluted; scabrosins lacking; South Africa . . . . . ***X. epigaea***
53(41). Salazinic and/or norstictic acids present 54
Salazinic acid lacking (hypostictic or stictic acid present) 69

54(53). Norstictic acid present in high concentration; Australasia 55
Norstictic acid lacking or present as traces 58
55(54). Lower medulla in part orange-red (skyrin) . . . . . *X. barbellata*
Lower medulla white 56
56(55). Upper surface weakly to strongly white-maculate; rhizines dense, furcate . . . . . *X. substrigosa*
Upper surface emaculate; rhizines moderately developed 57
57(56). Thallus forming small rosettes; terete laciniae developing on older lobes . . . . . *X. terrestris*
Thallus forming large irregular colonies; terete laciniae lacking . *X. arapilensis*
58(54). Upper surface white-maculate 59
Upper surface emaculate 61
59(58). Terete laciniae present on older lobes; China . . . . . *X. durietzii*
Terete laciniae lacking; Europe 60
60(59). Lobes strap-shaped, flat, to 7 mm wide . . . . . *X. subdiffluens*
Lobes dissected, weakly convoluted, to 3 mm wide . . . *X. pseudohungarica*
61(58). Lobes large and rotund, to 7 mm wide; South Africa . . . . . *X. crassilobata*
Lobes smaller, not rotund, to 4 mm wide 62
62(61). Thallus forming densely pulvinate cushions; lobes short and crowded, less than 1.2 mm wide; Europe . . . . . *X. felkaensis*
Thallus expanded, not pulvinate; lobes elongate, 0.5–4 mm wide 63
63(62). Lobes becoming moderately convoluted with dense rhizines 64
Lobes flat and plane to barely convoluted; rhizines sparse to moderate . . . 65
64(63). Thallus forming compact rosettes; lobes rather short, to 5 mm wide; rhizines moderate to dense, light brown to brown; western North America . . . . . *X. wyomingica*
Thallus expanded; lobes elongate less than 2 mm wide; rhizines dense, dark brown; South Africa . . . . . *X. subconvoluta*
65(63). Lobes elongate, stringy, less than 1 mm wide 66
Lobes shorter, imbricated, 1–4 mm wide 67
66(65). Lobes almost entirely terete; lower surface mottled brown and black; East Africa . . . . . *X. cylindriloba*
Lobes flat, only secondary laciniae terete; lower surface mottled yellow-brown; South Africa . . . . . *X. wesselsii*
67(65). Lobes narrow, 1–1.5 mm wide; lower surface dark brown; South Africa . . . . . *X. terricola*
Lobes broader, 1–4 mm wide; lower surface pale brown to brown 68
68(67). Secondary laciniae usually present, plane; thallus usually terricolous; Americas and Australia . . . . . *X. taractica*
Secondary laciniae absent or poorly developed; thallus saricolous; western Europe . . . . . *X. sublaevis*
69(53). Secondary laciniae absent or poorly developed; thallus saricolous; western Europe . . . . . *X. sublaeuisa*
Stictic acid present 70
70(69). Center of thallus with terete secondary laciniae 71
Laciniae if present plane to convoluted 72
71(70). Thallus pulvinate, brittle; lower surface dark brown; Mexico . . . . . *X. tolucensis*
Thallus not pulvinate, firm; lower surface pale brown; western North America . . . . . *X. neowyomingica*
72(70). Lobes imbricate, crowded. dissected; South America . . . . . *X. standaertii*
Lobes separate, flat, sublinear and sparsely dichotomously branched; South Africa and Madagascar . . . . . *X. subflabellata*
73(40). Lobes strongly convoluted, free-growing on soil; rhizines lacking; North America . . . . . *X. norchlorochroa*

Lobes flat and plane or rarely canaliculate, weakly convoluted or subterete 74
74(73). Norstictic acid present; Australia . . . . . *X. norpumila*
Salazinic or stictic acids present 75
75(74). Salazinic acid present 76
Stictic acid present 86
76(75). Lobes almost all terete, stringy; East Africa . . . . . *X. cylindriloba*
Lobes flattened, not stringy 77
77(76). Lower surface strongly rugose, very sparsely rhizinate; lobes curling upward 78
Lower surface not rugose, sparsely to moderately rhizinate; lobes not curling upward 79
78(77). Lobes rather narrow, to 1.5 mm wide; chalybaeizans unknown lacking; SWA/Namibia . . . . . *X. walteri*
Lobes broader, to 4 mm wide; chalybaeizans unknown present; South Africa . . . . . *X. hyporhytida*
79(77). Lower part of medulla deep orange-red (skyrin) . . . . . *X. rubromedulla*
Medulla white 80
80(79). Lobes very broad and rotund, 3–8 mm wide; South Africa . . . . *X. latilobata*
Lobes narrower, obtuse, to 6 mm wide 81
81(80). Upper surface white-maculate 82
Upper surface continuous, emaculate 84
82(81). Lobes narrow and elongated, constricted, 0.5–1.5 mm wide . . *X. constrictans*
Lobes broader, 2–6 mm wide, not constricted 83
83(82). Lower surface canaliculate, blackening only at the center . . . . . *X. salamphixantha*
Lower surface plane, black nearly to the margin . . . . . *X. neotasmanica*
84(80). Lobes very narrow, less than 0.5 mm wide; South Africa . . . . *X. eradicata*
Lobes broader, 1–3 mm wide; Australia 85
85(84). Thallus loosely adnate; lobes flattened . . . . . *X. versicolor*
Thallus closely adnate on soil; lobes becoming subterete . . . . . *X. pumila*
86(75). Lobes very narrow, less than 1 mm wide 87
Lobes broader, 1–2.5 mm wide 89
87(86). Rhizines lacking or very sparse; Madagascar, Australasia . . *X. suberadicata*
Rhizines very sparse to moderately developed 88
88(87). Lower surface smooth; South Africa . . . . . *X. esterhuyseniae*
Lower surface rugose; North America . . . . . *X. planilobata*
89(86). Lobes sublinear-elongate, separate, somewhat constricted, black rimmed . . . . . *X. simulans*
Lobes shorter, imbricate, not black-rimmed or constricted 90
90(89). Lower surface plane; South Africa . . . . . *X. austrocapensis*
Lower surface with a yellowish rim toward the tips; South Africa and South America . . . . . *X. hypopsila*

3. Key to Isidiate Species with a Brown Lower Surface

1. Medulla K– (to slowly K+ faint yellow) (containing 3-α-hydroxybarbatic, 4-*O*-methylhypoprotocetraric, barbatic, colensoic, diffractaic, evernic, fatty, fumarprotocetraric, hypoprotocetraric, lecanoric, lobaric, protocetraric, psoromic, succinprotocetraric acids or norlobaridone or scabrosin derivatives) 2
Medulla distinctly and quickly K+ yellow or yellow turning red (hypostictic, norstictic, salazinic, or stictic acids) 46

2(1). Isidia globose, short and usually unbranched, less than 0.2–0.3 mm high, usually hollow and often erumpent with pale tips 3
Isidia subglobose (when immature) to cylindrical, relatively tall and becoming branched, usually more than 0.2 mm high, the tips often darkening, solid (pustulate or erumpent in *X. constipata, X. remanens, X. scabrosa,* and *X. spargens*) 19
3(2). Thallus very tightly to tightly adnate; lobes less than 1 mm wide on the average 4
Thallus adnate to loosely adnate; lobes more than 1 mm wide 13
4(3). Medulla P+ red (fumarprotocetraric acid); Australia . . . . . ***X. dayiana***
Medulla P– 5
5(4). Medulla C+ red (lecanoric acid); South Africa . . . . . ***X. coneruptens***
Medulla C– 6
6(5). Barbatic acid present 7
Barbatic acid lacking 8
7(6). Isidia coarse, bullate, 0.2–0.3 mm in diameter; South Africa and SWA/Namibia . . . . . ***X. areolata***
Isidia slender, 0.1–0.2 mm in diameter; Australia . . . . . ***X. centralis***
8(6). Hypoprotocetraric acid present; SWA/Namibia . . . . . ***X. khomasiana***
Hypoprotocetraric acid lacking 9
9(8). Evernic acid present; southern Africa 10
Evernic acid lacking 11
10(9). Isidia moderate to dense, 0.15–0.25 mm in diameter; SWA/Namibia . . . . . ***X. evernica***
Isidia sparse, bloated, to 0.3 mm in diameter; South Africa . . . . ***X. eruptens***
11(9). Lobaric acid present; lower part of medulla orange-red (skyrin) Australia . . . . . ***X. zonata***
Lobaric acid lacking; medulla white 12
12(11). Fatty acids present; Australia . . . . . ***X. globulifera***
4-*O*-Methylhypoprotocetraric acid present; South Africa . . . . . ***X. calvinia***
13(3). Medulla P+ red or yellow (protocetraric, psoromic, or fumarprotocetraric acid) 14
Medulla P– (fatty acids, hypoprotocetraric acid, or norlobaridone) 16
14(13). Medulla P+ yellow (psoromic acid); Americas . . . . . ***X. lavicola***
Medulla P+ orange-red 15
15(14). Isidia thin, subcylindrical; protocetraric acid; Australia . . . . . ***X. stuartensis***
Isidia coarse and pustular, subsorediate; fumarprotocetraric acid; Lesotho . . . . . ***X. granulata***
16(13). Exuviatic acid present; Australia . . . . . ***X. exuviata***
Norlobaridone or hypoprotocetraric acid present 17
17(16). Hypoprotocetraric acid present . . . . . ***X. weberi***
Norlobaridone present 18
18(17). Thallus saxicolous; fatty acids lacking . . . . . ***X. scabrosa***
Thallus terricolous; constipatic acid series present . . . . . ***X. constipata***
19(2). Medulla C+ red (lecanoric acid); North America . . . . . ***X. joranadia***
Medulla C– 20
20(19). Medulla P+ red or P+ yellow 21
Medulla P– 27
21(20). Medulla P+ persistent yellow (psoromic acid) 22
Medulla P+ red or orange red (protocetraric or fumarprotocetraric acids) . . 23
22(21). Isidia subcylindrical, simple or sparingly branched, in part erumpent; North and South America . . . . . ***X. lavicola***
Isidia cylindrical, branched, not erumpent; southern Africa, SWA/Namibia . . . . . ***X. afrolavicola***

23(21). Protocetraric acid present 24
Fumarprotocetraric acid present 25
24(23). Isidia tall and cylindrical, branching; southern Africa . . . . . *X. fucina*
Isidia short, subcylindrical, in part erumpent, unbranched; Australia . . . . . *X. stuartensis*
25(23). Diffractaic acid present; South Africa . . . . . *X. natalensis*
Diffractaic acid lacking; pantemperate 26
26(25). Medulla white . . . . . *X. subramigera*
Medulla pale yellow-orange . . . . . *X. krogiae*
27(20). Norlobaridone present 28
Norlobaridone lacking 34
28(27). Thallus very tightly adnate, lobes 0.3–1.3 mm wide 29
Thallus adnate; lobes 1–4 mm wide 30
29(28). Thallus centrally areolate; lobes 0.3–0.5 mm; loxodin present . . . . . *X. exillima*
Thallus lobate at the center; lobes 0.4–1.3 mm wide; loxodin absent; South Africa . . . . . *X. subamplexuloides*
30(28). Isidia robust, branched, dark-tipped . . . . . *X. amplexula*
Isidia subglobose to cylindrical, pale-tipped and in part erumpent to pustulate 31
31(30). Loxodin absent; South Africa . . . . . *X. amplexuloides*
Loxodin usually present; Australasia 32
32(31). Thallus small; lobes 0.8–1.5 mm wide, strongly laciniate at the center . . . . . *X. lynii*
Thallus larger with broad lobes 1–4 mm wide 33
33(32). Saxicolous . . . . . *X. scabrosa*
Terricolous . . . . . *X. constipata*
34(27). Hypoprotocetraric acid present 35
Hypoprotocetraric acid lacking 37
35(34). Skyrin present in lower medulla . . . . . *X. neoweberi*
Skyrin lacking 36
36(35). Thallus adnate; lobes 2–3 mm wide . . . . . *X. weberi*
Thallus tightly adnate; lobes 0.7–1.3 mm wide . . . . . *X. endochrysea*
37(34). Scabrosin present; Australasia 38
Scabrosin lacking 40
38(37). Thallus adnate; lobes 1–2.5 mm wide . . . . . *X. remanens*
Thallus very tightly to tightly adnate; lobes 0.2–1 mm wide 39
39(38). Thallus very tightly adnate, lobes 0.2–1 mm wide . . . . . *X. immutata*
Thallus tightly adnate, lobes 0.5–1 mm wide . . . . . *X. nonreagens*
40(37). Diffractaic acid present 41
Diffractaic acid lacking 42
41(40). Lobes narrow, 0.4–1 mm, dispersed; Australia . . . . . *X. blackdownensis*
Lobes broader, 1–3mm wide, imbricate; western North America . . . . . *X. ajoensis*
42(40). Thallus tightly adnate; lobes 0.4–1 mm wide; Australia 43
Thallus adnate; lobes to 2 mm wide 44
43(42). Lower medulla pigmented orange-red; lobaric acid; Australia . . . . *X. zonata*
Colensoic acid present; Australia . . . . . *X. ballingalliana*
44(42). 3-α-Hydroxybarbatic acid present; western North America . . . . . *X. moctezumensis*
Fatty acids present 45
45(44). Unknown spargens fatty acids present; South Africa . . . . . *X. spargens*
Exuviatic acid present; Australia . . . . . *X. exuviata*
46(1). Medulla entirely pigmented reddish purple; isidia rugose-pustulate; South Africa . . . . . *X. rubropustulata*

Medulla white (lower medulla red-orange in *X. saniensis*) 47
47(46). Medulla pigmented orange-red in lower part; Lesotho and South Africa . . . . . ***X. saniensis***
Medulla entirely white 48
48(47). Isidia globose, mostly unbranched, 0.2–0.3 mm high, often hollow and erumpent 49
Isidia cylindrical, branching, to 2 mm high, entire and often black-tipped 63
49(48). Stictic acid present 50
Stictic acid lacking 55
50(49). Thallus very tightly to tightly adnate; lobes 0.2–0.8 mm wide 51
Thallus adnate; lobes 0.7–3 mm wide 52
51(50). Barbatic acid present; South Africa . . . . . ***X. umtamvuna***
Barbatic acid lacking; Australia and South Africa . . . . . ***X. victoriana***
52(50). Isidia erupting into large capitate subsorediate masses; southern Africa . . . . . ***X. pustulosorediata***
Isidia erumpent to diffuse subsorediate 53
53(52). Rhizines very sparse; South Africa . . . . . ***X. globisidiosa***
Rhizines moderately dense; South America 54
54(53). Isidia dense, becoming diffuse-subsorediate . . . . . ***X. subsorediata***
Isidia moderate, globose to subcylindrical, not becoming diffuse . . . . . ***X. subplittii***
55(49). Salazinic acid present (norstictic acid if present only in traces) 56
Salazinic acid lacking 60
56(55). Thallus loosely adnate, lobes 2–5 mm wide 57
Thallus tightly adnate; lobes 0.6–1.8 mm wide 58
57(56). Isidia dense, becoming diffuse, granular; South America, Australasia . . . . . ***X. cordillerana***
Isidia moderate, somewhat erumpent but not diffuse or granular; Asia . . . . . ***X. coreana***
58(56). Isidia sparse, globose-pustulate; thallus white pruinose; South Africa . . . . . ***X. saleruptens***
Isidia moderate to dense, globose to subcylindrical 59
59(58). Isidia mostly erumpent; SWA/Namibia . . . . . ***X. tenacea***
Isidia sparsely erumpent; Australia . . . . . ***X. praegnans***
60(55). Hypostictic acid present; South America . . . . . ***X. kalbii***
Norstictic acid present; Australia 61
61(60). Thallus tightly adnate; lobes 0.4–0.6 mm wide . . . . . ***X. norpraegnans***
Thallus adnate; lobes 0.5–2 mm wide 62
62(61). Salazinic acid present . . . . . ***X. segregata***
Salazinic acid lacking . . . . . ***X. flindersiana***
63(48). Stictic acid present 64
Stictic acid lacking 68
64(63). Thallus tightly adnate; lobes 0.4–1 mm wide 65
Thallus adnate; lobes 1–2 mm wide 67
65(64). Isidia in tall masses to 2 mm high; Kenya . . . . . ***X. glomerulata***
Isidia short, to 0.4 mm high; South America, southern Africa 66
66(65). Rhizines stout; isidia darkening at tips . . . . . ***X. neopropaguloides***
Rhizines delicate, translucent; isidia pale . . . . . ***X. subpallida***
67(64). Stictic acid complex present . . . . . ***X. plittii***
Stictic acid with salazinic acid present . . . . . ***X. succedans***
68(63). Hypostictic acid present 69
Hypostictic acid lacking; salazinic and/or norstictic acid present 70
69(68). Thallus turning brown at maturity; SWA/Namibia . . . . . ***X. harrisii***
Thallus yellow-green at maturity; Australia . . . . . ***X. gongylodes***

70(68). Salazinic acid present with only traces of norstictic acid 71
Norstictic acid present as major metabolite; salazinic acid lacking or present in near equal concentration 77
71(70). Isidia bullate, more than 0.3 mm in diameter; chalybaeizans unknown present; South Africa . . . . . *X. subbullata*
Isidia cylindrical, less than 0.2–0.3 mm in diameter; chalybaeizans unknown lacking 72
72(71). Thallus adnate to loosely adnate; lobes 1.5–4 mm wide 73
Thallus more tightly adnate; lobes 0.3–1.5 mm wide 76
73(72). Norlobaridone present; Argentina . . . . . *X. adleri*
Norlobaridone lacking 74
74(73). Barbatic acid present; California . . . . . *X. schmidtii*
Barbatic acid lacking 75
75(74). Isidia in part erumpent; lower surface uniformly darker brown . . . . . *X. coreana*
Isidia becoming black-tipped, entire; lower surface pale brown . . . . . *X. mexicana*
76(72). Center of thallus areolate; isidia short, moderately branched . . . . . *X. consociata*
Center of thallus lobate; isidia becoming tall, densely branched . . . . . *X. antleriformis*
77(70). Thallus tightly adnate; lobes 0.7–1.5 mm wide; Australasia . . . . . *X. streimannii*
Thallus adnate; lobes 1–4 mm wide 78
78(77). Barbatic acid present; western North America . . . . . *X. schmidtii*
Barbatic acid lacking 79
79(78). Hyposalazinic acid present; western North America . . . . . *X. maricopensis*
Norstictic acid alone present or mixed with salazinic acid 80
80(79). Norstictic acid alone present; North America . . . . . *X. dierythra*
Norstictic and salazinic acids present; Australia . . . . . *X. segregata*

4. Key to Isidiate Species with a Black Lower Surface

1. Medulla K– (alectoronic, barbatic, diffractaic, evernic, fatty, fumarprotocetraric, hypoprotocetraric, lecanoric, norlobaridone, or stenosporonic acids) 2
Medulla K+ yellow or K+ yellow turning red (hypothamnolic, norstictic, salazinic, or stictic acids) 16
2(1). Medulla C+ red (lecanoric acid) . . . . . *X. clivorum*
Medulla C– (fumarprotocetraric acid or norlobaridone 3
3(2). Medulla P+ red (fumarprotocetraric acid) 4
Medulla P– 5
4(3). Thallus loosely adnate; South Africa . . . . . *X. mbabanensis*
Thallus adnate; North America . . . . . *X. piedmontensis*
5(3). Norlobaridone present; Australasia 6
Norlobaridone lacking 8
6(5). Thallus very tightly adnate; lobes 0.5–1.2 mm wide . . . . . *X. calida*
Thallus adnate; lobes 1–2.5 mm wide 7
7(6). Isidia globose to subcylindrical, sparingly branched, becoming erumpent . . . . . *X. verdonii*
Isidia cylindrical, tall and branched . . . . . *X. thamnoides*
8(5). Thallus very tightly adnate; lobes 0.2–1 mm wide 9
Thallus adnate to loosely adnate; lobes 1–4 mm wide 12

9(8). Alectoronic acid present; South America . . . . . *X. alectoronica*
Alectoronic acid lacking; South Africa, Australia, or India 10
10(9). Hypoprotocetraric acid present; lobes 0.5–1 mm wide . . . . *X. neocongensis*
Hypoprotocetraric acid lacking; lobes 0.2–0.5 mm wide 11
11(10). Stenosporonic acid present; South Africa, India . . . . . *X. keralensis*
Barbatic acid present; Australia . . . . . *X. xerophila*
12(8). Medulla in part orange-red in lower part . . . . . *X. oribensis*
Medulla white 13
13(12). Fatty acids present; Africa 14
Fatty acids lacking; Australia 15
14(13). Constipatic acid series present . . . . . *X. transvaalensis*
Unknown fatty acids present . . . . . *X. meruensis*
15(13). Barbatic acid present . . . . . *X. vicaria*
Diffractaic acid present . . . . . *X. nashii*
16(1). Stictic acid present 17
Salazinic and/or norstictic acid present 21
17(16). Thallus very tightly adnate, often appearing areolate at the center; lobes 0.2–0.8 mm wide 18
Thallus adnate to loosely adnate, lobate at the center; lobes 0.5–5 mm wide 25
18(17). Isidia globose, unbranched, in part erumpent . . . . . *X. congensis*
Isidia cylindrical, branched or unbranched, not erumpent 19
19(18). Thallus dark brown at maturity; Australasia . . . . . *X. mougeotina*
Thallus yellow-green; South Africa and/or tropical America 20
20(19). Lobes short and blunt, margins black-rimmed; isidia dark-tipped . . . . . *X. pseudocongensis*
Lobe relatively elongate, the tips acute, margins and isidia pale . . . . . *X. substenophylloides*
21(16). Salazinic acid present (norstictic if present only in traces); Africa 22
Norstictic acid present as major metabolite (with or without salazinic acid) 23
22(21). Isidia globose, erumpent . . . . . *X. geesterani*
Isidia cylindrical, not erumpent . . . . . *X. diadeta*
23(21). Salazinic acid present in equal concentration; South Africa . . . . . *X. minuta*
Salazinic acid lacking or present in traces; Australia 24
24(23). Isidia dense, more than 0.07 mm in diameter and sometimes abrading . . . . . *X. heinari*
Isidia sparse to moderate, less than 0.07 mm in diameter, not abrading . . . . . *X. filsonii*
25(17). Medulla orange-red in the lower part . . . . . *X. subluminosa*
Medulla white 26
26(25). Upper surface uniformly white-maculate . . . . . *X. xizangensis*
Upper surface continuous (patchy white-maculate in *X. treurensis*) 27
27(26). Isidia globose, unbranched, less than 0.2–0.3 mm high, often hollow and erumpent 28
Isidia cylindrical, usually branched, up to 2 mm high, solid, the tips often darkening 35
28(27). Stictic acid present 29
Norstictic or salazinic acids present 31
29(28). Isidia in part erumpent, esorediate; Mexico . . . . . *X. amableana*
Isidia erupting into subsorediate masses 30
30(29). Lobes narrow, 0.5–1.2 mm wide; South Africa . . . . . *X. pustulifera*
Lobes broader, 1.5–3 mm wide; South America . . . . . *X. wrightiana*
31(28). Salazinic acid present 32
Norstictic acid present (salazinic acid, if present, in traces) 34

32(31). Isidia erupting into subsorediate masses; South America . . . . ***X. punctulata***
Isidia not erupting into sorediate masses; Australia or Europe 33
33(32). Isidia entire, shiny, rarely weakly erumpent; Europe . . . . . ***X. tinctina***
Isidia erumpent; Australia . . . . . ***X. isidiosa***
34(31). Thallus tightly adnate; isidia mostly erumpent . . . . . ***X. pustuliza***
Thallus loosely adnate; isidia in part erumpent . . . . . ***X. alexandrensis***
35(27). Stictic acid present 36
Stictic acid lacking 43
36(35). Surface white-maculate; rhizines lacking; South Africa . . . . . ***X. treurensis***
Surface emaculate; rhizines sparsely to moderately developed 37
37(36). Thallus tightly adnate to adnate; lobes less than 1 mm wide; Australasia . . . . . ***X. phillipsiana***
Thallus adnate to loosely adnate; lobes 1–5 mm wide 38
38(37). Lobes sublinear, elongate; thallus loosely adnate; USA . . . . . ***X. isidiascens***
Lobes subirregular to sublinear, generally short; thallus adnate to loosely adnate 39
39(38). Norstictic acid lacking; lusitana unknown present . . . . . ***X. verrucigera***
Norstictic acid usually present; lusitana unknown lacking 40
40(39). Isidia very thick, about 0.2 mm in diameter; usually collected on soil; Argentina . . . . . ***X. villamiliana***
Isidia thinner, less than 0.2 mm in diameter; collected on rocks 41
41(40). Lower surface weakly canaliculate and yellow-rimmed at the tips; sparsely rhizinate; South America . . . . . ***X. catarinae***
Lower surface plane at the tips; moderately to densely rhizinate 42
42(41). Isidia cylindrical, not erumpent; thallus adnate to loosely adnate; pantemperate (except for Australasia) . . . . . ***X. conspersa***
Isidia cylindrical but erumpent apically; thallus tightly adnate to adnate; Mexico . . . . . ***X. amableana***
43(35). Salazinic acid present (norstictic acid if present in traces) 44
Norstictic or hypothamnolic acid present 47
44(43). Chalybaeizans unknown present; South Africa . . . . . ***X. capensis***
Chalybaeizans unknown lacking 45
45(44). Thallus tightly adnate; lobes 0.7–1.3 mm wide; South Africa . . . ***X. diadeta***
Thallus adnate to loosely adnate; lobes 1–5 mm wide 46
46(45). Thallus usually loosely attached; isidia relatively thick, 0.1–0.2 mm in diameter . . . . . ***X. australasica***
Thallus adnate; isidia relatively thin, less than 0.1 mm in diameter . . . . . ***X. isidiigera***
47(43). Hypohamnolic acid present; South Africa . . . . . ***X. thamnolica***
Norstictic acid present as the major metabolite 48
48(47). Isidia in part lobulate; North America . . . . . ***X. norhypopsila***
Isidia cylindrical 49
49(48). Isidia tall (to 0.3 mm high) and densely branched, black-tipped . . . . . ***X. neotinctina***
Isidia shorter (0.1–0.2 mm high), sparsely branched, in part erumpent . . . . . ***X. alexandrensis***

5. Key to Nonisidiate, Nonsorediate Species with a Pale Lower Surface

1. Medulla containing yellow, orange-red, or reddish purple pigments (for dull red caused by discoloration by decomposed norstictic or salazinic acids key under medulla white) 2
Medulla white 24

2(1). Medulla pigmented deep purple-red throughout; South Africa 3
Medulla pigmented yellow or yellow-orange throughout, purple-red in patches, or orange-red in the lower part 4
3(2). Salazinic acid present . . . . . *X. endomiltoides*
Salazinic acid lacking . . . . . *X. ianthina*
4(2). Purple and/or red pigments scattered throughout medulla 5
Yellow to orange-red pigments located in lower part of the medulla or throughout 7
5(4). Thallus very tightly adnate; lobes 0.3–0.6 mm wide . . . . *X. inconspicua*
Thallus adnate to loosely adnate; lobes 1–4 mm wide 6
6(5). Pigments visible at the surface in purple-red "pores" . . . . . *X. marroninipuncta*
Pigments contained as scattered patches in the medulla . . . . . *X. dichromatica*
7(4). Medulla pigmented throughout pale yellowish orange . . . . . *X. mutabilis*
Medulla pigmented orange-red in the lower part (skyrin); South Africa or Australia 8
8(7). Medulla (white areas) K– (barbatic, 4-*O*-demethyldiffractaic, hypoprotocetraric, or protocetraric acids) 9
Medulla (white areas) K+ yellow or yellow turning red (hypostictic, norstictic, or salazinic acids) 15
9(8). Medulla P+ orange-red (protocetraric acid); South Africa 10
Medulla P– 12
10(9). Thallus adnate with subirregular lobes; surface emaculate . . . . . *X. subochracea*
Thallus loosely adnate with sublinear lobes; surface maculate 11
11(10). Lobes suberect, dark, rugose, and sparsely rhizinate toward the tips below . . . . . *X. subcolorata*
Lobes not suberect, pale brown, smooth, and moderately rhizinate below . . . . . *X. skyrinifera*
12(9). Barbatic acid present; Australia . . . . . *X. boonahensis*
Barbatic acid lacking; southern Africa 13
13(12). 4-*O*-Methyldiffractaic acid present . . . . . *X. ochropulchra*
Hypoprotocetraric acid present 14
14(13). Thallus adnate to loosely adnate; lobes 2–4 mm wide . . . . . *X. subdomokosii*
Thallus tightly adnate; lobes 0.8–1.5 mm wide . . . . . *X. karooensis*
15(8). Hypostictic acid present; South Africa and Lesotho 16
Norstictic or salazinic acids present 17
16(15). Stenosporonic acid present . . . . . *X. naudesnekia*
Stenosporonic acid lacking . . . . . *X. brevilobata*
17(15). Norstictic and salazinic acids present in equal concentration 18
Salazinic acid present (norstictic acid only as traces if present) 19
18(17). Thallus adnate; South Africa . . . . . *X. probarbellata*
Thallus loosely adnate; Australasia . . . . . *X. barbellata*
19(17). Stenosporonic acid present; Lesotho . . . . . *X. tsekensis*
Stenosporonic acid lacking 20
20(19). Surface distinctly white-maculate; South Africa 21
Surface continuous, emaculate 23
21(20). Thallus loosely adnate; lobes sparsely rhizinate, rugose below, and dark below at the tips . . . . . *X. denudata*
Thallus adnate; lobes moderately rhizinate and smooth, pale below at the tips 22
22(21). Upper surface smooth; thallus yellow green; chalybaeizans unknown lacking . . . . . *X. cirrhomedullosa*

Upper surface wrinkled and rugose; thallus dark greenish yellow; chalybaeizans unknown present . . . . . ***X. springbokensis***

23(20). Thallus loosely adnate with sublinear lobes 2–5 mm wide . . . . . ***X. subpigmentosa***

Thallus adnate with shorter, subirregular lobes 1.5–3 mm wide . . . . . ***X. ferruma***

24(1). Medulla C+ rose or red (gyrophoric or lecanoric acids); South Africa . . 25

Medulla C– (or C+ pale orange in a few species with barbatic acid . . . 28

25(24). Surface effigurate-maculate . . . . . ***X. leucostigma***

Surface continuous, emaculate 26

26(25). Thallus adnate to loosely adnate; gyrophoric acid present . . . . . ***X. gyrophorica***

Thallus tightly adnate to adnate; lecanoric acid present 27

27(26). Thallus tightly adnate, appearing areolate at the center . . . . ***X. worcesteri***

Thallus adnate, lobate at the center . . . . . ***X. arida***

28(24). Medulla K+ yellow or yellow turning red (echinocarpic, hypostictic, norstictic, salazinic, stictic, or unknown acids) 29

Medulla K– (4-*O*-demethylnotatic, 4-*O*-methylhypoprotocetraric, barbatic, diffractaic, evernic, fatty, fumarprotocetraric, hypoprotocetraric, protocetraric, or psoromic acids, or norlobaridone or scabrosins) 75

29(28). Surface white-maculate or effigurate-maculate 30

Surface continuous, emaculate 33

30(29). Thallus adnate; surface effigurate-maculate . . . . . ***X. namakwa***

Thallus adnate to loosely adnate; surface white-maculate 31

31(30). Lobes narrow, 0.6–1.2 mm wide, separate . . . . . ***X. affinis***

Lobes broader, 1–5 mm wide, mostly imbricated 32

32(31). Thallus darkish yellow-green; chalybaeizans unknown present; South Africa . . . . . ***X. neosynestia***

Thallus light yellow-green; chalybaeizans unknown lacking; Europe and North America . . . . . ***X. somloensis***

33(29). Thallus loosely attached to nearly free growing on pebbles and soil; lobes more or less convoluted 34

Thallus very tightly to loosely adnate on rock, rarely on soil; lobes plane, not convoluted 36

34(33). Some terete laciniae present; stictic acid present; North America . . . . . ***X. neowyomingica***

Terete laciniae lacking; salazinic acid present 35

35(34). Lobes elongate, separate; lower surface dark brown; South Africa . . . . . ***X. subconvoluta***

Lobes shorter, imbricate; lower surface pale brown; North America . . . . . ***X. wyomingica***

36(33). Echinocarpic acid present; Lesotho . . . . . ***X. putsoa***

Echinocarpic acid lacking 37

37(36). Hypostictic acid present 38

Norstictic, salazinic, stictic, or pseudostictic acid present 41

38(37). Fumarprotocetraric acid present; South Africa . . . . . ***X. paradoxa***

Fumarprotocetraric acid lacking 39

39(38). Thallus loosely adnate; Australia . . . . . ***X. metastrigosa***

Thallus tightly adnate to adnate 40

40(39). Thallus adnate; lobes sublinear, 0.6–1 mm wide; lower surface dark brown; South Africa . . . . . ***X. quintaria***

Thallus tightly adnate; lobes subirregular, 1–2 mm wide; lower surface pale brown; Australia . . . . . ***X. subcrustacea***

41(37). Stictic acid or pseudostictic acid present 42

Salazinic and/or norstictic acid present 49

42(41). Laciniae becoming terete in center of thallus; Mexico . . . . ***X. tolucensis***
Laciniae if present, plane to convoluted 43
43(42). Thallus adnate to loosely adnate; lobes 1–2 mm wide 44
Thallus very tightly to tightly adnate; lobes 0.4–1 mm wide 46
44(43). Lobes subirregular, crowded, imbricate, often becoming laciniate . . . . . ***X. cumberlandia***
Lobes sublinear, contiguous to subimbricate, lacking laciniae 45
45(44). Thallus adnate; surface deeply fissured; protocetraric acid and pseudostictic acid present; South Africa . . . . . ***X. hybrida***
Thallus loosely adnate; stictic acid present lacking; USA . . . . . ***X. neotaractica***
46(43). Thallus very tightly adnate, areolate at the center 47
Thallus tightly adnate, lobate at the center 48
47(46). Lobes black-rimmed; rhizines stout; Australia and South Africa . . . . . ***X. xanthomelanoides***
Lobes pale-rimmed; rhizines delicate; South Africa . . . . ***X. greytonensis***
48(46). Lobes sublinear; Brazil . . . . . ***X. oblisata***
Lobes short and subirregular; East Africa . . . . . ***X. convexula***
49(41). Norstictic acid present as major metabolite or in equal concentration with salazinic acid 50
Salazinic acid present; norstictic acid if present only in trace amounts . . 58
50(49). Salazinic acid if present only in trace amounts 51
Salazinic present in significant concentrations 55
51(50). Thallus adnate to loosely adnate; Australia 52
Thallus tightly adnate to adnate 54
52(51). Lobes broad, 2–5 mm wide, separate to contiguous; rhizines moderate to dense . . . . . ***X. arapilensis***
Lobes narrower, 0.7–2 mm wide, imbricate; rhizines sparse to moderate 53
53(52). Thallus center laciniate, the laciniae subascending; rhizines sparse . . . . . ***X. elixii***
Thallus not laciniate; rhizines moderate . . . . . ***X. metaclystoides***
54(51). Thallus tightly adnate; lobes dissected, 0.5–1.1 mm wide; Australia . . . . . ***X. parvoclystoides***
Thallus adnate; lobes not dissected, 0.8–1.5 mm wide; USA . . . . . ***X. californica***
55(50). Lobes very large, broad and rotund, 3–9 mm wide; South Africa . . . . . ***X. maxima***
Lobes smaller, 0.6–2 mm wide (to 6 mm wide only in *X. substrigosa*); Australasia or South Africa 56
56(55). Thallus loosely adnate, in part on soil; lobes 2–6 mm wide . . . . . ***X. substrigosa***
Thallus tightly adnate to adnate; lobes less than 2 mm wide 57
57(56). Thallus adnate; laciniate lobes at center becoming terete; Australia . . . . . ***X. wisangerensis***
Thallus tightly adnate to adnate; laciniae lacking; SWA/Namibia . . . . . ***X. ausiana***
58(49). Barbatic acid present; Australasia . . . . . ***X. hybridiza***
Barbatic acid lacking 59
59(58). Diffractaic acid present 60
Diffractaic acid lacking 62
60(59). Lobes broad and rotund, 2–3.5 mm wide; South Africa . . . ***X. diffractaica***
Lobes narrow, 0.7–2 mm wide 61
61(60). Lobes narrow and dissected, sublinear; Lesotho . . . . . ***X. lesothoensis***
Lobes subirregular to sublinear, short, not dissected; Australia . . . ***X. nana***

62(59). Stenosporonic acid present; Lesotho . . . . . ***X. tsekensis***
Stenosporonic acid lacking 63
63(62). Chalybaeizans unknown present; South Africa 64
Chalybaeizans unknown lacking 68
64(63). Thallus loosely adnate, usually collected without rock substrate . . . . . ***X. concolor***
Thallus very tightly adnate to adnate on rock substrate 65
65(64). Thallus very tightly adnate, areolate at the center; lobes 0.4–0.8 mm wide . . . . . ***X. perplexa***
Thallus adnate, the center lobate; lobes 1–3 mm wide 66
66(62). Surface covered with bullate-isidial structures . . . . . ***X. subbullata***
Surface smooth 67
67(63). Lobes light yellow and pruinose at the tips, darkening at the center . . . . . ***X. bibax***
Lobes uniformly light or darker yellow-green, epruinose . . . . . ***X. chalybaeizans***
68(63). Lobes very broad, 3–7 mm wide; South Africa . . . . . ***X. crassilobata***
Lobes narrower, 0.3–3 mm wide 69
69(68). Thallus very tightly adnate with an areolate center; lobes 0.5–1 mm wide . . . . . ***X. neorimalis***
Thallus tightly to loosely adnate, the center lobate; lobes 0.6–3 mm wide 70
70(69). Thallus tightly adnate to adnate, collected with rock substrate 71
Thallus adnate to loosely adnate, usually collected without rock substrate 72
71(70). Thallus with convoluted laciniae at the center; Australia . . . ***X. examplaris***
Laciniae absent; Australasia, USA, North America and South Africa . . . . . ***X. lineola***
72(70). Thallus pulvinate with small congested lobes 0.6–1.2 mm wide; eastern Europe . . . . . ***X. felkaensis***
Thallus not pulvinate; lobes 1–3 mm wide 73
73(72). Lobes laciniate, black-rimmed; Australasia . . . . . ***X. digitiformis***
Lobes entire, pale-rimmed; Europe or North America 74
74(73). Lobes mostly sublinear; North America . . . . . ***X. coloradoensis***
Lobes mostly subirregular; western Europe . . . . . ***X. sublaevis***
75(28). Medulla P+ orange-red or yellow (fumarprotocetraric, protocetraric, or psoromic acids) 76
Medulla P– (barbatic, diffractaic, evernic, fatty, hypoprotocetraric, or 4-*O*-methylhypoprotocetraric acids or norlobaridone or scabrosin) 90
76(75). Medulla P+ yellow; psoromic acid present . . . . . ***X. psoromifera***
Medulla P+ orange-red; fumarprotocetraric or protocetraric acid present 77
77(76). Fumarprotocetraric acid present 78
Protocetraric acid present 86
78(77). Surface white maculate 79
Surface continuous, emaculate 81
79(78). Lobes weakly convoluted; South Africa . . . . . ***X. leonora***
Lobes plane or subascending 80
80(79). Lower surface uniformly rhizinate; Europe . . . . . ***X. protomatrae***
Lower surface with large bare areas; Africa . . . . . ***X. phaeophana***
81(78). Thallus loosely adnate 82
Thallus tightly adnate to adnate 84
82(81). Thallus pulvinate, the lobes narrow and stringy, 0.4–1 mm wide, black-rimmed; South Africa . . . . . ***X. almbornii***

Thallus not pulvinate, the lobes broader, 1–2.5 mm wide, pale to black-rimmed 83

83(82). Physodalic acid present; North America . . . . . *X. monticola*
Physodalic acid lacking; Australia . . . . . *X. iniquita*

84(81). Lobes very narrow, 0.2–0.6 mm wide, crowded and rugulose at the center; Australia . . . . . *X. fumigata*
Lobes broader, 0.6–2.5 mm wide, not rugulose 85

85(84). Thallus more or less areolate at the center; lobes 0.6–1.2 mm wide; North America . . . . . *X. novomexicana*
Thallus lobate at the center; lobes 1–2.5 mm wide; Australia . . . . . *X. pertinax*

86(77). Thallus loosely adnate with broad lobes 2–6 mm wide; South Africa . . . . . *X. austroafricana*
Thallus tightly adnate to adnate; lobes 0.5–3 mm wide 87

87(86). 4-*O*-Methyldiffractaic acid present . . . . . *X. neotumidosa*
4-*O*-Methyldiffractaic acid lacking 88

88(87). Lobes narrow and sublinear, 0.5–1 mm wide; SWA/Namibia . . . . . *X. lagunebergensis*
Lobes broader, subirregular, 1.5–3 mm wide 89

89(88). Lobes convex; fatty acids present; South Africa . . . . . *X. tumidosa*
Lobes plane; fatty acids lacking; South Africa and Australia . . . . . *X. verruciformis*

90(75). Norlobaridone present 91
Norlobaridone lacking 100

91(90). Thallus loosely adnate with linear to sublinear lobes, usually collected free of the rock substrate 92
Thallus very tightly adnate to adnate with sublinear to subirregular lobes, usually collected with the rock substrate 95

92(91). Lobes very narrow and stringy, 0.2–1 mm wide 93
Lobes broader, not stringy, 0.8–3 mm wide; Australia 94

93(92). Surface white-maculate; lobes black-rimmed; loxodin present; Australia . . . . . *X. metamorphosa*
Surface emaculate; lobes pale-rimmed; loxodin lacking; South Africa . . . . . *X. tenuiloba*

94(92). Thallus becoming suberect with a nearly bare lower surface . . . *X. furcata*
Thallus appressed with a moderately rhizinate lower surface . . . . . *X. flaviscentireagens*

95(91). Thallus densely covered with small short lobules; Lesotho . . . . . *X. microlobulata*
Lobules lacking (elongate laciniae may be present); Australia or South Africa 96

96(95). Center of thallus bullate-areolate; lobes 0.3–0.7 mm wide . . . *X. dubitata*
Center of thallus lobate; lobes 0.6–3 mm wide 97

97(96). Thallus dark brown at the center; lobes tips yellow-green; South Africa . . . . . *X. obscurata*
Thallus uniformly yellow-green 98

98(97). Convex secondary laciniae present with a canaliculate lower surface; Australia . . . . . *X. incrustata*
Convex laciniae lacking 99

99(98). Loxodin lacking; South Africa . . . . . *X. norlobaronica*
Loxodin present; Australia . . . . . *X. filarszkyana*

100(90). Hypoprotocetraric acid present 101
Hypoprotocetraric acid absent 104

101(100). Thallus tightly adnate; lobes 0.7–1.5 mm wide . . . . . *X. laxencrustans*

Thallus adnate to loosely adnate; lobes 1.5–4 mm wide 102
102(101). Lobes inflated and puffy, convex; Lesotho . . . . . ***X. inflata***
Lobes plane, not inflated 103
103(102). Thallus adnate; lobes rather crowded, 1.5–2.5 mm wide, at most weakly rugose; Australia, South Africa . . . . . ***X. prodomokosii***
Thallus adnate to loosely adnate; lobes becoming heavily rugose age; lobes 2–4 mm wide; South Africa . . . . . ***X. perrugosa***
104(100). 4-*O*-Methylhypoprotocetraric acid present; South Africa . . . ***X. competita***
4-*O*-Methylhypoprotocetraric acid lacking 105
105(104). Barbatic acid present 106
Barbatic acid lacking (or present only as a trace) 107
106(105). Thallus very tightly adnate, areolate at the center; lobes 0.7–1.5 wide; South Africa . . . . . ***X. applicata***
Thallus adnate, lobate at the center; lobes 1–2.5 mm wide; North America and Australia . . . . . ***X. barbatica***
107(105). Diffractaic acid present 108
Diffractaic acid lacking 110
108(107). Major metabolite 4-*O*-Demethyldiffractaic acid; Lesotho . . . ***X. conjuncta***
4-*O*-Demethyldiffractaic acid present only as traces 109
109(108). Thallus tightly adnate; lobes 0.7–1.5 mm wide; South Africa . . . . . ***X. rugulosa***
Thallus adnate; lobes 1–3 mm wide; North America and Australia . . . . . ***X. tucsonensis***
110(107). Evernic acid present; southern Africa 111
Evernic acid lacking 112
111(110). Thallus tightly adnate with an areolate center; surface epruinose South Africa . . . . . ***X. sigillata***
Thallus adnate, the center lobate; surface becoming pruinose; SWA/Namibia . . . . . ***X. equalis***
112(110). Scabrosin derivatives present 113
Fatty or exuviatic acids present (scabrosin deivatives lacking) 115
113(112). Thallus very tightly adnate with an areolate center; scabrosin unknown R_{fc} 12 present; South Africa, Australia . . . . . ***X. brunnthaleri***
Thallus tightly to loosely adnate; Australia 114
114(113). Thallus tightly adnate, the center not areolate; lobes 0.8–1 mm wide . . . . . ***X. cravenii***
Thallus adnate to loosely adnate; lobes 0.9–3 mm wide . . . . . ***X. bungendorensis***
115(112). Thallus very tightly adnate with an areolate center; lobes 0.5–1 mm wide; South Africa . . . . . ***X. unctula***
Thallus tightly to loosely adnate; lobes 0.7–5 mm wide 116
116(115). Lichesterinic acid present; North America . . . . . ***X. montanensis***
Lichesterinic acid lacking 117
117(116). Exuviatic acid present; Australia . . . . . ***X. spargenosa***
Constipatic acid series or subdecipiens fatties present 118
118(117). Thallus adnate to loosely adnate with large rotund lobes 2.5–5 mm wide; South Africa . . . . . ***X. barklyensis***
Thallus tightly to loosely adnate with narrower, subirregular to sublinear lobes (0.8–3 mm) 119
119(118). Thallus adnate to loosely adnate; unknown fatty acids present as major metabolites 120
Thallus tightly adnate to adnate; constipatic acid present as the major metabolite 121
120(119). Thallus adnate to loosely adnate with sublinear lobes; traces of unknown

acids and the constipatic acid series present; Australia . . . *X. nebulosa*
Thallus adnate to more rarely loosely adnate with subirregular lobes; fatty acid unknowns 35 and 37 as major metabolites; South Africa and North America . . . . . *X. subdecipiens*
121(119). Thallus tightly adnate; lobes 0.8–1.5 mm wide; Australasia, Mexico, and Argentina . . . . . *X. oleosa*
Thallus adnate; lobes 1–4 mm wide; Australasia . . . . . *X. ustulata*

6. Key to Nonisidiate, Nonsorediate Species with a Black Lower Surface

1. Surface effigurate-maculate; Australia and South Africa 2
Surface continuous, emaculate or white-maculate 15
2(1). Medulla C+ red (lecanoric acid) . . . . . *X. protodysprosa*
Medulla C– 3
3(2). Medulla K+ yellow or yellow turning red (norstictic, salazinic, stictic, or thamnolic acids) 4
Medulla K– (barbatic, diffractaic, evernic, fumarprotocetraric, hypoprotocetraric, notatic, protocetraric or squamatic acids) 6
4(3). Thamnolic acid present . . . . . *X. cedrus-montana*
Thamnolic acid absent 5
5(4). Thallus loosely attached; lobes narrow and elongate,0.5–1.2 mm wide; norstictic and salazinic acids present . . . . . *X. pantherina*
Thallus adnate; lobes 1.5–4 mm wide; salazinic acid present . . . . . *X. effigurata*
6(3). Thallus adnate with subirregular lobes 7
Thallus loosely adnate with narrow, elongate lobes 8
7(6). Medulla P+ orange-red (fumarprotocetraric acid); Australia . . . . . *X. yowaensis*
Medulla P– (hypoprotocetraric acid); South Africa . . . . . *X. karoo*
8(6). Medulla P+ orange-red 9
Medulla P– 11
9(8). Fumarprotocetraric acid present . . . . . *X. pseudohypoleia*
Protocetraric acid present 10
10(9). Lobes 0.6–2 mm wide, stiff; rhizines sparse to moderate . . . . *X. hypoleia*
Lobes 0.5–0.7 mm wide, soft; rhizines nearly lacking to very sparse . . . . *X. mollis*
11(9). Evernic acid present; South Africa . . . . . *X. neodysprosa*
Evernic acid lacking 12
12(11). Barbatic acid present . . . . . *X. burmeisteri*
Barbatic acid lacking 13
13(12). Hypoprotocetraric acid present . . . . . *X. hypoprotocetrarica*
Hypoprotocetraric acid absent 14
14(13). Diffractaic acid present; Australia . . . . . *X. mannumensis*
Notatic acid present; Australia . . . . . *X. notata*
15(1). Medulla entirely deep orange-red 16
Medulla white, uniformly pale salmon-colored, or the upper part white and the lower part orange-red 17
16(15). Lobes opuntioid-constricted, strongly black-rimmed . . *X. endochromatica*
Lobes sublinear, not constricted, weakly black-rimmed . . . . *X. verecunda*
17(15). Medulla C+ red (gyrophoric, lecanoric, microphyllinic, or olivetoric acids); southern Africa 18
Medulla C– 23

18(17). Thallus very tightly adnate; lobes 0.2–0.9 mm wide 19
Thallus adnate to loosely adnate; lobes 0.5–5 mm wide 20
19(18). Olivetoric acid present . . . . . *X. heterodoxa*
Gyrophoric acid present . . . . . *X. olivetorica*
20(18). Lobes convex, appearing inflated; surface pruinose; SWA/Namibia . . . . . *X. serusiauxii*
Lobes flat, epruinose 21
21(20). Microphyllinic acid present; thallus forming compact mats; surface faintly reticulate-maculate . . . . . *X. ceresensis*
Lecanoric acid present; surface continuous 22
22(21). Thallus adnate; lobes subirregular, 1–2 mm wide . . . . . *X. lecanorica*
Thallus loosely attached; Lobes sublinear, 2–5 mm wide . . . . . *X. namaquensis*
23(17). Thallus very tightly adnate to tightly adnate, the center often appearing areolate at the center, always collected with the rock substrate; lobes 0.2–0.8 mm wide 24
Thallus adnate to loosely adnate, the center lobate, collected with or without the rock substrate; lobes usually more than 1 mm wide (except in *X. indumenica* and *X. lobulifera* from South Africa and a few stringy loosely adnate species) 42
24(23). Medulla K– (to slowly K+ yellowish) (barbatic, colensoic, fatty, fumarprotocetraric, hypoprotocetraric, or stenosporonic acids) 25
Medulla K+ yellow or yellow turning orange (constictic, hypostictic, norstictic, salazinic, or stictic acids) 32
25(24). Medulla P+ red-orange (fumarprotocetraric acid) 26
Medulla P– 27
26(25). Lobes 0.3–0.6 mm wide; South Africa . . . . . *X. swartbergensis*
Lobes about 1–2 mm wide; USA . . . . . *X. hypomelaena*
27(25). Barbatic acid present; Australia . . . . . *X. louisii*
Barbatic acid lacking; South Africa 28
28(27). Stenosporonic acid present 29
Stenosporonic acid lacking (or present only as traces) 30
29(28). Lobes elongate, black-rimmed; surface emaculate . . . . *X. stenosporonica*
Lobes short, blunt, pale-rimmed; surface faintly reticulate-maculate . . . . . *X. shebaiensis*
30(28). Hypoprotocetraric acid present; lobes subirregular, 0.6–1.5 mm wide . . . . . *X. domokosii*
Hypoprotocetraric acid lacking; lobes sublinear, 0.2–1 mm wide 31
31(30). Fatty acids present . . . . . *X. inuncta*
Colensoic acid present . . . . . *X. colensoica*
32(23). Stictic acid present 33
Stictic acid lacking 35
33(32). Barbatic acid present; Australia . . . . . *X. darlingensis*
Barbatic acid lacking 34
34(33). Lobes narrow, 0.2–0.6 mm wide; thallus center areolate; South Africa and Australasia . . . . . *X. xanthomelaena*
Lobes broader, 0.6–1.2 mm wide; thallus center bulllate-lobate; USA . . . . . *X. neoconspersa*
35(32). Salazinic acid present (norstictic lacking or present as a minor metabolite or in traces) 36
Constictic, hypostictic, or norstictic acids (salazinic if present only in traces or equal with norstictic) 39
36(35). Lobes to 1 mm wide; center of thallus not areolate . . . . . *X. proximata*
Lobes narrower, 0.3–0.6 mm wide; thallus center usually appearing areolate

. 37
37(36). Chalybaeizans unknown present . . . . . *X. conspersula*
Chalybaeizans unknown lacking 38
38(37). Lobes elongate, little branched; norstictic acid present as a minor metabolite; South Africa . . . . . *X. olifantensis*
Lobes short, dichotomously branched; norstictic acid absent; South Africa and Australia . . . . . *X. parvoincerta*
39(38). Norstictic acid present as major metabolite 40
Norstictic acid absent 41
40(39). Barbatic acid present . . . . . *X. donneri*
Barbatic acid lacking . . . . . *X. dissitifolia*
41(39). Constictic acid present; Australia . . . . . *X. gerhardii*
Hypostictic acid present; South Africa . . . . . *X. protoquintaria*
42(23). Medulla K– (diffractaic, fatty, fumarprotocetraric, hypoprotocetraric, protocetraric, or psoromic acids, norlobaridone or scabrosin) 43
Medulla K+ yellow or yellow turning red (hypostictic, norstictic, salazinic, or stictic acids) 70
43(42). Medulla P+ orange-red or yellow (fumarprotocetraric, protocetraric, or psoromic acids) 44
Medulla P– 54
44(43). Fumarprotocetraric acid present 45
Fumarprotocetraric acid lacking (protocetraric or psoromic acids present) 48
45(44). Surface white-maculate; South Africa . . . . . *X. viridis*
Surface continuous, emaculate 46
46(45). Thallus loosely adnate; lobes broad and sublinear, 2–4 mm wide; Australia and East Africa . . . . . *X. rogersii*
Thallus tightly adnate to adnate 47
47(46). Thallus adnate; lobes subirregular, short, 1–3 mm wide; Australia . . . . . *X. hypomelaenoides*
Thallus tightly adnate; lobes sublinear, 1–2 mm wide; USA . . . . . *X. hypomelaena*
48(44). Protocetraric acid only 49
Psoromic acid with or without protocetraric acid 51
49(48). Lobes broad and subirregular, 2–7 mm wide . . . . . *X. schenckiana*
Lobes linear to sublinear, 0.5–1 mm wide 50
50(49). Surface emaculate to very sparsely maculate; lobes linear, soft . . . . . *X. mollis*
Surface maculate; lobes sublinear, stiff . . . . . *X. hypoleia*
51(48). Lobes narrow, 0.4–1 mm wide; thallus rugose and crowded . . . . . *X. huachucensis*
Lobes broad, 1.5–7 mm wide; thallus expanded, not crowded 52
52(51). Protocetraric acid present with psoromic acid . . . . . *X. diacida*
Protocetraric acid lacking 53
53(52). Lobes broad and apically rotund, 3–7 mm wide; South Africa . . . . . *X. psoromica*
Lobes narrower, obtuse, 1.5–3 mm wide; North America . . . . . *X. nigropsoromifera*
54(43). Lower part of medulla orange-red (skyrin); South Africa 55
Medulla white 56
55(54). Thallus loosely adnate; hypoprotocetraric acid present . . . . . *X. contrasta*
Thallus adnate; fatty acids present . . . . . *X. coriacea*
56(54). Fatty acids present 57
Fatty acids lacking 62

57(56). Lobes broad and rotund, 3–6 mm wide . . . . . *X. aliphatica*
Lobes narrower, 1–2.5 mm wide, the tips obtuse or acute 58
58(57). Thallus pulvinate; lobes black-rimmed; unknown fatty present . . . . . *X. atroventralis*
Thallus adnate, not pulvinate; lobes pale-rimmed; subdecipiens fatty acid series present 59
59(58). Thallus loosely adnate; lobes digitate or elongate-laciniate 60
Thallus adnate, not laciniate 61
60(59). Lobes short digitate-laciniate; lower surface dull, moderately rhizinate . . . . . *X. imbricata*
Lobes densely laciniate, the laciniae sublinear; lower surface shiny, sparsely rhizinate . . . . . *X. laciniata*
61(59). Thallus closely adnate; lobes 0.8–1.5 mm wide; constipatic acid as major metabolite; Australia . . . . . *X. nigraoleosa*
Thallus adnate; lobes 1–2.5 mm wide; unknown fatty acid as major metabolite . . . . . *X. subnigra*
62(56). Hypoprotocetraric acid present; South Africa or USA 63
Hypoprotocetraric acid lacking; southern Africa or Australia 66
63(62). Thallus loosely adnate; lobes sublinear . . . . . *X. tablensis*
Thallus tightly adnate to adnate, collected with rock substrate; lobes subirregular to sublinear 64
64(63). Thallus tightly adnate with an areolate center; lobes 0.6–1.5 mm wide . . . . . *X. domokosii*
Thallus adnate with a lobate center; lobes 1–2 mm wide 65
65(64). Lobes thick and strongly convex; South Africa . . . . . *X. toninioides*
Lobes thin, flat, strongly rugose; USA . . . . . *X. dissensa*
66(62). Norlobaridone present; Australia 67
Norlobaridone lacking 68
67(66). Thallus loosely adnate to suberect; rhizines sparse . . . . . *X. dichotoma*
Thallus adnate on rock; rhizines moderate . . . . . *X. elaeodes*
68(67). Scabrosin series present; Australia . . . . . *X. rupestris*
Diffractaic acid present 69
69(68). Thallus loosely adnate, suberect; rhizines sparse; SWA/Namibia . . . . . *X. luderitziana*
Thallus adnate; rhizines moderate; Australia . . . . . *X. everardensis*
70(42). Medulla pigmented orange-red to dull reddish in lower part (skyrin or schenckiana unknown) or yellow to yellow-orange throughout (do not confuse with discoloration caused by norstictic or salazinic acid) 71
Medulla white, lacking pigments 75
71(70). Medulla pale yellow-orange throughout . . . . . *X. enteroxantha*
Medulla pigmented orange-red to dull rusty red in lower part only . . . 72
72(71). Lobes broad and rotund, 2–6 mm wide; pigment dull rusty red (schenckiana pigment); norstictic acid present . . . . . *X. colorata*
Lobes narrower, sublinear, 1–5 mm wide; pigment orange-red (skyrin); norstictic acid lacking 73
73(72). Surface white-maculate; lobes in part constricted . . . . . *X. rubromedulla*
Surface continuous, emaculate; lobes not constricted 74
74(73). Lobes broad, 2–5 mm wide; Australia and South Africa . . . . *X. luminosa*
Lobes narrower, 1–2 mm wide; South Africa . . . . . *X. surrogata*
75(70). Hypostictic acid present; Australia . . . . . *X. multipartita*
Hypostictic acid lacking 76
76(75). Stictic acid present as the major metabolite 77
Norstictic or salazinic acids present 87

77(76). Diffractaic acid present; South Africa . . . . . *X. indumenica*
Diffractaic acid lacking 78
78(77). Rhizines lacking; South Africa 79
Rhizines sparsely to moderately developed 80
79(78). Thallus tightly adnate, congested . . . . . *X. lobulifera*
Thallus loosely attached . . . . . *X. subruginosa*
80(78). Lobes broad, short, and rotund; surface white-maculate; rhizines very sparse; South Africa . . . . . *X. albomaculata*
Lobes narrower, subirregular to sublinear; surface continuous, emaculate; rhizines moderately developed 81
81(80). Lusitana unknown present; norstictic acid lacking; Lesotho . . . . . *X. protolusitana*
Lusitana unknown absent; norstictic acid usually present 82
82(81). Thallus tightly adnate; lobes 0.6–1.5 mm wide 83
Thallus adnate to loosely adnate; lobes 0.6–2.5 mm wide 84
83(82). Thallus more or less areolate at the center; USA . . . . . *X. neoconspersa*
Thallus lobate at the center with contiguous lobes; Australia, South Africa . . . . . *X. bicontinens*
84(82). Lobes mostly less than 1 mm wide 85
Lobes mostly more than 1 mm wide 86
85(84). Lobes black-rimmed; Australia and South Africa . . . . . *X. tegeta*
Lobes pale-rimmed; South Africa . . . . . *X. austrocapensis*
86(84). Lower surface of lobes faintly canaliculate with a raised yellowish rim at the tips; very sparsely rhizinate at the tips; South America and South Africa . . . . . *X. hypopsila*
Lower surface plane, lacking any rim, moderately rhizinate at the tips; Europe and North America . . . . . *X. angustiphylla*
87(76). Norstictic acid present as a major metabolite or with salazinic acid in equal concentration 88
Salazinic acid present; norstictic acid if present in traces only 95
88(87). Psoromic acid present; South Africa . . . . . *X. psornorstictica*
Psoromic acid lacking 89
89(88). Salazinic acid lacking 90
Salazinic acid present 92
90(89). Thallus loosely adnate to suberect; surface white-maculate; SWA/Namibia . . . . . *X. norwalteri*
Thallus adnate; surface continuous, emaculate 91
91(90). Lobes black-rimmed, rugose below; East Africa . . . . . *X. kiboensis*
Lobes pale-rimmed, smooth below; SWA/Namibia . . . . . *X. norcolorata*
92(89). Thallus adnate; lobes broad and rotund, 2–6 mm wide; southern Africa . . . . . *X. colorata*
Thallus loosely adnate; lobes narrower, 1–2.5 mm wide, the tips obtuse to acute; Australia 93
93(92). Lower surface very sparsely rhizinate, becoming rugose . . . . *X. subnuda*
Lower surface sparsely to moderately rhizinate, smooth 94
94(93). Lower surface sparsely rhizinate with simple rhizines . . . . . *X. congesta*
Lower surface moderately rhizinate with branching rhizines . . . . . *X. glareosa*
95(87). Upper surface white-maculate 96
Upper surface continuous, emaculate 99
96(95). Lobes narrow and constricted, 0.5–1.5 mm wide . . . . . *X. constrictans*
Lobes broader, not constricted, 1–6 mm wide 97
97(96). Thallus dark yellowish green; lobes rather short, subirregular to sublinear . . . . . *X. synestia*

Thallus light yellowish green; lobes, sublinear 98
98(97). Thallus leathery, pulvinate; rhizines dense, dark, long and branching . . . . . *X. africana*
Thallus membranaceous, not pulvinate; rhizines moderate, brown, unbranched . . . . . *X. neotasmanica*
99(95). Lobes sublinear to linear, rugose below with very sparse rhizines . . . 100
Lobes subirregular to sublinear, smooth and shiny below, sparsely to densely rhizinate 102
100(99). Lobes narrow, 0.4–1 mm wide; not ascending; collected on rocks; Australia . . . . . *X. rubrireagens*
Lobes broader, 1.5–4 mm wide, ascending; collected on rocks or on pebbles on soil; southern Africa 101
101(100). Chalybaeizans unknown present; South Africa . . . . . *X. hyporhytida*
Chalybaeizans unknown lacking; SWA/Namibia . . . . . *X. walteri*
102(99). Thallus tightly adnate to adnate, usually collected with rock substrate 103
Thallus loosely adnate, rarely collected with rock substrate 105
103(102). Thallus very tightly adnate; lobes less than 1 mm wide . . . . . *X. parvoincerta*
Thallus adnate; lobes 0.8–2.5 mm wide 104
104(103). Protocetraric acid present in high concentration; Lesotho . . . . . *X. mapholanengensis*
Protocetraric acid lacking (or present in traces; Australia and South Africa . . . . . *X. incerta*
105(102). Lobes large and rotund, 3–8 mm wide; South Africa . . . . . *X. latilobata*
Lobes narrower, apices obtuse or acute, 1–5 mm wide 106
106(105). Thallus with dense imbricate, black-rimmed laciniae; lower surface bare to sparsely rhizinate; Australia . . . . . *X. cheelii*
Thallus not densely imbricate-laciniate; lower surface moderately to densely rhizinate 107
107(106). Thallus with short, laciniate, black-rimmed lobes; East Africa . . . . . *X. salkiboensis*
Thallus with elongate, sublinear, pale or black-rimmed lobes 108
108(107). Thallus pulvinate; rhizines dense, becoming branched; East Africa . . . . . *X. africana*
Thallus not pulvinate; rhizines sparse to moderate, unbranched 109
109(108). Protocetraric acid present in high concentration; Lesotho . . . . . *X. mapholanengensis*
Protocetraric lacking or if present in traces; pantemperate . . *X. tasmanica*

Taxonomic Treatment

The 406 species of *Xanthoparmelia* are listed below in alphabetic order. Data on type specimen labels not given in the original publication are added in brackets. Rejected, dubious, or untypifiable names and names assigned incorrectly to the genus are listed after this section under "List of Nomina Inquirenda and Excluded and Untypifiable Names."

Xanthoparmelia adleri

Xanthoparmelia adleri Nash, Elix, and Johnston, 1987:286. [Type collection: Las Pailas, Prov. Salta, Argentina, *Adler* s.n. (ANUC, holotype; BAFC, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on soil and mosses, rarely rocks, to 5 cm broad, yellowish green; lobes subirregular to sublinear-elongate, 1.3–2.5 mm wide, separate to imbricate; upper surface continuous, emaculate, dull to shiny at the apices, often black-rimmed, moderately to densely isidiate, the isidia globose at first (Figure 12*a*), becoming subcylindrical, 0.10–0.15 mm in diameter, to 0.4 mm high, the tips syncorticate, pale, dense, and coralloid branched at maturity; medulla white; lower surface plane, light tan to pale brown, sparsely to moderately rhizinate, the rhizines pale brown, thin, simple, 0.4–1 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids,

norlobaridone.

ILLUSTRATION.—Nash, Elix, and Johnston, 1987, fig. 1.

DISTRIBUTION.—Argentina.

COMMENTS.—This rare lichen is distantly related to the norlobaridone-containing Australasian species *X. constipata* and *X. scabrosa*, but the isidia are generally cylindrical and not erumpent.

Xanthoparmelia affinis

FIGURE 24*a*

Xanthoparmelia affinis Hale, 1987b:319. [Type collection: Franschhoek Pass on hwy R45, elev. 650 m, Cape Province, South Africa, Grid 3318 CC, *Hale* 78184, 26 Oct 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate on rocks and pebbles, somewhat pulvinate, brittle, and easily breaking apart, 4–6 cm broad, darkish yellow-green; lobes sublinear, 0.6–1.2 mm wide, elongate but somewhat constricted, separate to imbricate; upper surface faintly to partly distinctly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane to barely convoluted, pale brown to brown, shiny, moderately rhizinate, the rhizines brown or blackening, simple to furcate, 0.2–0.6 mm long. Pycnidia common; conidia cylindrical, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids, chalybaeizans unknown (±trace).

ILLUSTRATION.—Hale, 1987b, fig. 1.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species is superficially very close to the more common South African *X. constrictans*, which has a jet-black lower surface. It is known from several higher elevation localities in the southwestern Cape region.

Xanthoparmelia africana

FIGURE 24*b*

Xanthoparmelia africana Hale, 1986b:564. [Type collection: Sirimon Track, Mt. Kenya, elev. 3300–3400 m, Kenya, *Fosberg and Mwangangi* 49919, 18 Mar 1968 (US, holotype; O, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate on rock, firm, sometimes forming thick pulvinate colonies 10–20 cm or more broad and several cm thick, bright yellowish green; lobes sublinear, 2–4 mm wide, dichotomously branched, crowded, and imbricate; upper surface weakly to rather distinctly white-maculate with age, shiny, isidia and soredia lacking; medulla white; lower surface plane, black at the center with a broad brown zone at the margins, densely rhizinate, the rhizines initially brown but soon blackening, simple to furcate, 0.5–1.5 mm long. Pycnidia well developed; conidia bifusiform, 0.5 × 6–8 µm. Apothecia well developed, subpedicellate, 5–10 mm in diameter; spores 6–7 × 9–12 µm.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

ILLUSTRATIONS.—Hale, 1986b, fig. 2; Swinscow and Krog, 1988, fig. 181.

DISTRIBUTION.—Kenya, Uganda.

COMMENTS.—In Kenya and Uganda *X. africana* is found commonly at high elevations (above 3000 m), forming thick pulvinate mats. *Xanthoparmelia tasmanica*, a widespread lichen in Australasia, southern Africa, and the Americas, is the most closely related species but it lacks distinct maculae, has a more membranous thallus, and is only sparsely to moderately rhizinate. In southern Africa, a sister species, *X. neotasmanica*, has a wide range below 2000 m. It is thinner, not at all pulvinate, more distinctly white-maculate, and has moderately dense, brown, unbranched rhizines.

Xanthoparmelia afrolavicola

FIGURE 24*c*

Xanthoparmelia afrolavicola Hale, 1989a:541. [Type collection: Natal Table Mountain near Pietermaritzburg, elev. 650 m, Natal Province, South Africa, Grid 2930 DA, *Hale* 74104 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, rather brittle and easily breaking apart, 5–7 cm broad, darkish yellow green; lobes subirregular to sublinear, 1.5–4 mm wide, irregularly dichotomously branched, subimbricate; upper surface continuous to faintly white maculate in patches, shiny, moderately to densely isidiate, the isidia cylindrical (Figure 12*b*), thin, 0.06–0.08 mm in diameter, 0.1–0.5 mm high, the tips syncorticate, blackening, unbranched or sparingly branched; lower surface plane, light brown, sparsely rhizinate, the rhizines pale brown, coarse, simple, 0.2–0.5 mm long. Pycnidia common; conidia cylindrical, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Psoromic, 2′-*O*-demethylpsoromic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, figs. 1, 2.

DISTRIBUTION.—South Africa (Natal), SWA/Namibia.

COMMENTS.—The only other isidiate psoromic acid-containing species, *X. lavicola* from western USA, Mexico, and South America, has coarser, partially erumpent isidia, a firm, adnate thallus, and a darker, moderately rhizinate lower surface. The species is known from several widely disjunct collections in Natal and the Waterberg Plateau in Namibia.

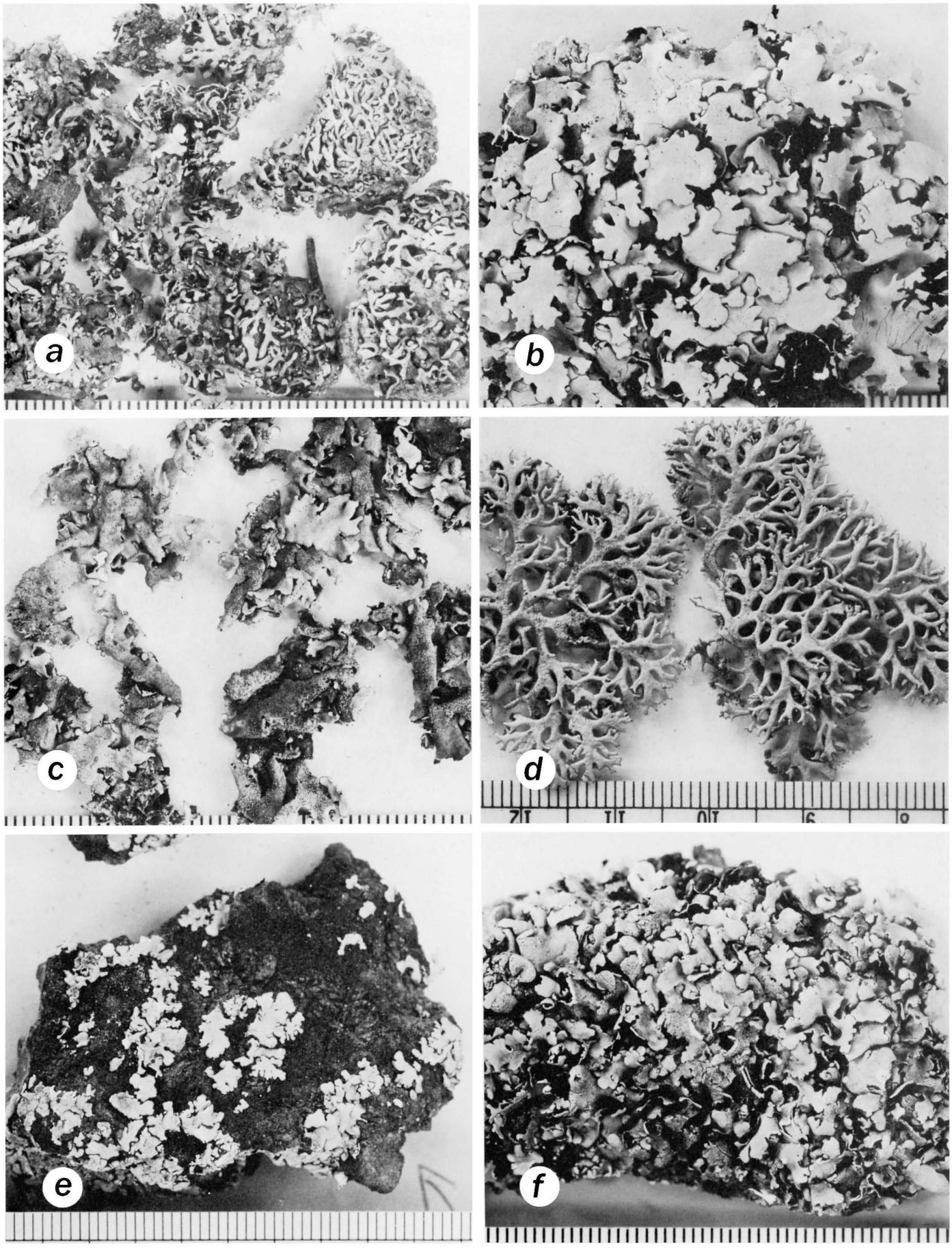
Xanthoparmelia aggregata

FIGURE 24*d*

Xanthoparmelia aggregata Knox in Knox and Brusse, 1983:144. [Type collection: Salt River, van Rhyn's Dorp Div., Cape Prov., Republic of South Africa, *Stokoe* 7721 (BOL, holotype; US, isotype).]
Parmelia aggregata (Knox) Brusse, 1984:320.

DESCRIPTION.—Thallus loosely attached on soil or rarely free growing, soft and delicate, 3–5 cm broad, light yellowish

FIGURE 24.—Species of *Xanthoparmelia*: *a*, *X. affinis* (*Hale* 78184, holotype in US); *b*, *X. africana* (*Fosberg* 49919); *c*, *X. afrolavicola* (*Hale* 74104, holotype in US); *d*, *X. aggregata* (*Stokoe* 7721); *e*, *X. ajoensis* (*Nash* 5999); *f*, *X. albomaculata* (*Almborn* 6722, isotype in US). Scale in mm.


a
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c
d
e
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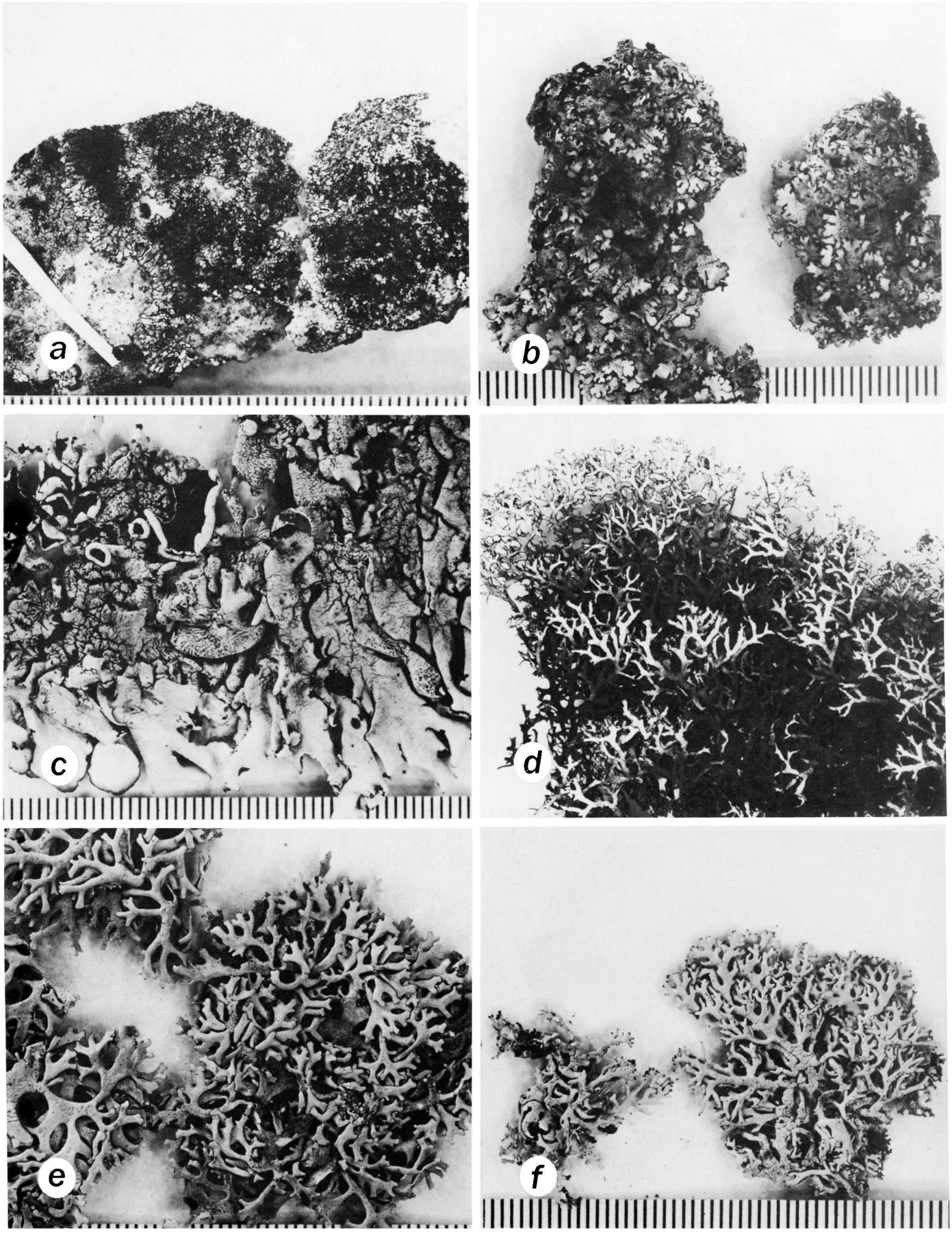
a
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green; lobes sublinear, 0.8–1.5 wide, regularly dichotomously branched, separate, and divaricate, becoming terete-laciniate toward the center; upper surface continuous, dull, emaculate, isidia and soredia lacking; medulla white; lower surface canaliculate, pale brown or concolorous with the upper surface and with a yellowish rim, rhizines very sparse, blackening, simple, 1–1.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Evernic (major), lecanoric (trace), and usnic acids (det. J.A. Elix).

ILLUSTRATION.—Knox and Brusse, 1983, fig. 1.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—One of the most remarkable of the terricolous lichens in both chemistry and appearance, *X. aggregata* is confined to an area of several square kilometers in the knersvlakte region near the Salt River in Namaqualand. Rarely free growing and vagrant, it normally grows loosely attached on elevated hardened soil patches surrounded by loose sandy quartzitic soil. Evernic acid (usually with traces of lecanoric acid) is otherwise known only in a small group of completely unrelated Namibian endemic species (*X. equalis* and *X. evernica*), in effigurate *X. dysprosa*, and in isidiate *X. eruptens*, the latter two from Cape Province.

Xanthoparmelia ajoensis

FIGURE 24*e*

Xanthoparmelia ajoensis (Nash) Egan, 1975:217.

Parmelia ajoensis Nash, 1974b:234. [Type collection: Organ Pipe Cactus National Monument, Pima Co., Arizona, USA, *Nash* 5999 (ASU, holotype; DUKE, US, isotypes).]

DESCRIPTION.—Thallus adnate on rock, 2–6 cm broad, yellow green; lobes subirregular, 1–3 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia subglobose to cylindrical (Figure 12*c*), 0.1–0.20 mm in diameter, 0.2–1.5 mm high, the tips syncorticate, brownish, sparsely branched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple to sparingly branched, 0.2–0.4 mm long. Pycnidia rarely developed; conidia bifusiform, 0.5 × 5–7 µm. Apothecia lacking.

CHEMISTRY.—Diffractaic (major), barbatic, baeomycesic (trace), squamatic, 3-α-hydroxybarbatic (trace), 4-*O*-demethylbarbatic (±trace), 2-*O*-methylobtusatic (±trace), constipatic (±), protoconstipatic (±), and usnic acids.

ILLUSTRATIONS.—Egan, 1975, fig. 3; Nash, 1974b, fig. 1.

DISTRIBUTION.—Western USA, Mexico.

COMMENTS.—This desert species, known from Arizona, New Mexico, and Colorado, as well as adjacent Mexico, is chemosyndromic with *X. moctezumensis* and *X. tucsonensis* and a member of the *X. mexicana* group (Culberson, Nash, and Johnson, 1979).

FIGURE 25.—Species of *Xanthoparmelia*: *a*, *X. alectoronica* (*López and Smith* 21216A, holotype in US); *b*, *X. alexandrensis* (*Elix* 11541); *c*, *X. aliphatica* (*Hale* 73107, holotype in US); *d*, *X. almbornii* (*Almborn* 1728, isotype in US); *e*, *X. amphixantha* (*Hale* 58399); *f*, *X. amphixanthoides* (Brunnthaleri s.n., holotype in W). Scale in mm.

Xanthoparmelia albomaculata

FIGURE 24*f*

Xanthoparmelia albomaculata Hale, 1985a:281. [Type collection: 6 mi N of Houtbosch, District Pietersburg, Transvaal, South Africa, *O. Almborn* 6722 (LD, holotype; US, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm and leathery, difficult to remove intact and usually collected with the rock, 8–20 cm broad, light to darker yellowish green; lobes sublinear to subirregular, 2–4 mm wide, crowded, becoming in part suberect, contiguous to imbricate; upper surface white-maculate to effigurate-maculate, especially on older lobes, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, very sparsely rhizinate, the rhizines black, coarse, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia not commonly developed, substipitate, 1–4 mm in diameter; spores 4–5 × 9–10 µm.

CHEMISTRY.—Stictic, constictic, and usnic acids.

ILLUSTRATION.—Hale, 1985a, fig. 1.

DISTRIBUTION.—South Africa (Transvaal, Natal).

COMMENTS.—This conspicuous lichen, which typically forms dense pure colonies up to 1 square meter on low sandstone outcrops and is often the only *Xanthoparmelia* present in moist lowland areas in Natal. It also occurs along the Drakensberg escarpment in Transvaal. Development of maculae is variable, typically nearly effigurate-maculate, at least in part, but also rarely barely discernible.

Xanthoparmelia alectoronica

FIGURE 25*a*

Xanthoparmelia alectoronica Hale, 1985a:281. [Type collection: Loma de El León, Sierra Portuguesa, Estado Lara, Venezuela, *López and Smith* 21216A (MERF, holotype; US, isotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, areolate at the center, 2–3 cm broad, dark yellowish green, darkening with age at the center; lobes sublinear, 0.2–0.7 mm wide, contiguous to subimbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia cylindrical (Figure 12*d*), 0.03–0.05 mm in diameter, to 0.1 mm high, the tips syncorticate, blackening, unbranched; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple, 0.1–0.3 mm long. Pycnidia lacking. Apothecia rare, adnate, to 1 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Alectoronic and usnic acids.

ILLUSTRATION.—Hale, 1985a, figs. 2, 3.

DISTRIBUTION.—Venezuela.

COMMENTS.—This is the only species in the genus with alectoronic acid. Externally it resembles other very tightly adnate species so common in Australia and South Africa, such

as *X. exillima* or *X. pseudocongensis*, but is known from only one locality at relatively low elevation (1100 m) from the Andes in Venezuela.

Xanthoparmelia alexandrensis

FIGURE 25*b*

Xanthoparmelia alexandrensis Elix and Johnston in Elix, Johnston, and Armstrong, 1986:186. [Type collection: Tucker Hill, Alexandra, Otago, New Zealand, *Elix* 9900 (CHR, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock, somewhat pulvinate and brittle, 3–6 cm broad, dull yellowish green; lobes sublinear, 0.8–1.5 mm wide, somewhat divaricately branched and imbricate, black rimmed, secondary laciniae often well developed, 0.3–0.5 mm wide; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia subglobose to subcylindrical (Figure 12*e*), 0.07–0.10 mm in diameter, 0.1–0.2 mm high, the tips epicorticate, in part erumpent but not becoming sorediate, sparsely branched; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines dark brown to black, simple or apically splayed, 0.3–0.6 mm long. Pycnidia rarely developed; conidia bifusiform, 0.5 × 6–7 µm. Apothecia lacking.

CHEMISTRY.—Norstictic (major), connorstictic, salazinic (minor), consalazinic, and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 2.

DISTRIBUTION.—Australia (NSW, Vic, Tas), New Zealand.

COMMENTS.—This rare species may be the isidiate morph of *X. subnuda*.

Xanthoparmelia aliphatica

FIGURE 25*c*

Xanthoparmelia aliphatica Hale, 1986b:566. [Type collection: 78.6 km S of Sutherland on Hwy R354, elev. ca. 900 m, Cape Province, South Africa, Grid 3220 DC, *Hale* 73107, 29 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, firm, 10–12 cm broad, yellowish green; lobes subirregular, 3–6 mm wide, apically subrotund, contiguous to imbricate; upper surface continuous, emaculate, shiny, rugose and cracked with age, isidia and soredia lacking; medulla white; lower surface plane, black, densely rhizinate, the rhizines simple, 0.5–1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 5–7 µm. Apothecia numerous, substipitate, 5–8 mm in diameter; spores 5–7 × 10–12 µm.

CHEMISTRY.—Fatty "subdecipiens" unknowns 33 and 37, constipatic acid series (± traces), and usnic acid.

ILLUSTRATION.—Hale, 1986b, fig. 3.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This large, conspicuous lichen has a black lower surface, a rare trait in fatty acid-containing species shared only by *X. nigraoleosa* in Australia and *X. subnigra* and isidiate *X. transvaalensis* in Africa. It is otherwise similar to *X. barklyensis*, which differs in having a pale brown lower surface.

Xanthoparmelia almbornii

FIGURE 25*d*

Xanthoparmelia almbornii (Hale) Hale, 1974b:486.

Parmelia almbornii Hale, 1971a:345. [Type collection: Table Mountain, near upper Cableway Station, Cape Province, Union of South Africa, *Almborn* 1728 (LD, holotype; TNS, US, isotypes).]

DESCRIPTION.—Thallus loosely adnate on rock, forming firm pulvinate mats, 5–8 cm broad, dark yellowish green, often blackening with age; lobes linear, 0.4–1 mm wide, dichotomously branched, subimbricate, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown at the tips, usually whitish at the center, moderately to densely rhizinate at the tips, more sparsely toward the center, the rhizines pale brown, simple, 1–2 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Fumarprotocetraric and usnic acids.

ILLUSTRATION.—Hale, 1974b, fig. 1*a*.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The loosely adnate, pulvinate thallus and elongate lobes resemble *X. affinis* (salazinic acid present). So far it is confined to sheltered sandstone ledges on the top of Table Mountain and a few nearby high elevation localities. The white center is a characteristic feature of the lower surface of this species.

Xanthoparmelia alternata

Xanthoparmelia alternata Elix and Johnston in Elix, Johnston, and Armstrong, 1986:188. [Type collection: West of Bullabulling, Dedari, 75 mi from Kambalda, Western Australia, Australia; *Sammy* UWA 1508 (UWA, holotype).]

DESCRIPTION.—Thallus loosely adnate to nearly free growing on soil, irregularly pulvinate, 3–8 cm broad, dull yellowish green; lobes sublinear, 1–3 mm wide, forming subfruticose terete laciniae toward the center; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface nearly plane to canaliculate, pale brown, sparsely rhizinate, the rhizines pale brown or darkening, simple to branched, 0.2–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, norstictic (±trace), protocetraric (±trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 3.

DISTRIBUTION.—Australia (NSW, Vic, SA, WA).

COMMENTS.—This is the Australian counterpart of the South African *X. amphixanthoides*, which usually produces both salazinic acid and the chalybaeizans unknown and has more convex secondary laciniae. It is rarely collected in arid shrubland, being most common in Western Australia.

Xanthoparmelia amableana

Xanthoparmelia amableana (Gyelnik) Hale, 1988b:401.
Parmelia amableana Gyelnik, 1934c:152. [Type collection: Guadalupe, Mexico, *Amable* 653 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

DESCRIPTION.—Thallus tightly adnate to adnate on rocks, 3–5 cm broad, dull yellow green; lobes subirregular, 0.8–2 mm wide, short and irregularly branched, congested and imbricate; upper surface continuous, emaculate, shiny, transversely cracked, and rugulose toward the center, densely isidiate, the isidia globose at first (Figure 12*f*), irregularly inflated and coarsely branched at maturity, 0.1–0.2 mm in diameter, to 0.6 mm high, the tips epicorticate, shiny, darkening, fragile, and in part erumpent at maturity; medulla white; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, unbranched, 0.2–0.4 mm long. Pycnidia present but poorly developed; conidia not found. Apothecia well developed, 1–3 mm in diameter; spores not found.

CHEMISTRY.—Stictic (major), constictic, norstictic, cryptostictic (trace), connorstictic (trace), and usnic acids.

DISTRIBUTION.—Mexico.

COMMENTS.—In the original very brief description, Gyelnik emphasized the coarse isidia with darkened tips, comparing it with salazinic acid-containing *Parmelia korosi-csomae* (= *X. tinctina*). A related species with stictic acid, *X. wrightiana* from Argentina, differs in having more distinctly globose, pale-tipped, unbranched isidia. *Xanthoparmelia amableana* is still known only from the type collection.

Xanthoparmelia amphixantha

FIGURE 25*e*

Xanthoparmelia amphixantha (Müller Argoviensis) Hale, 1974b:486.
Parmelia amphixantha Müller Argoviensis, 1888a:139. [Type collection: Lake Albacutya, Vict., Australia, *French* s.n. (G, lectotype).]
Parmelia subamphixantha Gyelnik, 1938a:290. [Type collection: Victoria, Australia, *Reader* 6 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

DESCRIPTION.—Thallus loosely adnate to free growing on soil, firm, often forming rosettes 2–3 cm broad, light yellow green; lobes sublinear, 1–2 mm wide, dichotomously branched, weakly convoluted, separate; upper surface nearly continuous to more usually strongly white-maculate (as in the type), shiny, isidia and soredia lacking; medulla white; lower surface canaliculate, pale brown or rarely darkening, the raised marginal rim concolorous with the upper surface, sparsely rhizinate, the rhizines irregularly scattered, simple to branched, brown to blackish, 1–2 mm long. Pycnidia lacking. Apothecia rare, substipitate, about 1 mm in diameter; spores 6 × 9–10 µm.

CHEMISTRY.—Stictic (major), constictic, norstictic, cryptostictic (trace), and usnic acids.

ILLUSTRATIONS.—Galloway, 1980, fig. 2; Elix, Johnston, and Armstrong, 1986, fig. 4.

DISTRIBUTION.—Australia (NSW, Vic, Tas, SA).

COMMENTS.—When describing *P. subamphixantha*, Gyelnik (1938a:269) noted, as had Müller earlier for *X. amphixantha*, the long blackened rhizines and the pale concolorous lower surface, typical features of the *X. amphixantha* group. This group includes eight well-circumscribed, closely related terricolous species with a canaliculate lower surface that are all confined to Australasia or southern Africa: sorediate *X. aurifera* and *X. concomitans*, and nonsorediate *X. bellatula*, *X. pseudoamphixantha*, *X. reptans*, *X. salamphixantha*, *X. subflabellata*, and *X. willisii*. Of the latter group, *X. pseudoamphixantha* (norstictic acid) and *X. reptans* (fumarprotocetraric acid) seem to represent chemotypes. *Xanthoparmelia amphixantha* is the commonest member of the group in Australia.

Xanthoparmelia amphixanthoides

FIGURE 25*f*

Xanthoparmelia amphixanthoides (Steiner and Zahlbruckner) Hale, 1974b:486.
Parmelia amphixanthoides Steiner and Zahlbruckner in Zahlbruckner, 1926:505. [Type collection: Laingsburg, Cape Province, South Africa, *Brunnthaler* s.n. (W, lectotype; WU, isolectotype).]

DESCRIPTION.—Thallus loosely adnate to nearly free growing on pebbles and soil, pulvinate, fairly firm, 3–8 cm broad, yellowish green; lobes sublinear, 0.7–1.5 mm wide, separate to imbricate, becoming laciniate with age, the ultimate branches terete, 0.3–0.5 mm wide, sometimes forming dense isidioid masses; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface weakly to strongly canaliculate, pale brown, the slightly raised marginal rim pale yellow, sparsely rhizinate, the rhizines pale brown or darkening, simple to splayed or furcate, 0.5–2 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 6–7 µm. Apothecia rare, substipitate, 2–5 mm in diameter; spores 4 × 9 µm.

CHEMISTRY.—Salazinic, consalazinic, connorstictic (±), hypoconstictic (±), and usnic acids, chalybaeizans unknown.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This terricolous species, common in Bokkeveld shale areas of southern Cape Province, is generally firmer, more robust, and less conspicuously terete-laciniate than stictic acid-containing *X. molliuscula*, another common soil lichen in South Africa. It is also related to X. alternata from Australia, which lacks the chalybaeizans unknown. A small population in the knersvlakte region of Namaqualand is nearly twice the size of the typical population (terete branches 0.5–0.8 mm wide).

Xanthoparmelia amplexula

Xanthoparmelia amplexula (Stirton) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:192.
Parmelia amplexula Stirton, 1881:69. [Type collection: Fassifern, [near Brisbane], Queensland, Australia, *Bailey* 262 (BM, lectotype).]
Parmelia conspersa var. *polyphylloides* f. *exasperata* Müller Argoviensis,

1883:47. [Type collection: Toowoomba, Qsld., Australia, *Hartmann* s.n. (G, lectotype).]

Parmelia violascens Stirton, 1900:77. [Type collection: Grampian Mountains, Vict., Australia, *Sullivan* s.n. (BM, lectotype).]

Parmelia subexasperata Gyelnik, 1931b:288. [Based on *P. conspersa* var. *polyphylloides* f. *exasperata* Müller Argoviensis.]

Parmelia lesdainii Gyelnik, 1934c:161. [Type collection: Tweed Heads, N.S.W., Australia, *Cheel* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia protoisidiata Gyelnik, 1934c:162. [Type collection: Mt. Pordon, Vict., Australia, *Harrisson* 1072 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia ambigua var. *exasperata* (Müller Argoviensis) Gyelnik, 1936:125.

DESCRIPTION.—Thallus adnate on rock, 5–8 cm broad, rather firm, yellowish green but darkening with age; lobes subirregular, 1–3.5 mm wide, often black-rimmed, contiguous to imbricate; upper surface continuous, emaculate, shiny, transversely cracked with age, moderately to densely isidiate, the isidia cylindrical (Figure 12*f*), 0.06–0.15 mm in diameter, 0.3–2 mm high, simple to densely coralloid branched, the tips syncorticate, dark brown, sometimes breaking off but not becoming erumpent; medulla white; lower surface plane, brown, sparsely rhizinate, the rhizines brown, rather coarse, simple, 0.5–1 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 6–7 µm. Apothecia rare, substipitate, 2–8 mm in diameter, the rim isidiate; spores 6 × 9–10 µm.

CHEMISTRY.—Norlobaridone, loxodin, scabrosin 4-acetate-4′-butyrate (±), scabrosin 4,4′-dibutyrate (±), scabrosin 4-acetate-4′-hexanoate (±), norlobariol (±trace), isonorlobaridone (±trace), norlobariol methyl ester (±trace), conorlobaridone (±trace), constipatic (±trace), protoconstipatic (±trace), and usnic acids.

DISTRIBUTION.—Australia (all states), New Zealand.

COMMENTS.—It is closely related to *X. scabrosa* but has distinctly corticated cylindrical isidia. A comparable species in Africa with chiefly subglobose, weakly erumpent isidia, *X. amplexuloides* (below) lacks loxodin and always contains unknown $R_{fc}12$. The syntype collection cited by Müller, *Wright* 77, Cuba, is *X. subramigera*.

Xanthoparmelia amplexuloides

FIGURE 26*a*

Xanthoparmelia amplexuloides Hale, 1989a:541. [Type collection: 38 km W of Bloemfontein on north side of Hwy R64, elev. 1500 m, Orange Free State, South Africa, Grid 2926 BA, *Hale* 78874, 3 Nov 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate, rather soft and fragile, 5–12 cm broad, light yellowish green to yellowish green; lobes subirregular, 1–2.5 mm wide, apically subrotund, and irregularly branched, imbricate; upper surface continuous, emaculate, shiny, rugose with age, moderately to densely isidiate, the isidia initially subglobose (Figure 12*h*), subcylindrical at maturity, 0.08–0.10 mm in diameter, to 1 mm high, tips weakly to distinctly epicorticate, pale, very rarely erumpent or breaking off, at times coralloid branched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.5 mm long. Pycnidia lacking. Apothecia substipitate, 1–2 mm in diameter; spores 5–6 × 9–11 µm.

CHEMISTRY.—Norlobaridone, unknown $R_{fc}12$, traces of unidentified substances, and usnic acid.

ILLUSTRATION.—Hale, 1989b, figs. 3, 4.

DISTRIBUTION.—South Africa (Transvaal, OFS, Natal, Cape Province).

COMMENTS.—The Australasian *X. amplexula*, as noted above, is a more robust, leathery lichen with dense, tall, black-tipped cylindrical isidia and usually contains loxodin in addition to norlobaridone and rarely the scabrosin complex. The present species is rather rare in the moister areas of the escarpment from eastern Cape Province to Transvaal.

Xanthoparmelia angustiphylla

FIGURE 26*b*

Xanthoparmelia angustiphylla (Gyelnik) Hale, 1988b:401.

Parmelia conspersa var. *angustiphylla* Gyelnik, 1931a:153. [Type collection: Mt. Csóványos, Diosjenö, Nógrád, Hungary, *Gyelnik* s.n., 24 Apr 1926 (BP, lectotype).]

Parmelia angustiphylla (Gyelnik) Gyelnik, 1936:124.

Parmelia angustiphylla f. *euangustiphylla* Gyelnik, 1936:124. [Nomen illeg.]

Parmelia subconspersa f. *marusica* Gyelnik, 1938a:290. [Type collection: Nagylalmács, Marusicum, Transylvania, *Gyelnik* s.n. (BP, lectotype).]

Parmelia conspersa var. *panniculosa* Erichsen, 1938:147. [Type collection: Neumunster, near Südbahnhof, Schleswig-Holstein, Germany, *Erichsen* s.n., 25 Apr 1937 (HGB, lectotype).]

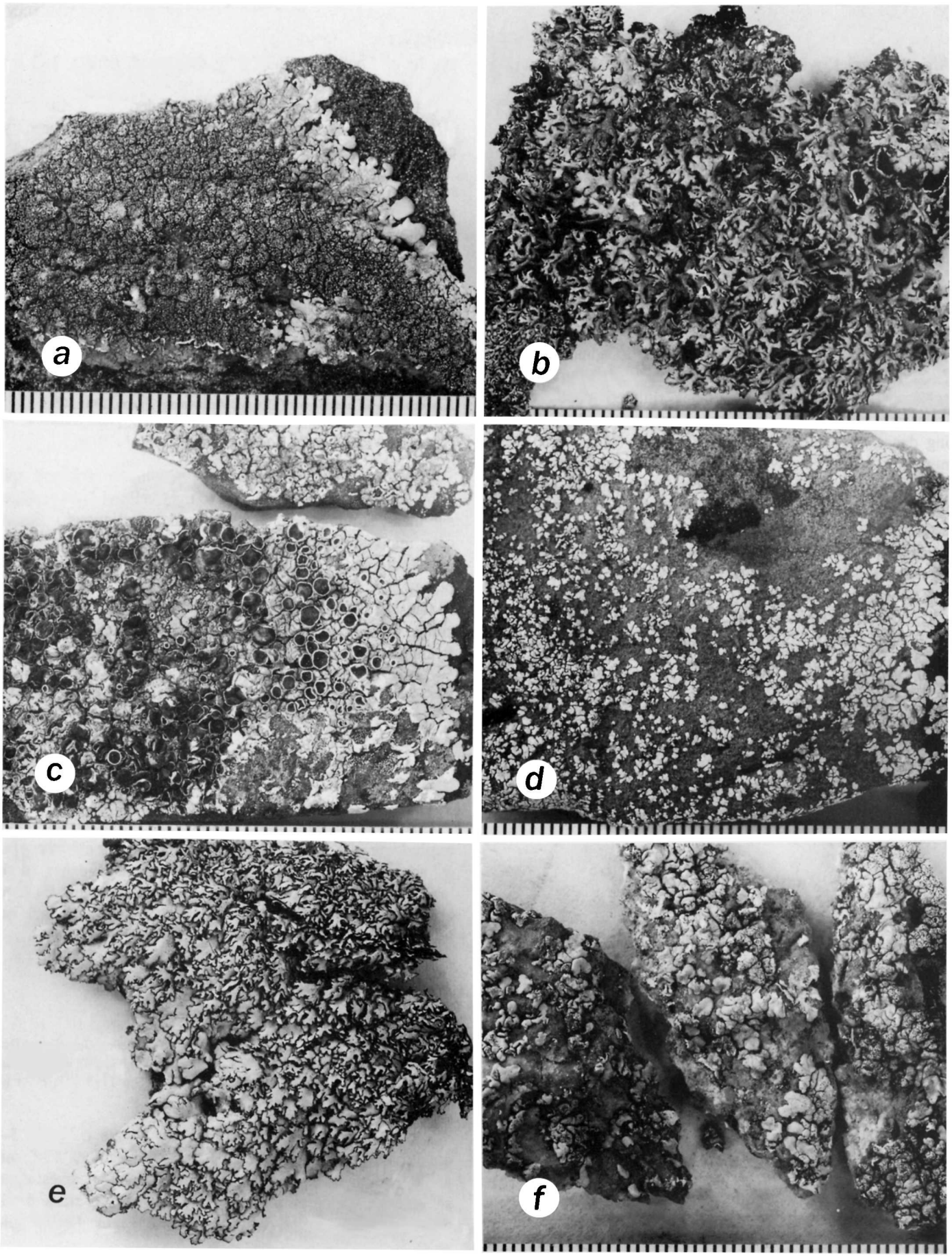
DESCRIPTION.—Thallus adnate to loosely adnate on rock, 4–10 cm broad, rather firm, sometimes pulvinate, dull yellowish green; lobes subirregular to sublinear, 0.8–1.5 mm wide, dichotomously branched, contiguous to imbricate and sometimes densely laciniate with age, the laciniae 0.3–0.5 mm wide; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple, 0.2–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 3–10 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

DISTRIBUTION.—Canada, USA, Sweden, Belgium, Germany, Hungary, Czechoslovakia.

COMMENTS.—This is a nonisidiate relative of *X. conspersa*. It is rather rare in Europe but common in eastern North America. Belgium specimens were identified by Lambinon and Sérusiaux (1985) as *X. hypopsila*, and I had also previously used this name for North American specimens. However, *X. hypopsila* is now considered to be a South American-South

FIGURE 26.—Species of *Xanthoparmelia*: *a*, *X. amplexuloides* (*Hale* 78874, holotype in US); *b*, *X. angustiphylla* (*Gyelnik* s.n., lectotype in BP); *c*, *X. applicata* (*Hale* 77664, holotype in US); *d*, *X. areolata* (*Hale* 76267, holotype in US); *e*, *X. atroventralis* (*Kofler* s.n., holotype in LD); *f*, *X. ausiana* (*Hale* 81143, holotype in US). Scale in mm.


a
b
c
d
e
f

African species with bare, convoluted lobe tips occurring primarily on soil.

Xanthoparmelia antleriformis

Xanthoparmelia antleriformis (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:194.

Parmelia antleriformis Elix, 1981:349. [Type collection: 2 km SW of Pallinup River Crossing, Eyre District, W.A., Australia, *Barnsley* 602 (CBG, holotype; MEL, isotype).]

Parmelia capnoides Kurokawa, 1985:78. [Type collection: 18 mi E of Kondinin, WA, Australia, *S. Nakanishi* 11-c (TNS, holotype, not seen).]

Paraparmelia capnoides (Kurodawa) Elix and Johnston in Elix, Johnston, and Verdon, 1986:280.

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–6 cm broad, dark yellowish green, blackening in part; lobes sublinear, 0.3–1.5 mm wide, black rimmed, contiguous to imbricate; upper surface continuous, emaculate, shiny, becoming densely isidiate, the isidia cylindrical (Figure 12*i*), ~0.1 mm in diameter, to 2 mm high, the tips syncorticate, blackening, becoming densely coralloid branched with age; medulla white; lower surface plane, pale brown, often darker toward the tips, sparsely to moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia lacking. Apothecia 2–5 mm in diameter; spores 4–5 × 6–8 µm.

CHEMISTRY.—Salazinic, consalazinic, norstictic (±trace), and usnic acids, atranorin (±).

ILLUSTRATIONS.— Elix, 1981, fig. 1; Kurokawa, 1985, fig. 2 (as *Parmelia capnoides*).

DISTRIBUTION.—Australia (NSW, Vic, Tas, NT, WA), Argentina, South Africa (Cape Province).

COMMENTS.—*X. antleriformis* is separated from other salazinic acid-containing, isidiate species with a pale lower surface, such as *X. mexicana*, by the more adnate thallus, narrower lobes, and coralloid isidia. It is rather rare but widely distributed in Australia and rarely collected outside of this continent.

Xanthoparmelia applicata

FIGURE 26*c*

Xanthoparmelia applicata Hale, 1987b:320. [Type collection: On low outcrops in karoo, 12 km N of Jansenville, on hwy R75, elev. 600 m, Cape Province, South Africa, Grid 3224 DB, *Hale* 77664, 18 Oct 1986 (US, holotype; PRE, isotype).]

Parmelia salax Brusse, 1984a:403. [Nomen novum based on *Xanthoparmelia applicata* Hale.]

DESCRIPTION.—Thallus very tightly adnate to tightly adnate on rock, usually appearing areolate at the center, 4–8 cm broad, light yellowish green; lobes sublinear, 0.7–1.5 mm wide, contiguous, crowded at the center; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia abundant; conidia bifusiform, 5–6 µm long. Apothecia abundantly developed, adnate, 1–4 mm in diameter; spores 6 × 9–10 µm.

CHEMISTRY.—Barbatic (major), 4-*O*-demethylbarbatic, norobtusatic (trace), 3-α-hydroxybarbatic acid (±trace), baeomycesic (±trace), and usnic acids (det. J. Elix).

ILLUSTRATION.—Hale, 1987b, fig. 2.

DISTRIBUTION.—South Africa (OFS, Cape Province), Lesotho.

COMMENTS.—This eastern Great Karoo species is very similar morphologically to rare *X. brunnthaleri*, a smaller greenish lichen with the scabrosin complex, to equally rare *X. sigillata* with evernic acid, and to the widespread *X. worcesteri* with lecanoric acid. All occur in arid karoo.

Xanthoparmelia arapilensis

Xanthoparmelia arapilensis (Elix and Armstrong) Filson, 1984:205.

Parmelia arapilensis Elix and Armstrong, 1983:467. [Type collection: Mt. Arapiles, Vict., Australia, *Beauglehole* 1218 (MEL, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock and soil, firm, large, 6–12 cm broad, dull to light yellowish green; lobes sublinear, strap-shaped, 2–5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, rugose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, somewhat darkening at the tips, moderately to densely rhizinate, the rhizines pale brown, rather delicate, simple to sparingly branched or splayed, 0.5–1 mm long. Pycnidia common; conidia cylindrical to subbifusiform, 0.5 × 5–6 µm. Apothecia substipitate, 2–5 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Norstictic, connorstictic, salazinic (±), and usnic acids.

ILLUSTRATION.—Elix and Armstrong, 1983, fig. 1.

DISTRIBUTION.—Australia (NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—The loose thallus and strap-shaped lobes remind one of *X. substrigosa*, which has similar chemistry but a more or less white-maculate surface and dense, dark, branching rhizines. Another Australian species with the same chemistry, *X. elixii*, is a smaller lichen with narrower, laciniate lobes 0.7–2 mm wide.

Xanthoparmelia areolata

FIGURE 26*d*

Xanthoparmelia areolata Hale, 1987a:251. [Type collection: Junction of Hwy N1 and Njelele Dam Road, N of Louis Trichardt, elev. 660 m, Transvaal, South Africa, Grid 2229 DD, *Hale* 76267, 25 Sep 1986 (US, holotype; ANUC, PRE, isotypes).]

DESCRIPTION.—Thallus very tightly adnate on rock, 5–8 cm broad, light yellow green; lobes subirregular, 0.5–1 mm wide, contiguous to scattered, forming areolate patches; upper surface continuous, emaculate, shiny, transversely cracked with age, isidiate, the isidia irregularly globose (Figure 13*a*), fragile,

the tips epicorticate, pale, erumpent and becoming pustulate, 0.2–0.3 mm in diameter, 0.2–0.3 mm high; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines simple, pale brown, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Barbatic, 4-*O*-demethylbarbatic, and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 1.

DISTRIBUTION.—South Africa (Cape Province, Transvaal), SWA/Namibia.

COMMENTS.—The isidia of *X. areolata* are relatively thick. It occurs in an extremely arid site north of the Soutpansberg Mountains, in a very arid part of northwestern Bushmanland, and near Windhoek in SWA/Namibia. *Xanthoparmelia centralis* from Australia has the same chemistry but the lobes are broader (to 1.5 mm wide) and the isidia smaller.

Xanthoparmelia arida

Xanthoparmelia arida Egan and Derstine, 1978:607. [Type collection: Wire Gap at west end of south canyon, 9.2 km SE of Casa Piedra, Presidio County, Texas, USA, *Derstine* 817 (US, holotype).]

DESCRIPTION.—Thallus adnate on rock, 3–8 cm broad, dull yellowish green; lobes subirregular, 1–3 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown, sparsely rhizinate, the rhizines pale brown, simple, 0.3–0.6 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia substipitate, 2–4 mm in diameter; spores 6 × 9 µm.

CHEMISTRY.—Lecanoric and usnic acids.

ILLUSTRATION.—Egan and Derstine, 1978, fig. 2.

DISTRIBUTION.—Western North America, South Africa (Cape Province).

COMMENTS.—This is the presumptive parent morph of *X. joranadia*. It is known from only a few collections in western Texas but is widespread in Namaqualand.

Xanthoparmelia atroventralis

FIGURE 26*e*

Xanthoparmelia atroventralis (Hale) Hale, 1974b:486.

Parmelia atroventralis Hale, 1971a:346. [Type collection: Black Mt., Distr. Qachas Nek, Lesotho, *Kofler* s.n. (LD, holotype; US, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, brittle, pulvinate, 4–6 cm broad, dull yellowish green, darkening with age; lobes subirregular to sublinear, 1–2 mm wide, contiguous to imbricate, black rimmed, becoming densely laciniate toward the center, the laciniae appressed, 0.3–0.7 mm wide; upper surface continuous to weakly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, rhizines lacking or sparsely rhizinate, the rhizines black, simple, about 0.5 mm long. Pycnidia lacking. Apothecia adnate to substipitate, 3–6 mm in diameter; spores 4 × 8 µm.

CHEMISTRY.—Unidentified fatty acid and usnic acid (det. J.A. Elix).

ILLUSTRATION.—Hale, 1971a, fig. 1b.

DISTRIBUTION.—Lesotho.

COMMENTS.—"Protolichesterinic acid?" was listed in the type description but the identity of the fatty acid is still unknown. This species occurs only at high elevations (above 3000 m) in the basaltic Drakensberg escarpment.

Xanthoparmelia aurifera

Xanthoparmelia aurifera Elix and Johnston in Elix, Johnston, and Armstrong, 1986:197. [Type collection: Bendigo, at Epsom, Vict., Australia, *Johnston* 1156 (CBG, holotype; MEL, isotype).]

DESCRIPTION.—Thallus loosely adnate to free growing on soil, scattered, 2–3 cm broad, light yellowish green; lobes sublinear, 1–2 mm wide; upper surface white-maculate, shiny, sorediate, the soralia orbicular, separate; medulla white; lower surface canaliculate with a distinct rim, pale brown, sparsely rhizinate, the rhizines, black, simple to furcate, 0.5–1.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic (major), constictic, norstictic, cryptostictic (trace), ursolic (±), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 5.

DISTRIBUTION.—Australia (Vic, SA).

COMMENTS.—This is a sorediate relative of *X. amphixantha*, known only from four localities in Australia.

Xanthoparmelia ausiana

FIGURE 26*f*

Xanthoparmelia ausiana Hale, 1989a:543. [Type collection: On sheltered granite ledge, 5 km NE of Aus on hwy 35 (road to Helmeringshausen), 4.7 km N of Hwy B4, elevation 1300 m, South West Africa/Namibia, Grid 2616 CB, *Hale* 81143, 27 Apr 1988 (US, holotype; PRE, isotype).]

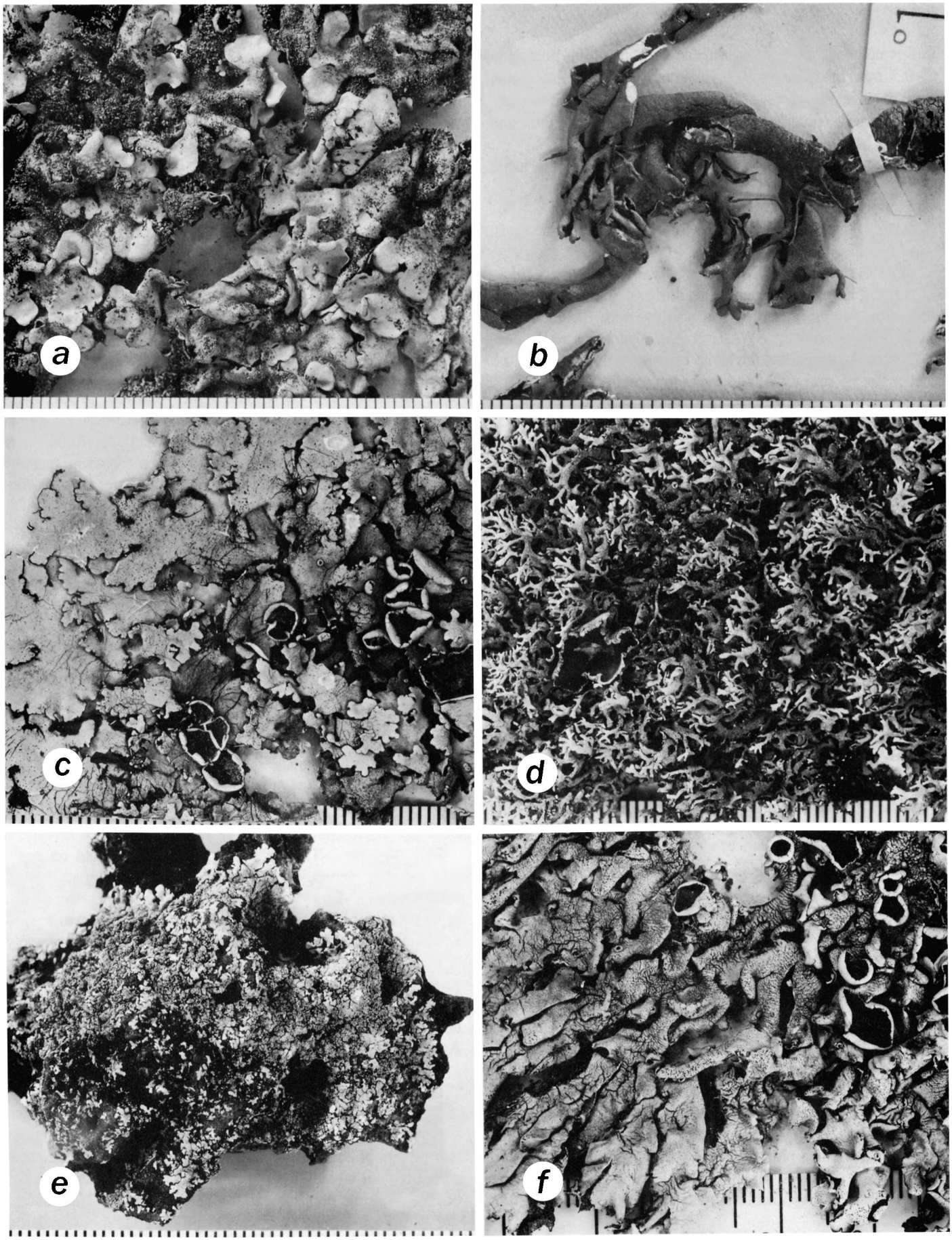
DESCRIPTION.—Thallus tightly adnate to adnate on rock, somewhat dispersed, 4–8 cm broad, light yellow green; lobes subirregular, 1–2 mm wide, short, and irregularly branched, separate to subimbricate; upper surface continuous to faintly white-maculate in patches, shiny, rugulose and transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.3–0.5 mm long. Pycnidia commonly developed; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Norstictic, salazinic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 5.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—The thallus color and lobe configuration remind one of *X. colorata*, a much larger lichen with the same chemistry but a black lower surface. The species occurs at the base of a granite dome in extremely arid southern Namibia.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Xanthoparmelia australasica

FIGURE 27*a*

Xanthoparmelia australasica D. Galloway, 1980:531. [Type collection: Karekare Beach, North Auckland, New Zealand, *Bartlett* s.n. (CHR, holotype; BM, isotype).]
Parmelia australasica (Galloway) Filson, 1982:519.

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather brittle, 5–20 cm broad, yellowish green; lobes sublinear, 1.8–4 mm wide, contiguous to densely imbricate; upper surface continuous to very weakly white-maculate in patches, shiny, moderately to densely isidiate, the isidia cylindrical (Figure 13*b*), 0.1–0.15 mm in diameter, to 1 mm high, the tips syncorticate, blackened, becoming dense and coralloid branched with age; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, simple, 0.3–0.6 mm long. Pycnidia lacking. Apothecia rather rare, substipitate, 3–8 mm in diameter; spores 4–5 × 9–10 µm.

CHEMISTRY.—Salazinic, norstictic (±trace), protocetraric (±trace), and usnic acids.

ILLUSTRATION.—Galloway, 1980, fig. 3.

DISTRIBUTION.—Australia (all states), New Zealand, North America, Argentina, Ethiopia, Kenya, Tanzania, South Africa (Cape Province).

COMMENTS.—This widespread, variable species is differentiated from closely related *X. isidiigera* by thicker isidia; *X. diadeta* from South Africa is tightly adnate with lobes 0.7–1.3 mm wide; and the European *X. tinctina* has globose unbranched isidia.

Xanthoparmelia australiensis

FIGURE 27*b*

Xanthoparmelia australiensis (Crombie) Hale, 1974b:486.
Parmelia australiensis Crombie, 1879:395. [Type collection: Table Mountain, Tasmania, Australia, *Brown* 525 (BM, lectotype).]

DESCRIPTION.—Thallus vagrant, free growing on soil, leathery, breaking apart into separate lobes, 5–6 cm broad, light yellowish green; lobes sublinear, 2–5 mm wide, strongly convoluted, separate; upper surface continuous, emaculate, shiny, cracked and rugose with age, isidia and soredia lacking; medulla white; lower surface plane, inrolled, pale brown to brown, erhizinate or very sparsely rhizinate, the rhizines pale brown, about 0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norlobaridone, loxodin, and usnic acid.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 6.

DISTRIBUTION.—Australia (SA).

COMMENTS.—This remarkable vagrant desert lichen is confined to the Nullarbor area and one locality in the Flinders Ranges. It is morphologically similar to the more common Australian *X. convoluta,* which contains salazinic acid. As pointed out by Filson (1982), the locality given on the type collection is almost certainly in error, for the species has never been collected in Tasmania.

FIGURE 27.—Species of *Xanthoparmelia: a, X. australasica* (*Bartlett* s.n., isotype in BM); *b, X. australiensis* (*Brown* 525, lectotype in BM); *c, X. austroafricana* (*MacOwan* 507, lectotype in BM); *d, X. austrocapensis* (Garside s.n., holotype in BOL); *e, X. ballingalliana* (*Elix* 20490, holotype in CBG); *f, X. barklyensis* (*Hale* 73015, holotype in US). Scale in mm.

Xanthoparmelia austroafricana

FIGURE 27*c*

Xanthoparmelia austroafricana (Stirton) Hale, 1974b:486.
Parmelia austroafricana Stirton, 1877:212. [Type collection: Near "Diamond Fields," *Shaw* s.n. (BM, lectotype; GLAM, PRE, isolectotypes).]
Parmelia conspersa var. *austroafricana* (Stirton) Stizenberger, 1890:152.
Parmelia subquercina Müller Argoviensis, 1891:377. [Type collection: South Africa, *MacOwan* s.n. (BM, lectotype; G, isolectotype).]
Hypogymnia rhodesiana Dodge, 1959:46. [Type collection: Forest Hill kop, Makoni, Zimbabwe, *Eyles* 825, Jul 1917 (BM, holotype; FH-Dodge, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, firm and rather leathery, 4–12 cm broad, dull yellowish green, darkening in part with age; lobes subirregular to sublinear, 2–6 mm wide, contiguous to imbricate; upper surface continuous to faintly white-maculate, shiny, almost always deeply transversely cracked, isidia and soredia lacking; medulla white; lower surface plane, rugose with age, brown to dark brown at the tips, light brown and dull toward the center, shiny, very sparsely to moderately rhizinate, the rhizines brown, simple to branched, 0.5–1.5 mm long. Pycnidia commonly developed; conidia bifusiform, 0.5 × 6–7 µm. Apothecia substipitate, 3–9 mm in diameter; spores 5 × 9–10 µm.

CHEMISTRY.—Protocetraric and usnic acids, unidentified fatty acid (±).

DISTRIBUTION.—South Africa (Transvaal, Cape Province), Zimbabwe.

COMMENTS.—The large, firm thallus with deep transverse fissures and the chemistry set this common lichen apart. It often grows on the tops of large exposed boulders. Müller Argoviensis (1891:377) did not recognize it as a *Xanthoparmelia* at all, only as a relative of *Parmelia tiliacea* with a pale rugose lower surface. A related species in South Africa, *X. subcolorata,* has narrower, often separate, subascending lobes and skyrin in the lower medulla.

Xanthoparmelia austrocapensis

FIGURE 27*d*

Xanthoparmelia austrocapensis Hale, 1987b:320. [Type collection: Platteklip, near Stellenbosch, *Garside* s.n., 15 Jul 1942 (BOL, holotype; US, isotype).]

DESCRIPTION.—Thallus loosely adnate on soil or rocks, 6–12 cm broad, often pulvinate, light yellowish green; lobes sublinear, 0.6–1.2 mm wide, elongate, and dichotomously branched, divaricately imbricate, lobate-laciniate, weakly convoluted at the tips, the laciniae about 0.3 mm wide; upper

surface continuous, emaculate, shiny at the tips but turning dull and rugose toward the center, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines rather coarse, sparsely furcate, 0.3–1.2 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia rarely developed, substipitate, 5–10 mm in diameter; spores usually poorly developed, 5 × 9 µm.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 3.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Of the related loosely adnate species in this difficult group with stictic acid, South African *X. simulans* has sublinear, irregularly constricted, strongly black rimmed lobes and *X. hypopsila* from southern South America and southwestern Cape Province, has broader lobes (1–2.5 mm wide) and very sparse rhizines. *Xanthoparmelia tegeta* from Australasia and South Africa is smaller, black-rimmed, and more closely adnate on rocks. *Xanthoparmelia planilobata*, a rare mostly terricolous lichen from western USA, has sparse rhizines and a rugose lower surface. This species is rather rarely collected in southwestern Cape Province.

Xanthoparmelia ballingalliana

FIGURE 27*e*

Xanthoparmelia ballingalliana Elix and Johnston, 1987:359. [Type collection: Red Falls, Lolworth Creek, Queensland, Australia, *Elix* 20490, 21 Jun 1986 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 1–4 cm broad, dull yellowish green; lobes subirregular to sublinear, 0.5–1 mm wide, dichotomously branched, contiguous to subimbricate; upper surface continuous, emaculate, shiny, transversely cracked with age, moderately to densely isidiate, the isidia subglobose at first (Figure 13*c*), becoming irregularly inflated to cylindrical, 0.07–0.1 mm in diameter, 0.1–0.5 mm high, the tips epicorticate, pale or darkening, weakly erumpent, sparsely branched; medulla white; lower surface plane, shiny, pale brown but darker at the tips, sparsely to moderately rhizinate, the rhizines very pale brown, simple, 0.1–0.3 mm long. Pycnidia lacking. Apothecia sessile, 1–2 mm in diameter; spores 4–6 × 8–10 µm.

CHEMISTRY.—Colensoic acid (major), scabrosin 4-acetate-4′-butyrate (±trace), scabrosin 4-acetate-4′-hexanoate (±trace), scabrosin 4,-4′-dibutyrate (±trace), scabrosin 4,-4′-diacetate (±trace), unknown fatty acids, and usnic acid (det. J. Johnston).

ILLUSTRATION.—Elix and Johnston, 1987, fig. 1.

DISTRIBUTION.—Australia (Qld).

COMMENTS.—This is the fifth species in the genus with colensoic acid, the others being *X. colensoica*, *X. keralensis*, *X. shebaiensis*, and *X. stenosporonica* from South Africa. Except for *X. colensoica* and this species, the major component in this group is stenosporonic acid. *Xanthoparmelia ballingalliana* is known from several localities in arid southeastern Queensland.

Xanthoparmelia barbatica

Xanthoparmelia barbatica (Elix) Egan, 1982:129.

Parmelia barbatica Elix, 1976:663. [Type collection: Kowen Forest, 18 km E of Canberra, A.C.T., Australia, *Elix* 1389 (MEL, holotype; CANB, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 4–8 cm broad, dull yellowish green, often darkening; lobes subirregular, 1–2.5 mm wide, contiguous to imbricate, becoming short laciniate with age; upper surface continuous, emaculate, shiny, rugulose and transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines pale brown to brown, simple, ~0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, adnate to substipitate, 2–7 mm in diameter; spores 4–6 × 9–10 µm.

CHEMISTRY.—Barbatic (major), 4-*O*-demethylbarbatic, dehydroconstipatic, constipatic (±traces), 3-α-hydroxybarbatic (±trace), squamatic (±trace), and usnic acids.

ILLUSTRATIONS.—Egan, 1982, fig. 1; Elix, 1976, fig. 1.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic), western USA.

COMMENTS.—This is the only adnate nonisidiate species with a pale brown lower surface and barbatic acid. *Xanthoparmelia applicata* and *X. rugulosa*, two barbatic acid-containing species from South Africa with a pale lower surface, are more tightly adnate. The single collection from Texas differs somewhat in minor metabolites (Egan, 1982), but I have not checked this material.

Xanthoparmelia barbellata

Xanthoparmelia barbellata (Kurokawa) Hale, 1984:79.

Parmelia barbellata Kurokawa, 1982:35. [Type collection: 9 mi E of Cooma on Numeralla road, N.S.W., Australia, *Kurokawa* 6452 (TNS, holotype).]

DESCRIPTION.—Thallus loosely adnate on soil or pebbles, firm, subpulvinate, 4–6 cm broad, yellowish green; lobes subirregular to sublinear, 1–4 mm wide, contiguous to imbricate, often black rimmed, becoming laciniate with age; upper surface continuous to faintly white-maculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla in part ochre; lower surface plane, pale to brown with some orange mottling, moderately rhizinate, the rhizines rather long and becoming furcate, brown, 0.5–1.5 mm long. Pycnidia common; conidia cylindrical to sub-bifusiform, 0.5 × 6–7 µm. Apothecia rare, substipitate, 3–10 mm in diameter; spores 4–6 × 6–7 µm.

CHEMISTRY.—Norstictic, salazinic, connorstictic, consalazinic, and usnic acids and skyrin.

ILLUSTRATION.—Kurokawa, 1982, fig. 1.

DISTRIBUTION.—Australia (NSW, ACT), New Zealand.

COMMENTS.—This rare, mostly terricolous lichen resembles

X. substrigosa, which has dense rhizines and lacks skyrin.

Xanthoparmelia barklyensis

FIGURE 27*f*

Xanthoparmelia barklyensis Hale, 1986b:566. [Type collection: Barkly Pass, about 18 km N of Elliott along Hwy R58, elev. ca. 1800 m, Cape Province, South Africa, Grid 3127 BB, *Hale* 73015, 9 Feb 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 8–15 cm broad, bright yellow green; lobes subirregular to sublinear, 2.5–5 mm wide, contiguous to imbricate, the center becoming short laciniate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately to densely rhizinate, the rhizines pale brown, simple, 0.5–1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 5–6 µm. Apothecia numerous, adnate, 3–5 mm in diameter; spores 5–7 × 9–11 µm.

CHEMISTRY.—Fatty "subdecipiens" unknowns 33 and 37 (major), constipatic (±trace), protoconstipatic (±trace), and usnic acid.

ILLUSTRATION.—Hale, 1986b, fig. 4.

DISTRIBUTION.—South Africa (OFS, Cape Province).

COMMENTS.—This species appears to be related to *X. aliphatica*, which has a pale brown lower surface. Both occur on Cave and Molteno sandstones in eastern Cape Province. The only other obvious relative of this large lichen with a pale lower surface is *X. subdecipiens*, which is adnate to loosely adnate.

Xanthoparmelia beatricea

FIGURE 28*a*

Xanthoparmelia beatricea Hale, 1987a:253. [Type collection: 5 km NE of Hwy N7 on the Douse-the-Glim road at the railroad crossing, elev. 200 m, Cape Province, South Africa, Grid 3118 BC, *Hale* 78606, 30 Oct 1986 (US, holotype; ANUC, LD, PRE, isotypes).]

DESCRIPTION.—Thallus vagrant, free growing on soil, firm and leathery, 6–10 cm broad but scattered over several meters, light yellow green; lobes sublinear, strongly convoluted and forming tube-like branches, 4–10 mm wide when expanded, little branched, 1–4 cm long, twisted and contorted; upper surface continuous, emaculate, dull, becoming strongly rugose with age, isidia and soredia lacking; medulla white; lower surface plane, sparsely to moderately rhizinate, the rhizines brown, simple to sparsely furcate, 0.3–0.5 mm long. Pycnidia rarely developed; conidia cylindrical, 0.5 × 9–12 µm. Apothecia lacking.

CHEMISTRY.—Protocetraric and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 2.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This soil lichen is unique among the vagrant, free-growing species in chemistry and also has the second largest conidia in the genus (*X. heterodoxa* has conidia to 14 µm long). It occurs in a well trampled sheep paddock in the Salt River area of Namaqualand.

Xanthoparmelia bellatula

FIGURE 28*b*

Xanthoparmelia bellatula (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:203.

Parmelia bellatula Kurokawa and Filson in Filson, 1982:521. [Type collection: 6 mi W. of Redcliffs along Werrimull Road, Vict., Australia, *Kurokawa* 6620 (TNS, holotype; MEL, isotype).]

DESCRIPTION.—Thallus loosely adnate to nearly free growing on soil, firm but easily breaking apart, 2–4 cm broad, light yellowish green; lobes sublinear, 0.6–1.5 mm wide, dichotomously branched, separate to imbricate with secondary weakly convoluted laciniae usually developing at the center with age; upper surface continuous, emaculate, shiny to dull, isidia and soredia lacking; medulla white; lower surface canaliculate with a yellowish rim, concolorous with the upper surface or pale brown, sparsely rhizinate, the rhizines pale brown or darkening, 0.5–1 mm long. Pycnidia lacking. Apothecia substipitate, 2–3 mm in diameter; spores absent.

CHEMISTRY.—Salazinic, consalazinic (±), norstictic (trace), protocetraric (trace), and usnic acids.

ILLUSTRATION.—Kurokawa and Filson, 1982, fig. 3.

DISTRIBUTION.—Australia (NSW, Vic, SA, WA).

COMMENTS.—This rare soil lichen falls in the *X. amphixantha* group but lacks white maculation on the surface. It is found in the Murray mallee scrub region with other terricolous species such as *X. eilifii*, *X. pseudoamphixantha*, *X. pumila*, and *X. terrestris*.

Xanthoparmelia benyovszkyana

FIGURE 28*c*

Xanthoparmelia benyovszkyana (Gyelnik) Hale, 1974b:486.

Parmelia benyovszkyana Gyelnik, 1934c:153. [Type collection: Tananarive, Madagascar, *Decary* s.n. (PC, lectotype; BP, isolectotype).]

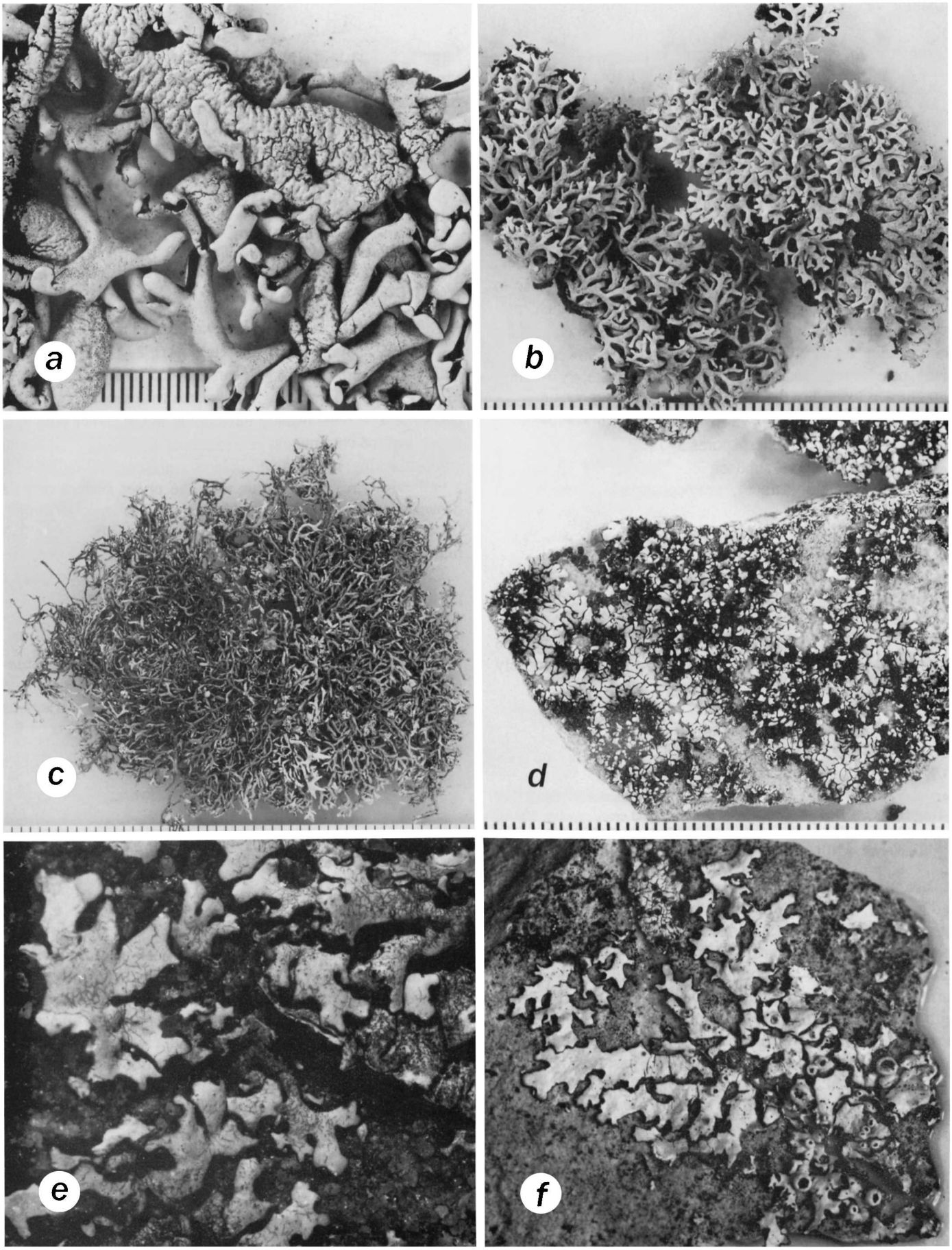
DESCRIPTION.—Thallus loosely adnate on pebbles to nearly free growing on soil and rocks, soft, more or less pulvinate, 4–5 cm broad, dull yellowish green, darkening with age; lobes linear, 0.2–0.6 mm wide, finely divaricately branched, the ultimate branches terete; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface weakly canaliculate with an indistinctly raised rim, pale brown or darkening, very sparsely rhizinate, the rhizines brown, simple, 0.2–0.5 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–7 µm. Apothecia lacking.

CHEMISTRY.—Stictic, norstictic, constictic, and usnic acids.

ILLUSTRATION.—Des Abbayes, 1961, fig. 2.

DISTRIBUTION.—Madagascar.

COMMENTS.—The rhizines of this rare Madagascar species


a
b
c
d
e
f

are concentrated in small patches. It is very similar in aspect to *X. suberadicata*, which is black below.

Xanthoparmelia bibax

FIGURE 28*d*

Xanthoparmelia bibax (Brusse) Hale, 1988b:401.

Parmelia bibax Brusse, 1986a:105. [Type collection: 17 km W of Citrusdal, top of Middelberg Pass, elev. 1100 m, Cape Province, S. Africa, Grid 3219 AA, *F. Brusse* CH4684 (PRE, holotype; LD, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 4–10 cm broad, bright yellowish green but darkening with age at the center; lobes subirregular to sublinear, 0.5–2 mm wide, irregularly branched, contiguous and crowded; upper surface continuous, emaculate, dull, becoming rugulose and short laciniate with age, more or less white pruinose at the tips, isidia and soredia lacking; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines brown, simple, 0.2–0.5 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–7 µm. Apothecia rarely developed, substipitate, 1–2 mm in diameter, the rim white pruinose; spores 6–7 × 8–10 µm.

CHEMISTRY.—Salazinic, consalazinic (±), norstictic (±), and usnic acids, chalybaeizans unknown.

ILLUSTRATION.—Brusse, 1986a, fig. 1.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species is confined to, and quite common in, Namaqualand. It presents an unusual banded aspect with light yellow lobe tips and darkening center.

Xanthoparmelia bicontinens

Xanthoparmelia bicontinens Elix and Nash in Nash and Elix, 1987:471. [Type collection: Errinundra Flora Reserve, Victoria, Australia, *Elix* 19949, 10 Apr 1986 (CBG, holotype; ASU, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–5 cm broad, yellowish green; lobes sublinear, 0.7–1.5 mm wide, sparingly dichotomously branched, contiguous to barely imbricate, black-rimmed toward the tips; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate, the rhizines black, robust, simple, 0.3–0.5 mm long. Pycnidia common; conidia cylindrical, 0.5 × 6–7 µm. Apothecia well developed, adnate, 1–2 mm in diameter; spores 4–5 × 7–8 µm.

CHEMISTRY.—Stictic, constictic, norstictic, cryptostictic (trace), and usnic acids.

ILLUSTRATION.—Nash and Elix, 1987, fig. 5.

DISTRIBUTION.—Australia (NSW, Vic), South Africa (Transvaal).

COMMENTS.—The only related species with this combination of characters is *X. neoconspersa* from western North America, which has a crowded, more tightly adnate, rugose thallus that darkens with age.

Xanthoparmelia blackdownensis

FIGURE 28*e*

Xanthoparmelia blackdownensis Elix and Johnston, 1987:360. [Type collection: Blackdown Tablelands, Leichhardt district, Queensland, Australia, *Verdon* 5243, 27 Jan 1983 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, rather dispersed, 1–3 cm in diameter, dull yellowish green; lobes subirregular to sublinear, 0.4–1 mm wide, stellate, irregularly branched, weakly constricted, separate to subimbricate; upper surface continuous, emaculate shiny, transversely cracked with age, sparsely to moderately isidiate, the isidia cylindrical (Figure 13*d*), 0.07–0.1 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, blackening, mostly unbranched; medulla white; lower surface plane, pale to light brown but darker at the tips, sparsely to moderately rhizinate, the rhizines pale to light brown, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Diffractaic (major), 4-*O*-demethylbarbatic, 3-α-hydroxybarbatic (trace), and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1987, fig. 2.

DISTRIBUTION.—Australia (Qld).

COMMENTS.—This species is comparable with the North America *X. ajoensis*, which is adnate with much broader lobes (1–2 mm wide) and larger isidia. It has been found only at the type locality.

Xanthoparmelia boonahensis

FIGURE 28*f*

Xanthoparmelia boonahensis Elix and Johnston, 1988b:354. [Type collection: Summit of Mt. French, Mt. French National Park, near Boonah, Queensland, Australia, *Rogers* 7640 (MEL, holotype).]

DESCRIPTION.—Thallus adnate on rock, 2–3 cm broad, pale yellow green; lobes sublinear, 0.8–1.5 mm wide, contiguous to subimbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla in part yellow-orange; lower surface plane, pale to dark brown, moderately rhizinate, the rhizines brown or blackening, simple, 0.3–0.5 mm long. Pycnidia commonly developed; conidia bifusiform, 0.5 × 5–7 µm. Apothecia adnate, poorly developed, ~0.5 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Barbatic (major), 4-*O*-demethylbarbatic (minor), constipatic (trace), protoconstipatic (trace), and usnic acids, skyrin.

ILLUSTRATION.—Elix and Johnston, 1988b, fig. 2.

DISTRIBUTION.—Australia (Qld).

COMMENTS.—The adnate thallus resembles *X. barbatica*,

FIGURE 28.—Species of *Xanthoparmelia*: *a*, *X. beatricea* (*Hale* 78606, holotype in US); *b*, *X. bellatula* (*Hale* 68554); *c*, *X. benyovszkyana* (*des Abbayes* 3); *d*, *X. bibax* (*Hale* 72166); *e*, *X. blackdownensis* (*Verdon* 5243, holotype in CBG) (×10); *f*, *X. boonahensis* (*Rogers* 7640, holotype in MEL) (×3). Scale in mm.

another barbatic acid-containing species in Australia and North America, but the pigmented lower medulla is distinctive. This is the only species containing skyrin and barbatic acid together. It is known only from the type locality.

Xanthoparmelia brevilobata

FIGURE 29*a*

Xanthoparmelia brevilobata Hale, 1987a:253. [Type collection: Naudesnek, elev. 2180 m, Cape Province, South Africa, Grid 3028 CB, *Hale* 76866, 9 Oct 1986 (US, holotype; ANUC, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate to adnate on rocks, coriaceous, 5–8 cm broad, dark yellowish green; lobes subirregular, 0.8–1.5 mm wide, irregularly branched, short and crowded, contiguous to imbricate; upper surface continuous, emaculate shiny, transversely cracked and sometimes bullate-rugose in older parts, isidia and soredia lacking; upper medulla white, lower medulla ochre; lower surface plane, shiny, brown or partly tinged with ochre, sparsely to moderately rhizinate, the rhizines brown, simple, 0.1–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–5 µm. Apothecia well developed, adnate, 2–5 mm in diameter, the disc plane; spores 5–6 × 8–9 µm.

CHEMISTRY.—Hypostictic (major), hyposalazinic (minor), hypoconstictic, and usnic acids, skyrin, unidentified anthraquinones (det. J.A. Elix).

ILLUSTRATION.—Hale, 1987a, fig. 3.

DISTRIBUTION.—South Africa (Cape Province), Lesotho.

COMMENTS.—This rare high elevation species is close to *X. saniensis*, another Drakensberg lichen which differs in having pustulate isidia. It also resembles *X. subcrustacea* from Australia. Both contain the hypostictic acid complex but *X. subcrustacea* lacks skyrin and has a thinner thallus. Another species in this complex from South Africa, *X. naudesnekia*, contains stenosporonic acid in addition to the hypostictic acid complex.

Xanthoparmelia brunnthaleri

FIGURE 29*b*

Xanthoparmelia brunnthaleri (Steiner and Zahlbruckner) Hale, 1974b:486.
Parmelia brunnthaleri Steiner and Zahlbruckner in Zahlbruckner, 1926:505. [Type collection: Matjesfontein, Grosse Karoo, Cape Distr., South Africa, *Brunnthaler* s.n. (WU, lectotype; W, isolectotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, the center appearing areolate, 3–6 cm broad, dull yellowish green; lobes subirregular to sublinear, 0.5–1.5 mm wide, rather short, weakly convex, contiguous; upper surface continuous, emaculate shiny, transversely cracked, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.3 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia numerous, adnate, 1–2 mm in diameter; spores 6–7 × 10–11 µm.

CHEMISTRY.—Scabrosin 4,4′-diacetate, unknown scabrosin $R_{fc}12$, and usnic acid (det. J.A. Elix).

DISTRIBUTION.—South Africa (Cape Province), SWA/Namibia, Australia.

COMMENTS.—Gyelnik (1935:22) noted the morphological similarity with *X. worcesteri*, a common karoo lichen with lecanoric acid. The present species, however, is by comparison quite rare in the karoo.

Xanthoparmelia bungendorensis

FIGURE 29*c*

Xanthoparmelia bungendorensis (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:205.
Parmelia bungendorensis Elix, 1981:351. [Type collection: 3 km E of Bungendore, N.S.W., Australia, *Elix* 3025 (MEL, holotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 7–10 cm broad, yellowish green; lobes subirregular to sublinear, 0.9–3 mm wide, contiguous to imbricate, laciniate with age and somewhat subascending, sometimes black rimmed; upper surface continuous, emaculate shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown, sparsely to moderately rhizinate, the rhizines pale brown, simple, 0.2–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia substipitate, 2–8 mm in diameter; spores 5–6 × 8–10 µm.

CHEMISTRY.—Scabrosin 4,4′-diacetate, scabrosin 4-acetate-4′-butyrate, scabrosin 4,4′-dibutyrate, scabrosin 4-acetate-4′-hexanoate, and usnic acid.

ILLUSTRATION.—Elix, 1981, fig. 2.

DISTRIBUTION.—Australia (NSW, ACT, Vic, Tas, SA, NT).

COMMENTS.—No other adnate or loosely adnate species contain the scabrosin derivatives. The only relative is tightly adnate *X. cravenii* from arid central Australia, and it contains additional fatty acids.

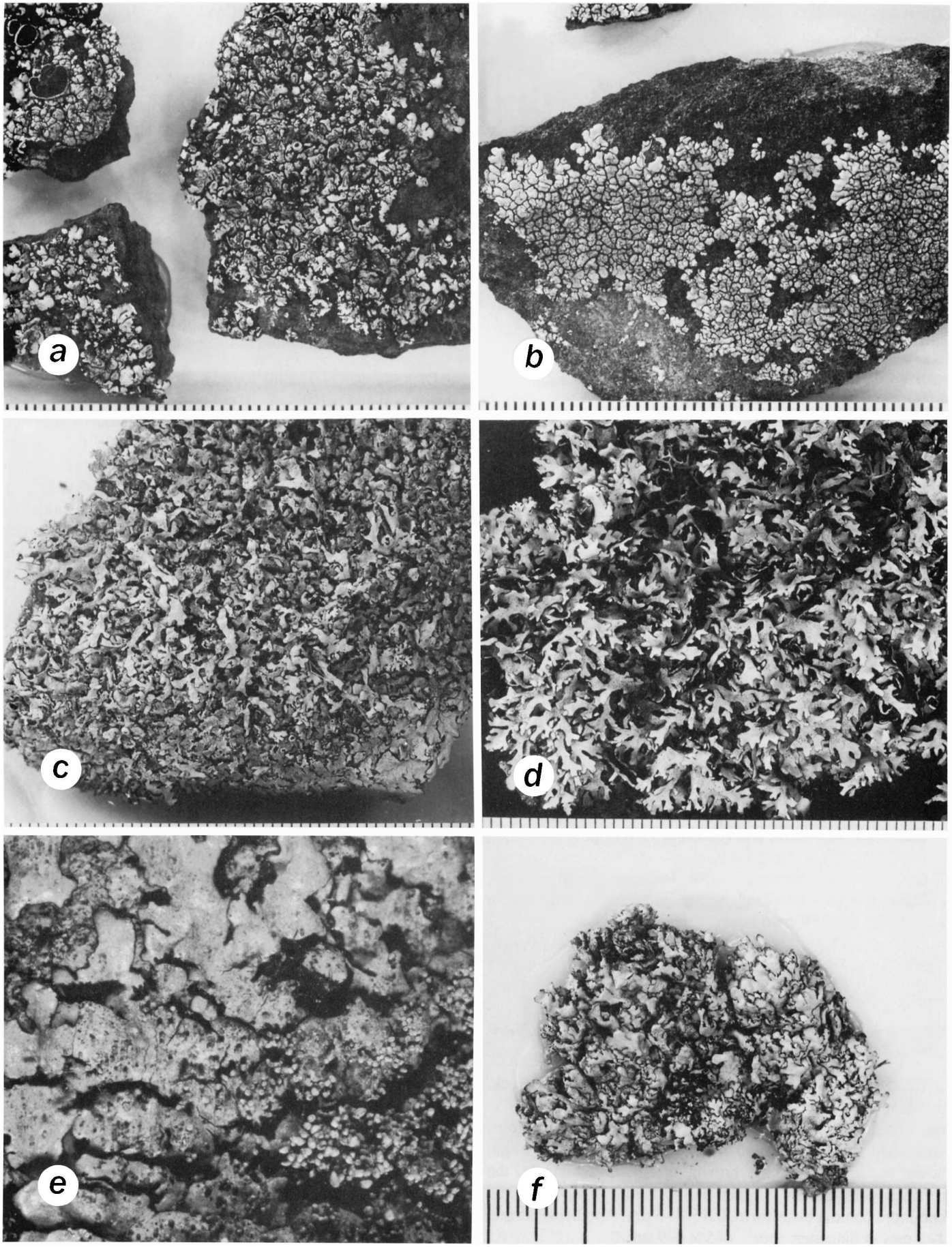
Xanthoparmelia burmeisteri

FIGURE 29*d*

Xanthoparmelia burmeisteri (Elix) Egan, 1982:129.
Parmelia burmeisteri Elix (*"burmeisterii"*), 1976:664. [Type collection: 10 km S of Nimmitabel, Snowy Mountains Hwy., N.S.W., Australia, *Elix* 1613 (MEL, holotype; CANB, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, more or less pulvinate, 6–10 cm broad, dark yellowish green; lobes sublinear to linear, 0.5–1 mm wide, divaricate-imbricate and in part subascending, black rimmed; upper surface effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, dull, sparsely rhizinate, the rhizines

FIGURE 29.—Species of *Xanthoparmelia*: *a*, *X. brevilobata* (*Hale* 76866, holotype in US); *b*, *X. brunnthaleri* (*Hale* 78547); *c*, *X. bungendorensis* (Elix 1831); *d*, *X. burmeisteri* (*Elix* 1994); *e*, *X. calida* (*Elix* 21180, holotype in CBG (×10)); *f*, *X. californica* (*Schmidt* 464, holotype in US). Scale in mm.


a
b
c
d
e
f

black, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6 µm. Apothecia substipitate, 3–10 mm in diameter; spores 4–6 × 6–8 µm.

CHEMISTRY.—Barbatic (major), 4-*O*-demethylbarbatic, and usnic acids.

ILLUSTRATION.—Elix, 1976, fig. 2.

DISTRIBUTION.—Australia, South Africa (Cape Province).

COMMENTS.—This is a typical member of the *X. hypoleia* complex. It is comparatively rare in Australia, where *X. hypoprotocetrarica* and *X. notata* are much more common, and is known only from a few collections in Namaqualand in South Africa, where *X. hypoleia* and *X. hypoprotocetrarica* predominate.

Xanthoparmelia calida

FIGURE 29*e*

Xanthoparmelia calida Elix and Johnston, 1987:361. [Type collection: Andromache River, 25 km SW of Proserpine, Queensland, Australia, *Elix* 21180, 2 Jul 1986 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 2–4 cm broad, yellowish green or darkening to olive-brown or blackish in older lobes; lobes subirregular to sublinear, 0.5–1.2 mm wide, short and irregularly branched, blackish rimmed at the tips, contiguous; upper surface continuous, emaculate opaque, transversely cracked with age, moderately to densely isidiate, the isidia subglobose at first, mostly irregularly inflated to cylindrical with age, 0.08–0.15 mm in diameter, 0.2–0.5 mm high, the tips epicorticate, pale or darkening, sparingly short coralloid branched; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines black, robust, simple, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norlobaridone (major), scabrosin 4-acetate-4′-butyrate, scabrosin 4-acetate-4′-hexanoate, scabrosin 4,4′-dibutyrate, unknown scabrosin (trace), and usnic acid.

ILLUSTRATION.—Elix and Johnston, 1987, fig. 3.

DISTRIBUTION.—Australia (Qld).

COMMENTS.—This rare species is externally close to *X. exillima*, a more widespread species in Australia and southern Africa with a pale brown lower surface.

Xanthoparmelia californica

FIGURE 29*f*

Xanthoparmelia californica Hale, 1984:73. [Type collection: Folsom, Sacramento Co., California, USA, *Schmidt* 464 (US, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–6 cm broad, yellowish green; lobes subirregular, 0.8–1.5 mm wide, contiguous to imbricate; upper surface continuous, emaculate shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.3–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–6 µm. Apothecia adnate, 1–3 mm in diameter; spores 4–5 × 8–9 µm.

CHEMISTRY.—Norstictic, connorstictic, and usnic acids.

ILLUSTRATION.—Hale, 1984, fig. 1.

DISTRIBUTION.—Western North America.

COMMENTS.—This is the only nonisidiate, norstictic acid-containing adnate *Xanthoparmelia* in North America. Two isidiate species with this chemistry, *X. dierythra* (pale below) and *X. norhypopsila* (black below), are apparently unrelated.

Xanthoparmelia callifolioides

FIGURE 30*a*

Xanthoparmelia callifolioides Adler, Elix, and Johnston in Elix and Johnston, 1988a:505. [Type collection: Las Pailas, Salta Province, elev. 2280 m, Argentina, *Adler* s.n., Feb 1986 (BAFC, holotype; ANUC, US, isotypes).]

DESCRIPTION.—Thallus loosely adnate to nearly free growing on soil and pebbles, 5–10 cm broad, light yellowish green; lobes sublinear, 1.5–3 mm wide, subdichotomously branched, lobulate toward the center, the laciniae elongate, 0.7–1.2 mm wide, plane to weakly convoluted, imbricate; upper surface continuous, emaculate, shiny, soredia and isidia lacking; medulla white; lower surface plane, weakly canaliculate, light brown, sparsely to moderately rhizinate, the rhizines pale brown, simple or sparsely branched, 1–2 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Salazinic (major), consalazinic, norstictic (±trace), protocetraric (±trace), and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1988a, fig. 14.

DISTRIBUTION.—Argentina.

COMMENTS.—Related to *X. taractica*, *X. callifolioides* has well developed laciniae and is convoluted. It has been collected only a few times in Salta Province.

Xanthoparmelia calvinia

FIGURE 30*b*

Xanthoparmelia calvinia Hale, 1986b:567. [Type collection: Akkerendam Nature Reserve near Calvinia, elev. 1000 m, Cape Province, South Africa, Grid 3119 BD, *Hale* 75103, 29 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus tightly adnate on rock and small pebbles, 4–6 cm broad, light brownish yellow green; lobes short, subirregular, 0.5–2 mm wide, contiguous; upper surface continuous to faintly reticulate white-maculate at the tips, shiny, becoming strongly rugose and finally coarsely isidiate at the center, the isidia bullate-globose, 0.1–0.3 mm in diameter and 0.2–0.3 mm high, the tips epicorticate, erumpent and bursting open to reveal a hollow center; medulla white; lower surface plane, brown to dark brown, moderately rhizinate, the rhizines brown, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—4-*O*-Methylhypoprotocetraric (major), 4-*O*-demethylnotatic, and usnic acids, unknown $R_{fc}30$ (major).

ILLUSTRATION.—Hale, 1986b, fig. 5.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This unusual karoo lichen has hollow globose isidia (not unlike those of *X. evernica*) and peculiar reticulate maculation on the surface. Chemically it is related to *X. competita*, which lacks isidia.

Xanthoparmelia camtschadalis

FIGURE 30c

Xanthoparmelia camtschadalis (Acharius) Hale, 1974b:486.

Borrera camtschadalis Acharius, 1814:223. [Type collection: Kamchatka, USSR, *Tilesius* s.n. (H-Ach, lectotype; UPS, isolectotype).]

Parmelia camtschadalis (Acharius) Eschweiler 1833:202.

Parmelia vagans f. *elegans* Mereschkowsky, 1913:58. [Type collection: Salgir Valley near Simpheropolin, Taurica Peninsula, USSR, *Mereschkowsky* no. 58 in *Lichenes Rossiae Exsiccati* (BP, lectotype; UPS, W, isolectotypes).]

Parmelia vagans f. *elegans* subf. *minuscula* Savicz ex Gyelnik, 1935:52 [Type collection: Near Lake Kossogol, Mongolia, *Smirnov* 482 (M, lectotype).]

Parmelia vagans f. *elegans* subf. *minuscula* Savicz, 1935:318. [Type collection: Ochotsk tract, Yakutsk, USSR, *Drobov and Tarabukin* s.n. (not seen).]

Parmelia desertorum f. *minuscula* (Savicz) Gyelnik, 1938b:6.

Parmelia desertorum f. *elegans* (Mereschkowsky) Gyelnik, 1938b:6.

Parmelia taractica var. *vagans* f. *elegans* (Mereschkowsky) Poelt and Vězda, 1981:223. [Illegitimate combination. Basionym not cited.]

DESCRIPTION.—Thallus vagrant, free growing on soil, intact and firm or sometimes fragmenting, 3–7 cm broad, dull to light yellowish green; lobes sublinear, 1.3–3 mm wide, separate to overlapping; upper surface uniformly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface convoluted but not strongly inrolled, with a more or less well-developed pale yellowish rim, pale brown or darkening at the tips, sparsely to moderately rhizinate, the rhizines pale brown or darkening, thin, simple to furcate, 0.3–1 mm long. Pycnidia lacking. Apothecia very rare, substipitate; spores not found.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

ILLUSTRATION.—Elenkin, 1901b, pl. 3.

DISTRIBUTION.—Europe, USSR, China, Mongolia, western North America.

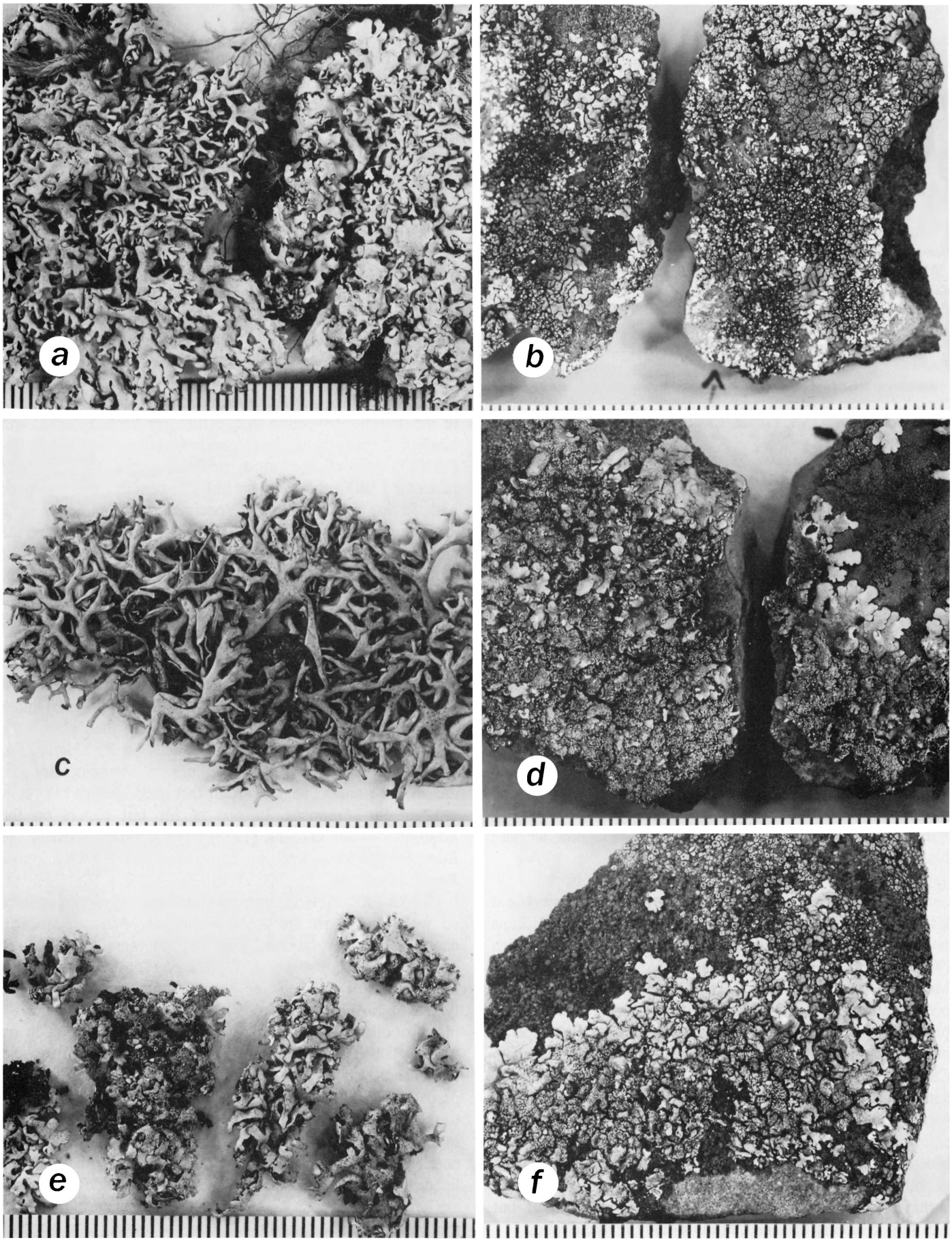
COMMENTS.—The vagrant *Xanthoparmeliae*, of which *X. camtschadalis* was the first described species, have always held a fascination for lichenologists. They are conspicuous lichens on soil in deserts, steppes, and high plains of North America (Williams, 1892), eastern Europe, USSR (Elenkin, 1901b), Mongolia, Australia, and South Africa. According to the present taxonomy, *X. camtschadalis* is characterized by the presence of salazinic acid and a white-maculate surface. It occurs in Eurasia and North America (Colorado northward into Canada). The other species in this group, *X. australiensis*, *X. beatricea*, *X. chlorochroa*, *X. convoluta*, *X. idahoensis*, *X. kotisephola*, *X. lipochlorochroa*, *X. neochlorochroa*, *X. norchlorochroa*, *X. norconvoluta*, *X. pachyclada*, and *X. vagans* lack maculae (except for unusual *X. idahoensis*) and have various chemistries. A related European species, which should perhaps be included here, is *Xanthoparmelia subdiffluens*, but it differs in having flattened, rarely weakly revolute lobes.

Unfortunately there has long been confusion among lichenologists on the identity of *X. camtschadalis*, which has often been called *X. vagans* by European lichenologists. In 1924 Du Rietz attempted to establish, once and for all, the identity of *Parmelia camtschadalis* ("Was ist *Borrera camtschadalis?*"). He had one important advantage over earlier workers, namely access to Acharian and other types in UPS. He concluded that Eschweiler (1833) was the first one to use the name incorrectly, for what is now known as *Everniastrum cirrhatum* (Fries) Sipman, a tropical corticolous species. Vainio (1921), Hue (1898), Müller Argoviensis (1887), and others followed this concept in the 19th century.

This mistaken idea was given further credence by Savicz (1914), who, unable to find "*Parmelia camtschadalis* Eschw." on trees in Kamchatka, concluded that the Acharian specimen collected by Tilesius was mislabeled and that the lichen on soil in Kamchatka was *P. conspersa* f. *stenophylla*. A duplicate of the Tilesius collection in FH-Tuck (ex herb. Floerke) and labelled *P. congruens*, is *X. camtschadalis*. Mereschkowsky (1920b), one of the most perceptive but unappreciated lichenologists in the early part of this century, did not agree with Savicz since he found a specimen of a *Xanthoparmelia* in Geneva, labeled Kamchatka ("misit Palibin"), which he correctly identified as *Parmelia camtschadalis*. He died before a promised revision of this group was finished. Savicz (1923) responded with outrage to Mereschkowsky's conclusions and proposed that the name *P. cirrhata* be adopted for *P. camtschadalis*.

In any event Du Rietz (1924) correctly identified *Borrera camtschadalis* as a *Xanthoparmelia* but synonymized both it and *P. stenophylla* (Acharius) Du Rietz (= *X. somloensis*) under *P. molliuscula*, a South African species. He then placed the other vagrant, terricolous species, including *X. chlorochroa* and *X. vagans*, under *P. molliuscula* var. *vagans*. Both *X. chlorochroa* and *X. vagans* are in fact good species but occur only in the Americas. In one of his last papers on the *Xanthoparmeliae* Gyelnik (1938b) synonymized most of the European taxa, as well as Australian *X. convoluta*, under *Parmelia vagans*.

Elenkin (1901b) took a special interest in the vagrant species so well known in the Russian steppes. After conducting ecological studies, he concluded that the vagrant forms were derived from *P. conspersa* f. *stenophylla*. Mereschkowsky (1918) carefully studied this group in the Crimea. He found typical *P. conspersa* growing attached to rocks, but on a nearby plateau collected free-growing, convoluted species which he called *P. conspersa* f. *vaga* (= *X. subdiffluens*). He was convinced that these vagrant forms represented a self-perpetuating population distinct from those growing attached to rock. Cretziou (1933) briefly discussed this unusual group in Roumania, and Mattick (1951) classified them as "aerolichenes." Klement (1950) leaned toward the theory that vagrant lichens, while probably derived from adnate saxicolous forms, are genetically distinct and represent good species. Obviously the biological relationship between the adnate and vagrant


a
b
c
d
e
f

forms is still unresolved, but most field evidence indicates that vagrant forms behave as distinct species.

Xanthoparmelia capensis

FIGURE 30*d*

Xanthoparmelia capensis Hale, 1986b:567. [Type collection: 27 km E of Swellendam on N2, elev. ca 200 m, Cape Province, South Africa, Grid 3420 BA, *Hale* 74046, 3 Feb 1986 (US, holotype; PRE, isotype).]
Parmelia capicola Brusse, 1988:539.

DESCRIPTION.—Thallus adnate on rock, 4–6 cm broad, pale yellowish green; lobes subirregular, 1.2–2.0 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, isidia globose to subcylindrical (Figure 13*e*), 0.08–0.15 mm in diameter, 0.4–0.7 mm high, the tips syncorticate or weakly epicorticate, pale to black-tipped, sometimes breaking off apically, mostly unbranched; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, simple, about 0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids, chalybaeizans unknown.

ILLUSTRATION.—Hale, 1986b, fig. 6.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species is similar to stictic acid-containing *X. verrucigera* in adnation and lobe configuration but has a different chemistry. It is relatively rare in southern Cape Province. *Xanthoparmelia australasica* from Australia and New Zealand, another isidiate species with salazinic acid (but without the chalybaeizans unknown), is more loosely adnate and has sublinear lobes.

Xanthoparmelia catarinae

FIGURE 30*e*

Xanthoparmelia catarinae Hale, 1989a:543. [Type collection: Florianopolis-Estreito, Santa Catarina, Brazil, *Poeschmann-Hájková* in *Vězda, Lichenes Selecti Exsiccati* 761 (US, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock, brittle, 5–8 cm broad, yellowish green; lobes sublinear, 0.8–2 mm wide, dichotomously branched, weakly convoluted at the tips, imbricate; upper surface continuous, emaculate, shiny, sparsely to moderately isidiate, the isidia initially subglobose (Figure 13*f*), irregularly cylindrical at maturity, 0.14–0.18 mm in diameter, 0.2–0.8 mm high, the tips syncorticate, darkening, mostly simple to coralloid branched; medulla white; lower surface plane, black, with a barely raised dark to yellowish rim, shiny, very sparsely rhizinate below the tips, sparsely rhizinate toward the center, the rhizines black, coarse, unbranched, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Stictic (major), constictic, norstictic, cryptostictic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1989a, figs. 6, 7.

DISTRIBUTION.—Brazil.

COMMENTS.—This is the isidiate morph of *X. hypopsila*. It is differentiated from the North American *X. isidiascens* by the subconvolute, yellow-rimmed lobe tips and narrower lobes.

Xanthoparmelia cedrus-montana

Xanthoparmelia cedrus-montana Brusse in Knox and Brusse, 1983:145.
Parmelia stenophylla f. *hypomelaena* Vainio ex Lynge, 1937:89. [Type collection: Ceres, Cape Prov., South Africa, *Leslie* [476] (TUR, Vainio herb. no. 34575, holotype).]
Parmelia cedrus-montana (Brusse) Brusse, 1984:320.

DESCRIPTION.—Thallus loosely adnate on rock, at times pulvinate, 5–8 cm broad, dull yellowish green; lobes sublinear to linear, 1–2 mm wide, elongate, separate to imbricate; upper surface effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, dull, sparsely to moderately rhizinate, the rhizines black simple, 0.5–1 mm long. Pycnidia rare; conidia weakly bifusiform, 0.5 × 4–6 µm. Apothecia common, substipitate, 2–6 mm in diameter; spores 6–8 × 10–12 µm.

CHEMISTRY.—Thamnolic, squamatic, dehydroxythamnolic (trace), caperatic, and usnic acids.

ILLUSTRATION.—Knox and Brusse, 1983, fig. 2.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This is a member of the *X. hypoleia* group and the only species in *Xanthoparmelia* with thamnolic acid. A few specimens seem to contain only squamatic acid. It has a very restricted range in lower Namaqualand, where it is common.

Xanthoparmelia centralis

FIGURE 30*f*

Xanthoparmelia centralis Elix and Johnston in Elix, Johnston, and Armstrong, 1986:207. [Type collection: 13 km N of Angas Downs Homestead, Liddle Hills, N.T., Australia, *Elix* 11172 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–7 cm broad, darkish yellow green; lobes subirregular, 0.5–1.5 mm wide; upper surface continuous, emaculate, shiny, rugulose with age, moderately isidiate, the isidia globose to subcylindrical (Figure 13*g*), 0.8–1.8 mm in diameter, to 0.2 mm high, the tips epicorticate, in part erumpent, simple or sparsely branched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Barbatic, 4-*O*-demethylbarbatic, 3-α-hydroxybarbatic, and usnic acids.

FIGURE 30.—Species of *Xanthoparmelia*: *a, X. callifolioides* (*Adler* s.n., isotype in US); *b, X. calvinia* (*Hale* 75103, holotype in US); *c, X. camtschadalis* (*Savicz* 48); *d, X. capensis* (*Hale* 74046, holotype in US); *e, X. catarinae* (*Poeschmann-Hájková* 761, holotype in US); *f, X. centralis* (*Elix* 11172). Scale in mm.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 7.

DISTRIBUTION.—Australia (NT).

COMMENTS.—This rare Australian endemic is one of two species in the genus with barbatic acid and erumpent isidia. The other, *X. areolata* from South Africa, has much thicker isidia (to 0.3 mm in diameter) and lobes 0.5–1 mm wide. It is morphologically similar to salazinic acid-containing *X. praegnans*.

Xanthoparmelia ceresensis

FIGURE 31*a*

Xanthoparmelia ceresensis Hale, 1986b:568. [Type collection: Ceres Nature Reserve at Michells Pass, 1.5 km SW of Ceres on Hwy R46, elev. ca. 600 m, Cape Province, South Africa, Grid 3319 AD, *Hale* 72008, 24 Jan 1986 (US, holotype; PRE, isotype).]

Parmelia ceresensis (Hale) Brusse, 1988:539.

DESCRIPTION.—Thallus adnate to loosely adnate on rock and soil over rock, pulvinate, easily breaking apart, 5–7 cm broad, darkish yellow green; lobes sublinear, 0.5–0.7 mm wide, sparsely dichotomously branched, crowded and appressed-imbricate; upper surface continuous or faintly reticulate-maculate and rugose at the tips, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, very sparsely rhizinate, the rhizines black, coarse, simple, 0.3–0.5 mm long. Pycnidia well developed; conidia bifusiform, 0.5 × 5–7 µm. Apothecia not fully developed, 0.6–1 mm in diameter; spores not found.

CHEMISTRY.—Microphyllinic (major), 4-*O*-demethylmicrophyllinic (major), 4-*O*-methylolivetoric (trace), and usnic acids (det. C. Culberson and A. Johnson).

ILLUSTRATION.—Hale, 1986b, fig. 7.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This curious species, known only from one locality in Fynbos, forms brittle, somewhat pulvinate colonies. The appressed sublinear lobes and faint reticulate-maculation, as well as the unusual chemistry (only occurrence of microphyllinic acid in the genus), are unique.

Xanthoparmelia ceresina

FIGURE 31*b*

Xanthoparmelia ceresina (Vainio) Hale, 1988b:402.

Parmelia ceresina Vainio in van der Byl, 1931:13. [Nomen nudum.]

Parmelia ceresina Vainio in Lynge, 1937:87. [Type collection: Ceres, Cape Province, South Africa, *Leslie* 474 (TUR, lectotype).]

DESCRIPTION.—Thallus adnate on rock, 3–8 cm broad, darkish yellow green; lobes subirregular to sublinear, 0.8–2 mm wide, imbricate; upper surface continuous, shiny, transversely cracked and rugulose with age, soredia and isidia lacking; medulla white; lower surface plane, pale to dark brown, shiny, moderately rhizinate, the rhizines brown, stout, simple, 0.3–0.8 mm long. Pycnidia common; conidia cylindrical, 0.5 × 4–6 µm. Apothecia common, substipitate, 3–5 mm in diameter, the rim entire to crenate; spores 4–6 × 9–11 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, and usnic acids.

DISTRIBUTION.—South Africa (SW Cape Province).

COMMENTS.—Known from the Table Mountain and nearby Ceres region, *X. ceresina* is close to *X. phaeophana* but lacks maculae, has short, more evenly dispersed rhizines, and is so adnate that it cannot be removed easily from the rock substrate.

Xanthoparmelia chalybaeizans

FIGURE 31*c*

Xanthoparmelia chalybaeizans (Steiner and Zahlbruckner) Hale, 1974b:486.

Parmelia schenckiana var. *chalybaeizans* Steiner and Zahlbruckner in Zahlbruckner, 1926:510. [Type collection: Matjesfontein, Cape Distr., South Africa, *Brunnthaler* s.n. (W, lectotype; WU, isolectotype).]

Parmelia chalybaeizans (Steiner and Zahlbruckner) Gyelnik, 1936:128.

Parmelia conspersula f. *chalybaeizans* (Steiner and Zahlbruckner) Gyelnik, 1938b:24.

Parmelia bylii Gyelnik, 1938a:270. [Nomen in herbario as synonym of *P. schreuderiana* Gyelnik.]

Parmelia schreuderiana Gyelnik, 1938a:270. [Type collection: Lokenberg, Calvinia, South Africa, *v. d. Byl* 1197 (W, lectotype; BP, isolectotype).]

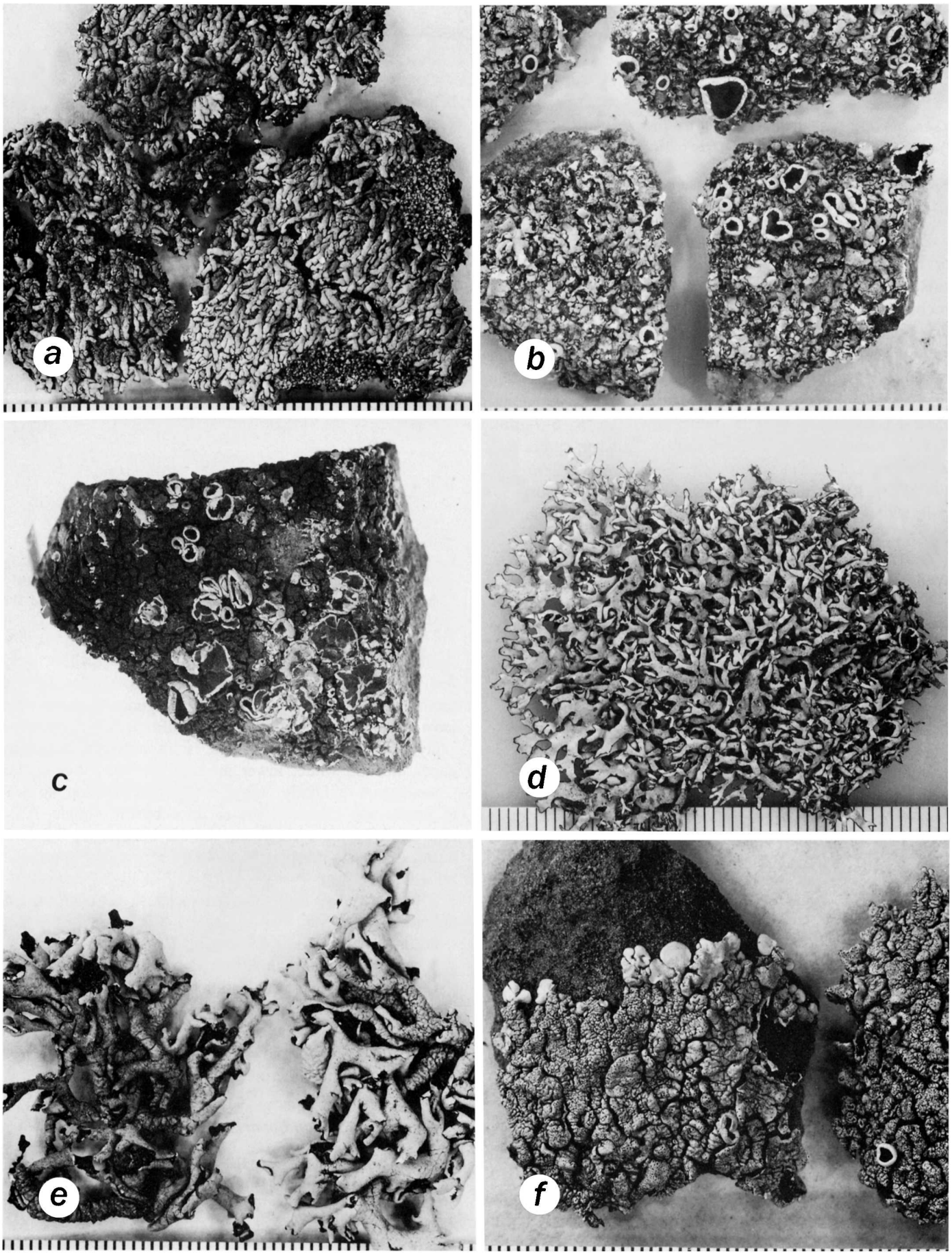
DESCRIPTION.—Thallus tightly adnate to adnate on rock, firm, 4–8 cm broad, rather light yellowish green, rarely darkening with age (as in the type specimen); lobes subirregular to sublinear, 1–3 mm wide, rather short, irregularly branched, rarely short laciniate, contiguous to imbricate; upper surface continuous, emaculate, shiny, becoming cracked and rugose with age, isidia and soredia lacking; medulla white or turning uniformly pale yellow in some herbarium specimens; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.5 mm long. Pycnidia well developed; conidia bifusiform, 0.5 × 6–7 µm. Apothecia very common, substipitate, 2–8 mm in diameter; spores 6–7 × 10–12 µm.

CHEMISTRY.—Salazinic, consalazinic, norstictic (±trace), and usnic acids, chalybaeizans unknown.

DISTRIBUTION.—South Africa (Cape Province, Ciskei).

COMMENTS.—This is one of the commonest adnate *Xanthoparmeliae* in Namaqualand and karoo regions of South Africa. It has a wide range of variation in color and lobe width. *Xanthoparmelia concolor* differs in being loosely adnate, and *X. springbokensis* is consistently darker, white-maculate, more loosely adnate, and contains skyrin.

FIGURE 31.—Species of *Xanthoparmelia*: *a*, *X. ceresensis* (*Hale* 72008, holotype in US); *b*, *X. ceresina* (*Hale* 78150); *c*, *X. chalybaeizans* (Brunnthaleri s.n., lectotype in W); *d*, *X. cheelii* (*Boorman* L1314); *e*, *X.chlorochroa* (*Imshaug* 11394); *f*, *X. cirrhomedullosa* (*Hale* 80605, holotype in US). Scale in mm.


a
b
c
d
e
f

Xanthoparmelia cheelii

FIGURE 31*d*

Xanthoparmelia cheelii (Gyelnik) Hale, 1974b:486.

Parmelia cheelii Gyelnik, 1938a:271. [Type collection: Goulburn, Rocky Hill, N.S.W., Australia, *Cheel* s.n. (BP, lectotype).]

Parmelia conspersa var. *nigromarginata* Stirton, 1900:78. [Type collection: [Tambo River], Gippsland, Australia, *Lucas* s.n. (BP, lectotype).]

DESCRIPTION.—Thallus loosely adnate on rock, brittle, more or less pulvinate, 5–10 cm broad, yellowish green; lobes sublinear, 0.9–2 mm wide, black rimmed, imbricate and becoming densely short laciniate at the center, the laciniae 0.5–1 mm wide; upper surface continuous to very weakly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, simple to sparsely furcate, 0.3–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia rare, substipitate, 2–7 mm in diameter; spores 6–7 × 10–11 µm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 8.

DISTRIBUTION.—Australia (NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—This widespread Australasian species is related to and intergrades with *X. tasmanica* but can usually be identified by the brittle, densely short-laciniate thallus. A collection in M (*Green* s.n., Australia) was called *Parmelia pulvinata* by Krempelhuber but never published.

Xanthoparmelia chlorochroa

FIGURE 31*e*

Xanthoparmelia chlorochroa (Tuckerman) Hale, 1974b:486.

Parmelia chlorochroa Tuckerman, 1860:383. [Type collection: Fort Clark, Upper Missouri River, USA, *Hayden* s.n. (FH-Tuck, lectotype; DUKE, US, isolectotypes).]

DESCRIPTION.—Thallus vagrant, free growing on soil, firm and leathery, intact or fragmenting into separate lobes, 3–10 cm broad, yellowish green; lobes sublinear, 1.5–5 mm wide, dichotomously branched, separate to overlapping; upper surface continuous, emaculate, shiny, rugulose and cracked with age, isidia and soredia lacking; medulla white; lower surface rather strongly convoluted but not always completely inrolled, pale to dark brown, often with a lighter raised rim toward the tips, moderately to densely rhizinate, the rhizines pale brown, simple to furcate, 0.3–1 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 6–7 µm. Apothecia very rare, substipitate, 2–4 mm in diameter; spores 5–6 × 11–13 µm.

CHEMISTRY.—Salazinic, consalazinic (±), lobaric (±), and usnic acids.

ILLUSTRATIONS.—Egan, 1975, fig. 1; Williams, 1892, fig. 1 (as *Parmelia molliuscula*).

DISTRIBUTION.—Canada, western USA, Mexico.

COMMENTS.—After describing this distinctive American lichen (first as *Parmelia conspersa terrestris*) in his herbarium, Tuckerman (1882) reduced it to a synonym of *Parmelia molliuscula*, thus helping to perpetuate the confusion surrounding the correct names in this group of vagrant lichens (see discussion above under *X. camtschadalis*). Williams (1892) first reported the discovery of apothecia in this species, and also called it *P. molliuscula*. Willey (1896) found another fertile plant and continued to use this name. However, *X. chlorochroa* seems to be endemic to the high plains and semi-desert areas of western North America and Mexico. It is closely related to the Australian *X. convoluta*, which has more strongly inrolled lobes. It also intergrades with *X. wyomingica*, which is not vagrant. Stictic acid-containing *X. vagans* is morphologically similar, occurring with *X. chlorochroa* in the central Rocky Mountains but extending also into South America.

Xanthoparmelia cirrhomedullosa

FIGURE 31*f*

Xanthoparmelia cirrhomedullosa Hale, 1989a:545. [Type collection: Large S-facing Cave sandstone ledges, Greyling Pass on W side of Hwy R396, 9 km N of Rossouw, elev. 2100 m, Cape Province, South Africa, Grid 3127 AB, *Hale* 80605, 6 Apr 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate on sheltered rock, leathery, 5–7 cm broad, darkish yellow green; lobes subirregular with rotund tips, 1–4 mm wide, short, contiguous at the margin, crowded at the center; upper surface uniformly white-maculate, shiny, strongly rugose with age, isidia and soredia lacking; upper medulla white, lower medulla orange; lower surface plane, brown or faintly orange, smooth to rugulose, sparsely to moderately rhizinate, the rhizines brown, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia substipitate, 2–4 mm in diameter; spores 4–5 × 9–10 µm.

CHEMISTRY.—Salazinic and usnic acids, skyrin, chalybaeizans unknown.

ILLUSTRATION.—Hale, 1989a, fig. 7.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The combination of a white-maculate surface and the medullary pigment skyrin is found only in this species and in *X. subcolorata*, a large, sublinear-lobed, loosely adnate lichen with an eroding lower surface. It is known only from the type locality in eastern Cape Province.

Xanthoparmelia clivorum

Xanthoparmelia clivorum (Brusse) Hale, 1988b:402.

Parmelia clivorum Brusse, 1984:315. [Type collection: Witelskloof, 3 km W of Olyvenboskraal, Cape Province, South Africa, Grid 3218 BD, *Brusse* 3069, 2 May 1981 (PRE, holotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm, 3–6 cm broad, light yellowish green; lobes subirregular, 1–2 mm wide, short and crowded, black-rimmed, imbricate; upper surface continuous, emaculate, shiny, transversely cracked and rugulose with age, moderately isidiate, the isidia globose to subcylindrical and basally constricted (Figure 13*h*), 0.11–0.18 mm in diameter, to 0.3 mm high, the tips syncorticate, pale, mostly unbranched; medulla white; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, coarse, 0.2–0.7 mm long, unbranched. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Lecanoric and usnic acids.

ILLUSTRATION.—Brusse, 1984, fig. 2.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Known only from the type collection on a large sheltered ledge exposed to wintertime coastal mists, *X. clivorum* may be the isidiate morph of *X. namaquensis*, a common lichen farther north in arid Namaqualand.

Xanthoparmelia colensoica

FIGURE 32*a*

Xanthoparmelia colensoica Nash, Elix, and Johnston in Elix and Johnston, 1988b:355. [Type collection: Bainskloof Pass, Cape Province, South Africa, Grid 3319 CA, *Nash* 23505, 20 Jan 1986 (ASU, holotype; PRE, ANUC, isotypes).]

DESCRIPTION.—Thallus tightly adnate on rock, 1–3 cm broad, yellow green but darkening with age; lobes sublinear, 0.4–1 mm wide, dichotomously branched, separate to contiguous, black-rimmed near the apices; upper surface continuous, emaculate, shiny, transversely cracked and areolate at the center. soredia and isidia lacking; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple or tufted, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Colensoic (major), norcolensoic (minor), stenosporonic (trace), lividic (trace), physodic (trace), oxyphysodic (trace), and usnic acids (det. J.A. Elix).

ILLUSTRATION.—Elix and Johnston, 1988a, fig. 3.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This rare lichen is closely related to *X. stenosporonica*, a rather common species in the Drakensbergs of Transvaal and Natal, which contains stenosporonic acid as the major component. *Xanthoparmelia shebaiensis* has colensoic acid as a minor component but can be distinguished easily by the reticulate white-maculate surface.

Xanthoparmelia coloradoensis

FIGURE 32*b*

Xanthoparmelia coloradoensis (Gyelnik) Hale, 1988b:402.

Parmelia ioannis-simae var. *coloradoensis* Gyelnik, 1931b:287. [Type collection: Cariberu, Colorado, USA, *Plitt* P-2 [*Clokey* 14, 18 Feb 1916] (US, lectotype; BP, isolectotype).]

Parmelia somloensis var. *rotundata* Gyelnik, 1931b:282. [Type collection: Haleakala, Hawaii, *Faurie* 507 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia imitans var. *coloradoensis* (Gyelnik) Gyelnik, 1934c:155. [Invalid combination without citation of basionym.]

Parmelia phaeophana f. *coloradoensis* (Gyelnik) Gyelnik, 1938b:35.

DESCRIPTION.—Thallus adnate to more usually loosely adnate and fairly easily collected free of rock, extremely variable, rather firm, 5–10 cm broad, yellowish green; lobes subirregular to sublinear, 1.5–3 mm wide, irregularly branched and relatively short to elongate, contiguous to imbricate and crowded, sometimes in part laciniate; upper surface continuous or rarely in part faintly white-maculate, shiny to dull, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately to densely rhizinate, the rhizines pale brown, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–6 µm. Apothecia commonly developed, substipitate, 3–15 mm in diameter; spores 4–5 × 7–9 µm.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

DISTRIBUTION.—Western USA, Mexico, Hawaii.

COMMENTS.—The *X. taractica* group in western North America presents a complex, intergrading array of lobe types and adnation. *Xanthoparmelia lineola*, tightly adnate and narrow-lobed, lies at one extreme while *X. wyomingica*, which is in part free-growing with convoluted lobes, is at the other. The vast intermediate saxicolous population with adnate to loosely adnate lobes is represented by *X. coloradoensis*, too large to be lumped with *X. lineola* but saxicolous and sufficiently adnate to separate it from *X. wyomingica*. Typical *X. taractica*, as presently conceived, is a soil lichen from Argentina, extending as far north as Mexico and also occurring in Australasia.

Xanthoparmelia colorata

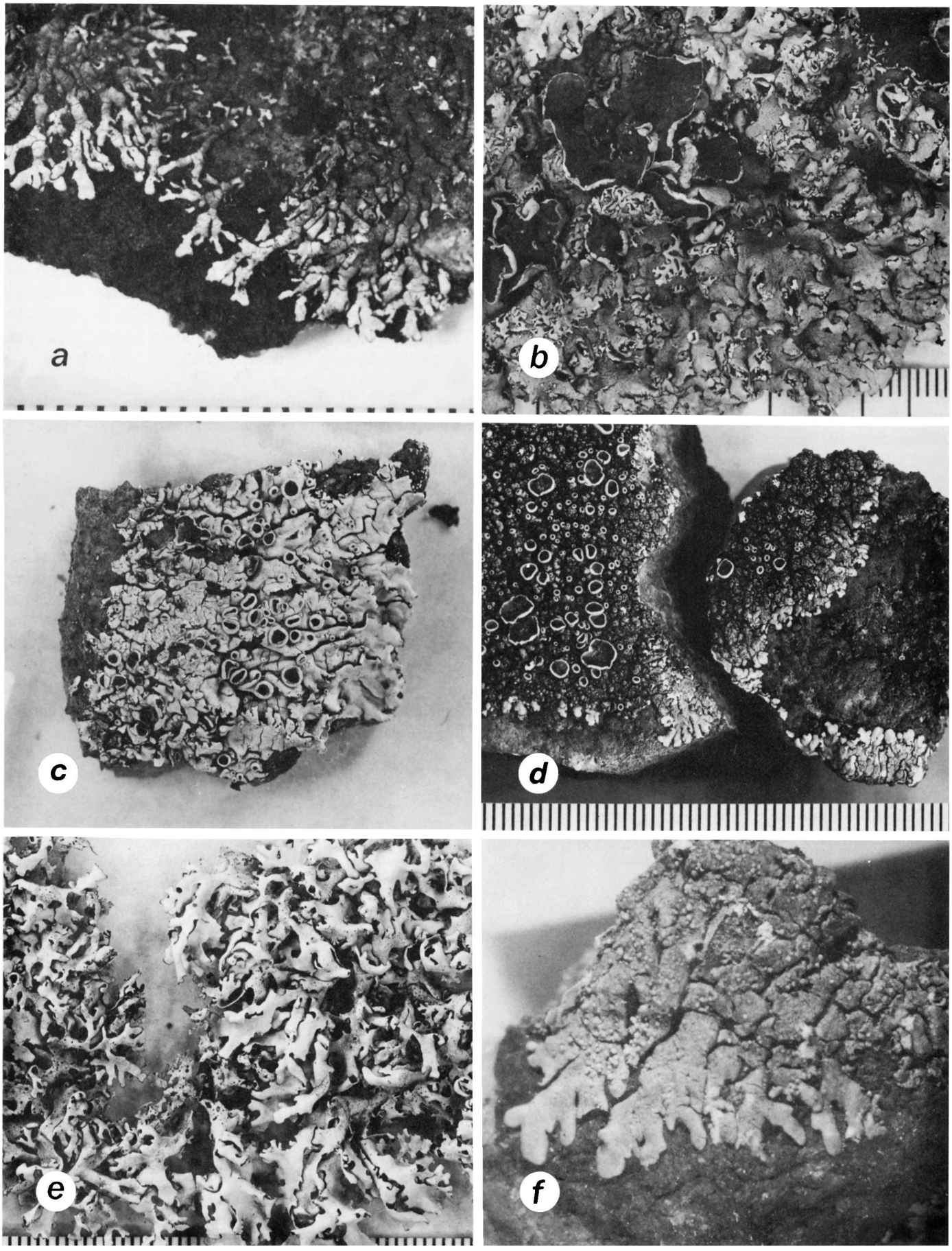
FIGURE 32*c*

Xanthoparmelia colorata (Gyelnik) Hale, 1974b:486.

Parmelia colorata Gyelnik, 1938a:272. [Type collection: Bitterfontein, Namaqualand, South Africa, *v.d. Byl* 1192 (W, lectotype; BP, isolectotype).]

DESCRIPTION.—Thallus adnate on rock, often appearing loosely adnate but difficult to collect free of rock, firm and leathery, 4–12 cm broad and often coalescing to form extensive colonies, bright yellowish green; lobes subirregular, 2–6 mm wide, apically rotund, contiguous to imbricate, at times black rimmed; upper surface continuous, emaculate, dull, coarsely pruinose with age, especially at the tips, becoming transversely cracked, isidia and soredia lacking; upper medulla white, lower medulla usually dull rusty colored, at least in part; lower surface plane, black, dull, sparsely rhizinate, the rhizines black, coarse, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, substipitate, 3–15 mm in diameter; spores 6–7 × 10–12 µm.

CHEMISTRY.—Salazinic (major), norstictic (major), consalazinic, and usnic acids, schenckiana pigment (±).


a
b
c
d
e
f

DISTRIBUTION.—South Africa (Cape Province), SWA/Namibia.

COMMENTS.—This is the most conspicuous *Xanthoparmelia* in the South African karoo. In a sample of 53 specimens, only three completely lacked the medullary pigment; none contained caperatic acid, which occurs widely in other members of the *X. schenckiana* group. See *X. schenckiana* for further discussion.

Xanthoparmelia competita

FIGURE 32*d*

Xanthoparmelia competita Hale, 1986b:568. [Type collection: 3.6 km N of Hwy R62 on Kruisrivier Road, E of Calitzdorp, elev. ca 500 m, Cape Province, South Africa, Grid 3321 BB, *Hale* 73019, 30 Jan 1986 (US, holotype; PRE, isotype).]

Parmelia eximia Brusse, 1986:183. [Type collection: 65 km WNW of Willowmore, Cape Province, South Africa, Grid 3322 BB, *Brusse* 4840, 5 Feb 1986 (PRE, holotype; BM, COLO, LD, US, isotypes).]

DESCRIPTION.—Thallus tightly adnate on rock, 3–6 cm broad, dull yellowish green; lobes subirregular, 0.7–1.5 mm wide, short and contiguous; surface continuous to finely reticulately rugose or white-maculate at the tips, shiny, becoming strongly rugose-bullate toward the center, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia numerous, adnate, 2–4 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—4-*O*-Methylhypoprotocetraric (major), hypoprotocetraric acid (minor), 4-*O*-demethylnotatic, and usnic acids, an $R_{fc}30$ unknown (major) (det. J.A. Elix).

ILLUSTRATIONS.—Hale, 1986b, fig. 8; Brusse, 1986a, fig. 6 (as *Parmelia eximia*).

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Chemically this species is closely related to *X. calvinia*. While lobe configuration is similar, *X. competita* is brighter yellow and lacks isidia. It appears to be restricted to southern Cape Province.

Xanthoparmelia concolor

Xanthoparmelia concolor (Sprengel) Hale, 1974b:486.

Parmelia concolor Sprengel, 1827:328. [Type collection: Cape of Good Hope, South Africa, [*Ecklon* s.n.] (S, lectotype).]

Xanthoparmelia laxchalybaeizans Hale, 1987a:258. [Type collection: Nieuwoudtville Nature Reserve off hwy R27, elev. 800 m, Cape Province, South Africa, Grid 3119 AC, *Hale* 72216, 29 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, rarely on soil, rather stiff and firm, 6–10 cm broad, dull yellowish green; lobes subirregular to sublinear, 1–2.5 mm wide, imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately to densely rhizinate, the rhizines pale brown, simple, 0.5–1 mm long. Pycnidia well developed; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 4–8 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Salazinic, consalazinic, norstictic (±trace), and usnic acids, chalybaeizans unknown.

ILLUSTRATION.—Hale, 1987a, fig. 11 (as *X. laxchalybaeizans*).

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species has the same chemistry as *X. chalybaeizans*, a widespread tightly adnate to adnate lichen in Namaqualand and the karoo of South Africa. It is rather common in southern Cape Province. The epithet *concolor* was used by Nylander and other nineteenth-century workers for *X. leonora*, a species which contains fumarprotocetraric acid. Although the authenticity of Sprengel collections is always in doubt since his herbarium was sold and disposed of at various times, the Stockholm specimens appear to be labeled by Sprengel himself and represent the only lectotypifiable material I have seen.

Xanthoparmelia concomitans

Xanthoparmelia concomitans Elix and Johnston in Elix, Johnston, and Armstrong, 1986:210. [Type collection: 1/4 mi beyond lookout, Alexandra, Otago, New Zealand, *Martin* s.n. (CHR, holotype).]

DESCRIPTION.—Thallus free growing on soil, very fragile, forming small rosettes 0.5–1 cm broad, yellowish green; lobes linear, 0.5–1.5 mm wide, dichotomously branched, separate; upper surface continuous to weakly white-maculate, shiny, sorediate at the lobe tips, the soralia orbicular, ~1 mm in diameter; medulla white; lower surface canaliculate, pale brown, with a weakly developed pale yellowish rim, sparsely rhizinate, the rhizines thin, black, sparsely furcate, 0.5–1.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric (±), protocetraric (±trace), fatty acid (trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 9.

DISTRIBUTION.—Australia (Vic, WA), New Zealand.

COMMENTS.—Although related to nonsorediate *X. reptans*, it has a much smaller thallus and restricted distribution in semi-arid paddocks on the South Island and in two localities in South Australia.

Xanthoparmelia condaminensis

FIGURE 32*e*

Xanthoparmelia condaminensis Elix and Johnston, 1987:363. [Type collection: E of Condamine, Condamine Highway, Queensland, Australia, *Ballingall and Scott* s.n., 18 Aug 1984 (CBG, holotype).]

DESCRIPTION.—Thallus loosely attached to soil or pebbles

FIGURE 32.—Species of *Xanthoparmelia*: *a*, *X. colensoica* (*Nash* 23505, holotype in ASU); *b*, *X. coloradoensis* (*Plitt* 14, lectotype in US). *c*, *X. colorata* (*Byl* 1192, isolectotype in BP); *d*, *X. competita* (*Hale* 73019, holotype in US); *e*, *X. condaminensis* (*Ballingall and Scott* s.n., holotype in CBG); *f*, *X. congensis* (*Ledien* 32, lectotype in G) (×10). Scale in mm.

and debris, forming irregular subpulvinate patches or rosettes 8–10 cm broad, fairly firm but easily breaking apart, pale yellowish green; lobes sublinear, 1–2 mm wide, elongate, dichotomously branched, weakly convoluted, separate to subimbricate and entangled, marginally sparsely laciniate, the laciniae about 0.5 mm wide; upper surface continuous, emaculate, shiny to opaque, convex, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, pale tan to brown or darker at the tips, very sparsely rhizinate, the rhizines concolorous with the lower surface, simple or tufted, robust, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–6 µm. Apothecia rare, subpedicellate, 1–3 mm in diameter; spores 4–6 × 8–10 µm.

CHEMISTRY.—Constipatic, protoconstipatic, and usnic acids, scabrosin 4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±), and scabrosin 4,4′-dibutyrate (±).

ILLUSTRATION.—Elix and Johnston, 1987, fig. 4.

DISTRIBUTION.—Australia (Qld).

COMMENTS.—In morphology this terricolous lichen resembles *X. terrestris*, which contains norstictic and salazinic acids. It is also very close to the South African *X. epigaea*, which has more distinctly convoluted lobes and the subdecipiens fatty acid series. It is known only from the type collection.

Xanthoparmelia coneruptens

Xanthoparmelia coneruptens Hale, 1989a:545. [Type collection: On overhanging sandstone ledge, on Hwy R364, 32.4 km S of jct with R27, elev. 600 m, Cape Province, South Africa, Grid 3119 CD, *Hale* 79859, 24 Mar 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus tightly adnate on rock, light yellowish green, 3–5 cm broad; lobes subirregular, 0.4–1 mm wide, short and crowded, imbricate; upper surface continuous to faintly reticulate white-maculate, shiny to dull white, pruinose with age, transversely cracked, pustulate-isidiate, the pustules entire or erupting, breaking open and become coarsely sorediate; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, ~2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Lecanoric and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 8.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This is a chemotype of *X. eruptens* and in fact the commonest member of this pustulate-isidiate group. It is typically found on the underside of large overhanging sandstone cliffs in localities in western Cape Province, south of Namaqualand, subject to winter fogs.

Xanthoparmelia congensis

FIGURE 32*f*

Xanthoparmelia congensis (B. Stein) Hale, 1974b:486.

Parmelia congensis B. Stein, 1889:139. [Type collection: Vivi, Congo, Africa, *Ledien* [32] (G, lectotype).]

Parmelia portoalegrensis Lynge, 1914:147. [Type collection: Porto Alegre, Rio Grande do Sul, Brazil, *Malme* 571 (S, lectotype; UPS, isolectotype).]

Xanthoparmelia crateriformis Elix and Johnston in Elix, Johnston, and Armstrong, 1986:221. [Type collection: 8 km NE of Nerriga, N.S.W., Australia, *Elix* 11582 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 2–6 cm broad, darkish yellow green; lobes sublinear, 0.2–0.8 mm wide, separate to contiguous, little branched; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia globose, 0.08–0.20 in diameter, 0.2–0.3 mm high, the tips epicorticate, pale, erumpent and often bursting open but not becoming sorediate, unbranched; medulla white; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic (major), norstictic, cryptostictic, constictic, menegazziaic, and usnic acids.

ILLUSTRATIONS.—Lynge, 1914, tab. 5, fig. 13 (as *Parmelia portoalegrensis*); Elix, Johnston, and Armstrong, 1986, fig. 11 (as *X. crateriformis*).

DISTRIBUTION.—Mexico, Venezuela, Brazil, Zaire, Uganda, South Africa (Natal, Transvaal, Transkei), Australia (Qld, NSW), India, China (Hong Kong).

COMMENTS.—The identity of *Parmelia congensis* has only recently been established as a consequence of our better understanding of isidial morphology and a more careful reexamination of several types involved. It is a very widespread lichen characterized by the globose, erumpent isidia, black lower surface (as noted by Stein) and stictic acid. Other species which have been confused with it are *X. mougeotina*, *X. pseudocongensis*, and *X. substenophylloides*.

Xanthoparmelia congesta

FIGURE 33*a*

Xanthoparmelia congesta (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:212.

Parmelia congesta Kurokawa and Filson, 1975:36. [Type collection: Podinna Rock, 24.1 km N of Minnipa, S.A., Australia, *Filson* 11901c (MEL, holotype; TNS, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 7–14 cm broad, yellowish green or darkening; lobes sublinear, 1–2 mm wide, becoming imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia substipitate, 3–10 mm in diameter; spores 5–6 × 8–10 µm.

CHEMISTRY.—Norstictic, salazinic (±), connorstictic (trace), and usnic acids. The type description did not include salazinic acid, which may occur in equal concentration with norstictic acid.

ILLUSTRATIONS.—Filson and Rogers, 1979, pl. 11B; Kurokawa and Filson, 1975, fig. 1.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—The only related species with norstictic acid is *X. glareosa*, another Australian endemic with more elongate, moderately rhizinate lobes.

Xanthoparmelia conjuncta

FIGURE 33*b*

Xanthoparmelia conjuncta Hale, 1989a:545. [Type collection: On small dolerite boulders in meadow, 2.6 km NW of Sani Pass, elev. 2900 m, Lesotho, Grid 2929 DB, *Hale* 81327, 6 May 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, leathery, 4–6 cm broad, dark yellowish green; lobes subirregular, 0.7–1.5 mm wide, irregularly branched, contiguous to subimbricate; upper surface continuous, emaculate, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, brown, moderately rhizinate, the rhizines brown, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–6 µm. Apothecia adnate, 1–3 mm in diameter; spores poorly developed, 4–5 × 8–9 µm.

CHEMISTRY.—Diffractaic (major), 4-*O*-demethyldiffractaic, barbatic (trace), 4-*O*-demethylbarbatic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 9.

DISTRIBUTION.—Lesotho.

COMMENTS.—This high elevation species is externally similar to *X. lesothoensis* Hale, which contains both diffractaic and salazinic acids. It is known only from low dolerite boulders in alpine meadows.

Xanthoparmelia consociata

Xanthoparmelia consociata (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:214.

Parmelia consociata Elix, 1981:352. [Type collection: 1.5 km SW of Glendale Crossing, A.C.T., Australia, *Elix* 3142 (MEL, holotype; CBG, isotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, appearing areolate at the center, 3–8 cm broad, dark yellowish green; lobes sublinear, 0.3–1 mm wide, short, crowded, imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia cylindrical (Figure 13*i*), 0.07–0.09 mm in diameter, 0.1–0.2 mm high, the tips syncorticate, black tipped, sparsely branched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines brown, simple, 0.2–0.3 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia adnate, 1–1.5 mm in diameter; spores 4–5 × 6–9 µm.

CHEMISTRY.—Salazinic (major), norstictic, consaazinic (±), and usnic acids.

ILLUSTRATION.—Elix, 1981, fig. 3.

DISTRIBUTION.—Australia (NSW, ACT, NT).

COMMENTS.—This centrally areolate species is separated from *X. exillima* (norlobaridone present) by the chemistry. It has been rarely collected in Australia.

Xanthoparmelia conspersa

FIGURE 33*c*

Xanthoparmelia conspersa (Acharius) Hale, 1974b:485.

Lichen conspersus Acharius, 1798:118. [Type collection: Sweden, s.c., H-Ach, lectotype (upper specimen); BM-Ach, isolectotype).]

Parmelia conspersa (Acharius) Acharius, 1803:205.

Imbricaria conspersa (Acharius) Koerber, 1855:81.

Imbricaria conspersa ** *isidiata* Anzi, 1860:28. [Type collection: Bardon Hill, Leicestershire, England, *Leighton, Lichenes Brittanici Exsiccati* 78 (UPS, lectotype).]

Parmelia conspersa c. *corallina* Krempelhuber, 1861:135. [Type collection: Mittenwalder Thale, Germany, *Krempelhuber* 31 (M, lectotype).]

Parmelia conspersa ssp. *digitulata* Nylander, 1878:247. [Type collection: Vosges, France, *Mougeot* s.n. (H, Nyl. herb. no. 34770, lectotype).]

Parmelia conspersa var. *isidiata* (Anzi) Stizenberger, 1882:307.

Imbricaria conspersa a) *munda* Hazslinszky, 1884:68. [Type collection: Hungaria, *Hazslinszky* s.n. (BP, lectotype).]

Imbricaria conspersa b) *coralloidea* Hazslinszky, 1884:68. [Type collection: Hungaria, *Hazslinszky* s.n. (BP, lectotype).]

Parmelia loxodes var. *digitulata* (Nylander) Olivier, 1894:58.

Parmelia conspersa var. *digitulata* f. *intermedia* Mereschkowsky, 1920a:487. [Type collection: Lugano, Italy, *Mereschkowsky* s.n. (G, lectotype).]

Parmelia conspersa f. *dispersa* Mereschkowsky, 1920a:486. [Type collection: Lugano-Savosa, Italy, *Mereschkowsky* [2] (G, lectotype).]

Parmelia conspersa var. *isidiata* f. *heteroclyta* Mereschkowsky, 1920a:487. [Type collection: Lugano-Massagno, Switzerland, *Mereschkowsky* in 1917 (G, lectotype; BM, isolectotype).]

Parmelia conspersa f. *munda* (Hazslinszky) Zahlbruckner, 1929:131.

Parmelia conspersa var. *laciniatula* Erichsen, 1930:11. [Type collection: Boklund, [Kreis Rendsburg-Eckernforde], Schleswig-Holstein, Germany, *Erichsen* s.n., 7 Aug 1916 (HBG, lectotype).]

Parmelia isidiata (Anzi) Gyelnik, 1930b:31.

Parmelia isidiata f. *lacinulata* Gyelnik, 1930b:31. [Type collection: Bonnamaiton, France, s.c. (H, Nyl. herb. no. 34769, lectotype).]

Parmelia conspersa var. *tatrensis* Suza, 1930:26. [Type collection: Lake Batizovské Tatry, Czechoslovakia, *Suza* s.n., Aug 1924 (PRM, lectotype).]

Parmelia isidiata var. *adventiva* Gyelnik, 1931a:154. [Type collection: Trachytsziklán a Dodogókö, Esztergom, Dömös, Hungary, *Timkó* 4369 (BP, lectotype).]

Parmelia bakonyensis Gyelnik, 1931a:154. [Type collection: Mt. Szöllöhegy, near Csékut, Comit. Veszprém, Hungary, *Gyelnik* s.n. (BP, lectotype).]

Parmelia atlantica Gyelnik, 1931b:280. [Type collection: Haute Saône, Luxeuil, France, *Bouly de Lesdain* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed). Not *Parmelia atlantica* Ach., 1803:50 (= *Tornabenia*).]

Parmelia ramigera Gyelnik, 1931b:281. [Type collection: Hacienda d'Angasmurca, Libertad, Peru, *Standaert* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

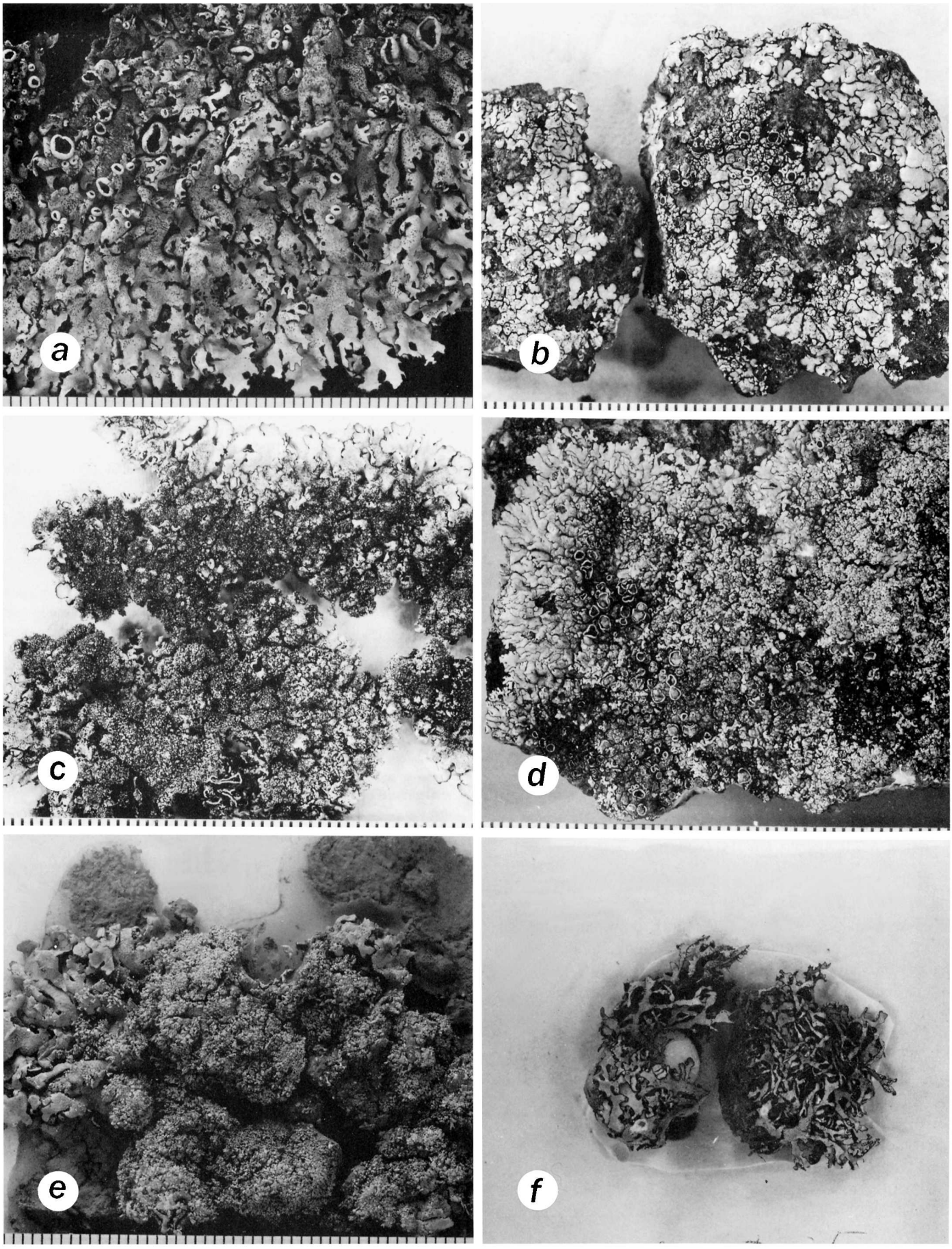
Parmelia conspersa var. *vadaskertensis* Gyelnik, 1931b:291. [Type collection: Vadaskert, Budapest, Hungary, *Gyelnik* s.n. (BP, lectotype).]

Parmelia pseudoramigera Gyelnik, 1931b:286. [Type collection: Herrin Run, Baltimore, Maryland, USA, *Plitt* P-1 (BP, lectotype).]

Parmelia lojkana Gyelnik, 1932a:216. [Type collection: Turjaremete, Comit. Ung, Hungary, *Szatala* s.n. (BP, lectotype; packet 34115; identical collection 22574 is an isolectotype).]

Parmelia bohemica Gyelnik, 1932a:218. [Type collection: Pribenice, Czechoslovakia, *Servit* s.n. (BP, lectotype).]

Parmelia isidiata f. *phonolitica* Gyelnik, 1932a:210. [Type collection: Rösselberg, Czechoslovakia, *Klement* s.n. (BP, lectotype).]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Parmelia lojkana f. *phonoliticola* Gyelnik in Servit and Klement, 1933:29. [Type collection: Bröse Mittelgebirge, North Bohemia, *Klement* s.n. (BP, lectotype).]
Parmelia laxa var. *mediterranea* Gyelnik, 1934c:158. [Nomen nudum.]
Parmelia regis-matthiae Gyelnik and Fóriss in Gyelnik, 1934c:163. [Type collection: Lillafüred, Mt. Szentistván, Bükk Mountains, Hungary, *Fóriss* s.n. (BP, lectotype).]
Parmelia isidiigera f. *pseudoramigera* (Gyelnik) Gyelnik, 1935:27.
Parmelia lacinulata (Gyelnik) Gyelnik, 1935:36.
Parmelia conspersa f. *mediterranea* (Gyelnik) Gyelnik, 1936:123.
Parmelia angustiphylla f. *vadaskertensis* (Gyelnik) Gyelnik, 1936:124.
Parmelia isidiigera f. *corallina* (Krempelhuber) Gyelnik, 1936:126.
Parmelia austroafricana f. *digitulata* (Nylander) Gyelnik, 1938b:21.
Parmelia pseudoservitiana f. *ornata* Gyelnik, 1938a:287. [Type collection: Saugues, Haute Loire, France, *Novatien* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]
Parmelia conspersa f. *lignicola* Gyelnik and Fóriss in Gyelnik, 1938a:274. [Type collection: Losonsz, Neogradense, Hungary, *Fóriss* 105 (BP, lectotype).]
Parmelia isidiigera f. *coralloidea* (Hazslinszky) Gyelnik, 1938b:7.
Parmelia subconspersa f. *munda* (Hazslinszky) Gyelnik, 1938b:7.
Parmelia conspersa f. *isidiata* (Anzi) Berry, 1941:76.
Parmelia conspersa f. *glomulifera* Erichsen, 1941:23. [Type collection: Kreis Soltau, Nieder-Haverbek, Prov. Hannover, Germany, *Erichsen* s.n., 15 Aug 1904 (HBG, lectotype).]
Parmelia isidiata f. *heteroclyta* (Mereschkowsky) Szatala, 1929b:88.
Parmelia conspersa f. *arboricola* Koskinen, 1955:80. [Type collection: Ruissalo, Turku, Finland, *A. Koskinen* s.n., 26 Sep 1944 (H, lectotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rarely on bark or lignum, often rather brittle, 4–12 cm broad, dull yellowish green; lobes subirregular, 1–3 mm wide, contiguous to imbricate, black rimmed with age, sometimes densely laciniate with age at the center; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia initially in part globose but cylindrical at maturity (Figure 14*a*), 0.06–0.2 mm in diameter, to 1 mm high, black tipped, simple or becoming densely coralloid branched; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate, the rhizines black, rather coarse, simple to furcate, 0.5–1 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 6–7 µm. Apothecia rather rare, substipitate, the rim isidiate, 2–8 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Stictic, constictic, cryptostictic, norstictic, connorstictic, menegazziac (trace), hyposalazinic (±trace), and usnic acids (Culberson, Culberson, and Johnson, 1981).

ILLUSTRATIONS.—Anders, 1928, tab. 22, fig. 1; Jahns, 1980, fig. 415; Krog, Osthagen, and Tonsberg, 1980:203; Ozenda and Clauzade, 1970, fig. 510.

DISTRIBUTION.—Canada, USA, Mexico, Costa Rica, Venezuela, Peru, Brazil, Chile, United Kingdom, Finland, Sweden, Norway, Belgium, France, Germany, Austria, Switzerland, Hungary, Czechoslovakia, Italy, Poland, Greece, Yugoslavia, Turkey, USSR, Japan.

FIGURE 33.—Species of *Xanthoparmelia*: *a*, *X. congesta* (*Elix* 2804); *b*, *X. conjuncta* (*Hale* 81327, holotype in US); *c*, *X. conspersa* (*Santesson* 14186). *d*, *X. conspersula* (*Almborn* 5499); *e*, *X. constipata* (*Seppelt* s.n., holotype in MEL); *f*, *X. constrictans* (*Eaton* s.n., lectotype in BM). Scale in mm.

COMMENTS.—This is by far the best known and most widespread *Xanthoparmelia* species in Europe. As can be judged from the large number of described forms and varieties, it has a very wide range of variation in isidial branching and adnation. None of these taxa, as far as most lichenologists are concerned (e.g., Kušan, 1932), deserves taxonomic rank. Although most common in Europe and eastern North America (Hale, 1964), it is pantemperate except for its absence from Australasia and southern Africa. Closely related *X. verrucigera* in southern Europe and Africa lacks norstictic acid but has an unknown compound (lusitana unknown) occurring between stictic and norstictic acids on TLC plates.

No exact lectotypification of *Lichen conspersus* has been made previously. The Acharian collection consists of two specimens, the upper one densely isidiate, the lower one very sparsely isidiate. In 1964 (Hale, 1964:467), I indicated that Gyelnik (1930b:31) had lectotypified *L. conspersus* by default with the lower "nonisidiate" specimen. He called the upper densely isidiate one *Parmelia isidiata* (Anzi) Gyelnik, and the "nonisidiate" one *P. conspersa*. In any event Gyelnik incorrectly considered *P. conspersa* to be a nonisidiate species throughout his career. I have selected the upper specimen as the lectotype.

As Hillmann (1936) had found, the syntype of *Imbricaria conspersa* ***isidiata* (*Rabenhorst, Lichenes Europaei Exsiccati* 65, seen in UPS) is mostly *X. somloensis*.

Several species are externally more or less identical with *X. conspersa* and may be considered as chemotypes: in Australia, where *X. conspersa* itself does not occur, this includes *X. isidiigera* (salazinic acid), *X. neotinctina* (norstictic acid), and *X. vicaria* (barbatic acid); in North America *X. piedmontensis* (fumarprotocetraric acid); and in Europe and South Africa *X. verrucigera* (stictic acid and the lusitana unknown).

Xanthoparmelia conspersula

FIGURE 33*d*

Xanthoparmelia conspersula (Nylander) Hale, 1974b:486.
Parmelia conspersula Nylander in Crombie, 1876a:19 and 1876b:168. [Type collection: Table Mountain, Cape of Good Hope, South Africa, *Eaton* s.n. (BM, lectotype; H, Nyl. herb. no. 34673, isolectotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, the center appearing areolate, 3–8 cm broad; dull yellow green or darkening with age; lobes sublinear, 0.3–0.6 mm wide, short, contiguous to subimbricate; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, dark brown to black, moderately rhizinate, the rhizines brown to black, simple, 0.2–0.3 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia numerous, adnate, 1–2 mm in diameter; spores 5 × 9–10 µm.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This rarely collected lichen in the Table Mountain area is the very tightly adnate morphotype in the series of species that includes *X. parvoincerta* and *X. incerta*, both adnate species in Australia and South Africa with broader lobes.

Xanthoparmelia constipata

FIGURE 33*e*

Xanthoparmelia constipata (Kurokawa and Filson), Elix and Johnston in Elix, Johnston, and Armstrong, 1986:215.

Parmelia constipata Kurokawa and Filson, 1975:37. [Type collection: Koonamore Vegetation Reserve, S.A., Australia, Seppelt s.n. (MEL, holotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on soil, rather fragile, 3–8 cm broad, yellowish green; lobes subirregular, 1.2–2.5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia cylindrical to irregularly inflated, 0.08–0.2 mm in diameter and up to 0.3 mm high, the tips epicorticate, erumpent and becoming pustulate, sparsely branched; medulla white; lower surface plane, pale to darker brown, moderately rhizinate, the rhizines pale brown, simple, 0.5–1 mm long. Pycnidia lacking. Apothecia immature, substipitate about 1 mm in diameter; spores not found.

CHEMISTRY.—Norlobaridone, loxodin (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±), scabrosin 4,4′-dibutyrate (±), scabrosin 4,4′-diacetate (±trace), constipatic, protoconstipatic, and usnic acids, unidentified fatty acids.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 1: fig. 2.

DISTRIBUTION.—Australia (Qld, SA, NT, WA).

COMMENTS.—This is a very close relative of *X. scabrosa*, which normally lacks scabrosin and fatty acid derivatives and is not found on soil. It is, however, much more rarely collected, occurring in arid inland sites.

Xanthoparmelia constrictans

FIGURE 33*f*

Xanthoparmelia constrictans (Nylander) Hale, 1974b:486.

Parmelia constrictans Nylander in Crombie, 1876a:19 and 1876b:168. [Type collection: Table Mountain, Cape Province, South Africa, *Eaton* s.n. (BM, lectotype; H, Nyl. herb. no. 34813, isolectotype).]

Parmelia conspersa var. *constrictans* (Nylander) Müller Argoviensis, 1883:48.

Imbricaria constrictans (Nylander) Jatta, 1902:470.

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rarely on soil, firm, somewhat pulvinate, 5–10 cm broad, dull yellow green; lobes sublinear, 0.5–1.5 mm wide, elongate and irregularly constricted, black rimmed with brownish tips, divaricately branched, subascending; upper surface continuous to distinctly white-maculate in patches, shiny, isidia and soredia lacking; medulla white; lower surface plane, dark brown at the tips but soon black in the center, shiny, sparsely to moderately rhizinate, the rhizines thin and rather long, conspicuous, black, simple to sparsely furcate, 0.5–1.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–8 μm. Apothecia substipitate, 2–8 mm in diameter; spores 6–7 × 10–11 μm.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 10.

DISTRIBUTION.—South Africa (Cape Province), Australia (NSW).

COMMENTS.—This poorly understood species has only rarely been collected in southwestern Cape Province since its discovery over 100 years ago. It is much larger than *X. eradicata*, which was described at the same time from Table Mountain. Another South African lichen occurring in the same range, *X. rubromedulla*, has a stiff thallus, stronger maculae, and skyrin in the lower medulla.

Xanthoparmelia contrasta

FIGURE 34*a*

Xanthoparmelia contrasta Hale, 1987a:253. [Type collection: On west side of Hwy R43, 17.4 km N of N2, N of Floorshoogte, elev. 350 m, Cape Province, South Africa, Grid 3419 AB, *Hale* 78367, 26 Oct 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 5–8 cm broad, light yellowish green; lobes subirregular to sublinear, 1–2 mm wide, dichotomously branched, imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla in part ochre; lower surface plane, shiny, black, sparsely to moderately rhizinate, the rhizines dark brown to black, simple, 0.3–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1987a, fig. 4.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.— The only related species with hypoprotocetraric acid, *X. tablensis*, has longer, separate to loosely imbricate lobes 1–2.5 mm wide and lacks skyrin. *Xanthoparmelia contrasta* is known only from the Fynbos of southwestern Cape Province.

Xanthoparmelia convexula

Xanthoparmelia convexula (Müller Argoviensis) Hale, 1988b:402.

Parmelia convexula Müller Argoviensis, 1892:459. [Type collection: Socotra, *Balfour* s.n. (G, lectotype).]

Xanthoparmelia karamojae Krog and Swinscow, 1987:425. [Type collection: 8 km S of Angoremoru, Pian County, Karamoja Distr., Uganda, *Swinscow* 2U33/1 (BM, holotype; O, US, isotypes).]

DESCRIPTION.—Thallus tightly adnate on rock, rather dispersed, 2–8 cm broad, dull yellowish green; lobes rather short and subirregular, 0.5–1 mm wide, contiguous to imbricate, rugose with age, dying away at the center to give a centrifugate growth pattern; upper surface continuous, shiny at the tips but otherwise dull, soredia and isidia lacking;

medulla white; lower surface plane, light brown, moderately rhizinate, the rhizines brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 μm. Apothecia numerous, adnate, 0.5–1.5 mm in diameter; spores 4–5 × 9–10 μm.

CHEMISTRY.—Stictic, constictic, and usnic acids.

ILLUSTRATION.—Krog and Swinscow, 1987, fig. 4 (as *X. karamojae*).

DISTRIBUTION.—Uganda, Socotra.

COMMENTS.—As Gyelnik (1935:31) noted, the type of *P. convexula* is extremely poor. While the lobes of *X. karamojae* are slightly but not markedly wider, it occurs at nearly the same elevation in Uganda as does *X. convexula* in Socotra and agrees in general morphology and chemistry.

Xanthoparmelia convoluta

FIGURE 34*b*

Xanthoparmelia convoluta (Krempelhuber) Hale, 1974b:487.

Parmelia convoluta Krempelhuber, 1881:337. [Type collection: Central Australia, *Giles* s.n. (M, lectotype; G, W, isolectotypes).]

Parmelia subaustraliensis Gyelnik, 1931a:156. [Based on *P. convoluta* Krempelhuber.]

Parmelia vagans f. *convoluta* (Krempelhuber) Gyelnik, 1936:127.

Parmelia desertorum f. *convoluta* (Krempelhuber) Gyelnik, 1938b:7.

DESCRIPTION.—Thallus vagrant, free growing on soil, leathery, breaking apart into separate tubular lobes lacking dorsiventrality, twisted, 4–10 cm broad, dull yellowish green; lobes sublinear, 3–8 mm wide (10 mm unrolled), separate and little branched; upper surface continuous, emaculate, dull, reticulately cracked and rugulose with age, isidia and soredia lacking; medulla white; lower surface strongly convoluted and inrolled, pale to darker brown, sparsely rhizinate, the rhizines brown, delicate, the tips often whitening, unbranched, 0.2–0.5 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 6–7 μm. Apothecia rare, substipitate, 2–4 mm in diameter; spores 6 × 10–11 μm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

ILLUSTRATION.—Filson and Rogers, 1979, fig. 22B.

DISTRIBUTION.—Australia (SA, Vic).

COMMENTS.— This conspicuous soil lichen is confined to Australia. Its closest relative is the Australian *X. australiensis*, as noted by Krempelhuber (1881:337), and the American *X. chlorochroa*, which is a smaller plant with less strongly inrolled lobes. Gyelnik (1931a:156) coined the name *P. subaustraliensis* in the mistaken belief that *P. convoluta* Krempelhuber was antedated by *P. conspersa* f. *convoluta* Rabenhorst (1871), a nomen nudum identified with *X. somloensis*.

Xanthoparmelia cordillerana

FIGURE 34*c*

Xanthoparmelia cordillerana (Gyelnik) Hale, 1974b:487.

Parmelia cordillerana Gyelnik, 1938a:276. [Type collection: Hacienda d'Angasmurca, Depto. Libertad, Peru, *Standaert* s.n. (BP, lectotype; TUR, isolectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia etheridgensis Elix, 1981:355. [Type collection: Seamans Hut, Etheridge Range, Kosciusko National Park, N.S.W., Australia, *Elix* 5771 (MEL, holotype; CBG, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, 5–12 cm broad, dull yellowish green, darkening with age; lobes subirregular to sublinear, 2–5 mm wide, contiguous to imbricate, black rimmed, transversely or irregularly cracked with age; upper surface continuous, emaculate, shiny, densely isidiate, the isidia coarse (Figure 14*b*), basally constricted and irregularly subglobose to subcylindrical, 0.08–0.15 mm in diameter, to 0.6 mm high, the tips epicorticate, erumpent and becoming pustulate-sorediate, at times forming diffuse subsorediate masses over the surface, unbranched; medulla white; lower surface plane, shiny, pale brown to brown, moderately rhizinate, the rhizines pale brown or darkening, simple, 0.3–0.5 mm long. Pycnidia lacking. Apothecia rare, substipitate, 1–5 mm in diameter; spores 5–6 × 8–9 μm.

CHEMISTRY.—Salazinic, consalazinic, norstictic (trace), gyrophoric (±trace), protocetraric (±trace), and usnic acids.

ILLUSTRATION.—Elix, 1981, fig. 5 (as *P. etheridgensis*).

DISTRIBUTION.—Australia (NSW, ACT, Tas), New Zealand, Peru.

COMMENTS.—Vainio had identified the same duplicate from Bouly de Lesdain as *P. pustulata* Vainio but never published the name. Gyelnik (1938a:276) considered the species to be sorediate. In fact the isidia are fairly distinct in early stages but soon become subsorediate and obscurely defined. The species is found in exposed alpine and subalpine habitats not only in South America but also in Australia.

Xanthoparmelia coreana

FIGURE 34*d*

Xanthoparmelia coreana (Gyelnik) Hale, 1988b:402.

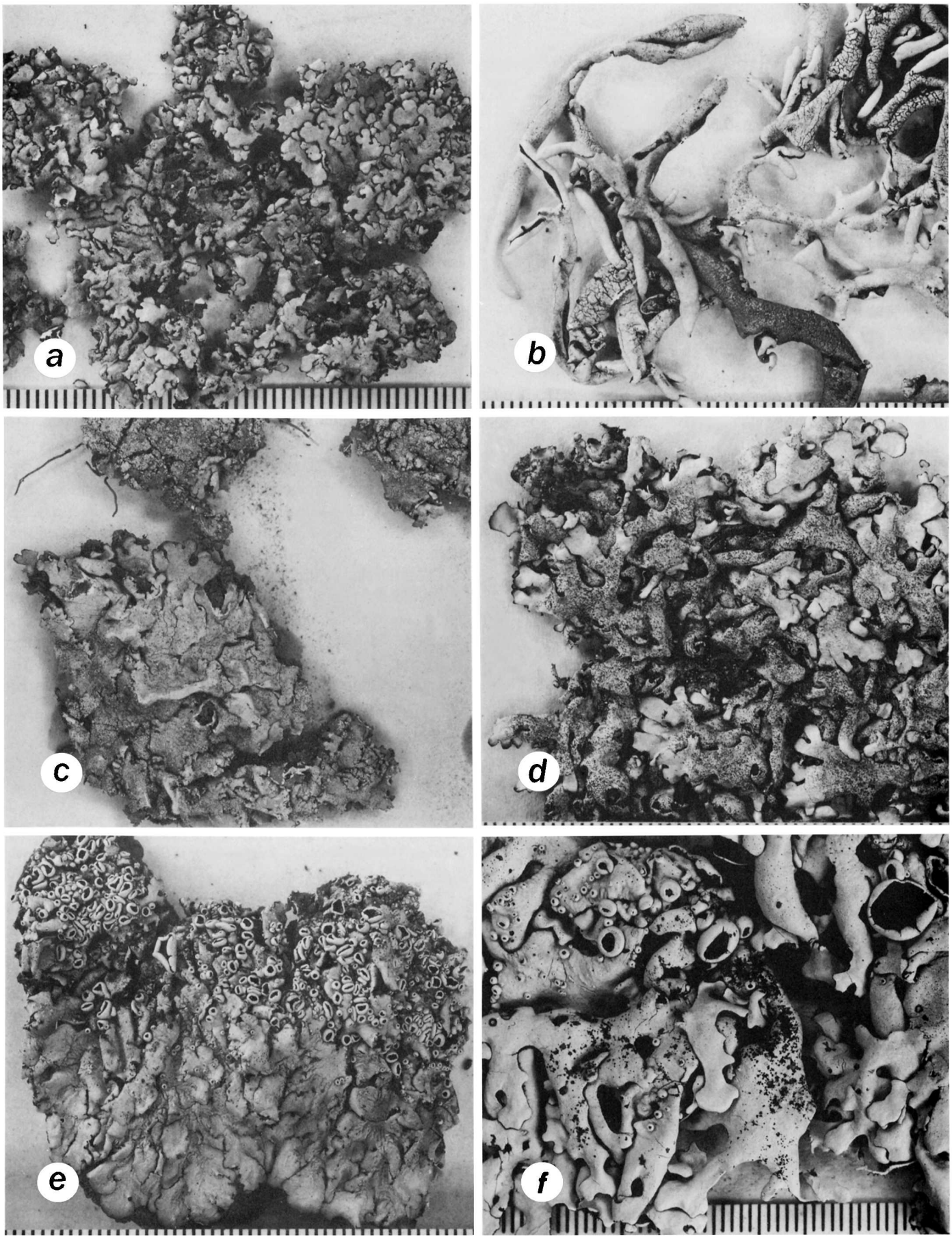
Parmelia coreana Gyelnik, 1931b:280. [Type collection: Palto Island, Korea, *Faurie* 4526 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

DESCRIPTION.—Thallus loosely adnate on rock, firm, 6–10 cm broad, yellowish green; lobes sublinear, 2–4 mm wide, separate to imbricate; upper surface continuous to weakly white-maculate, moderately isidiate, the isidia at first basally constricted, cylindrical to irregularly inflated at maturity (Figure 14*c*), 0.10–0.20 mm in diameter, to 0.5 mm high, the tips epicorticate, brownish, weakly erumpent, simple to sparsely branched; medulla white; lower surface plane, brown to dark brown, sparsely to moderately rhizinate, the rhizines brown, simple, 0.3–0.6 mm long. Pycnidia rarely developed; conidia bifusiform, 0.5 × 6 μm. Apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

DISTRIBUTION.—Japan, Korea.

COMMENTS.—This species appears to be confined to Japan and Korea. The characteristic features are the subcylindrical isidia, faint maculae, and dark brown lower surface. *Xantho-*


a
b
c
d
e
f

parmelia mexicana, a related but more widespread species, has shorter, subirregular lobes and a pale brown lower surface.

Xanthoparmelia coriacea

FIGURE 34*e*

Xanthoparmelia coriacea Hale, 1987a:254. [Type collection: Naudesnek, elev. 2180 m, Cape Province, South Africa, Grid 3028 CB, *Hale* 76870, 9 Oct 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate on rock, firm and leathery, 6–10 cm broad, yellowish green; lobes subirregular, apically rotund, 2–4 mm wide, short, contiguous; upper surface continuous, emaculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla in part ochre; lower surface plane, black, moderately rhizinate, the rhizines rather coarse, simple, black, 0.3–0.5 mm long. Pycnidia common; conidia bifusiform, 5–6 µm. Apothecia abundant, substipitate, 2–8 mm in diameter; spores 5–6 × 8–10 µm.

CHEMISTRY.—Fatty "subdecipiens" unknowns 33 and 37 (major), constipatic (±trace), protoconstipatic (±trace), and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1987a, fig. 5.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.— A member of the *X. subdecipiens* series, *X. coriacea* is distinguished by the leathery thallus. It is a rare species, occurring on basalts in the high Drakensberg escarpment. It represents the first reported occurrence of skyrin in a species with fatty acids and a black lower surface. Of the other fatty acid-containing species with a black lower surface, *X. aliphatica* has much broader, more membranous lobes (3–6 mm wide), *X. laciniata* has narrower, laciniate lobes, and *X. subnigra* has narrow sublinear lobes (1–2.5 mm wide).

Xanthoparmelia cotopaxiensis

Xanthoparmelia cotopaxiensis Nash, Elix, and Johnston, 1987:288. [Type collection: Río Saquimula, Prov. Cotopaxi, Ecuador, *Nash* 23847 (ASU, holotype; ANUC, US, isotypes).]

DESCRIPTION.—Thallus tightly adnate on rocks and gravel, 3–7 cm broad, yellow green but darkening; lobes sublinear-elongate, 0.5–1.0 mm wide, separate to imbricate, developing minute digitate lobulae 0.1–0.2 mm wide at the lobe tips; upper surface dull, shiny at the tips, sorediate, soralia sublaminal to submarginal, orbicular, 0.3–0.8 mm in diameter, coalescing; medulla white; lower surface plane, brown to dark brown, blackening apically, moderately rhizinate, rhizines simple to sparsely branched, brown to black, 0.3–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, norstictic (trace), protocetraric (trace), and usnic acids.

ILLUSTRATION.—Nash, Elix, and Johnston, 1987, fig. 3.

DISTRIBUTION.—Ecuador.

COMMENTS.—This sorediate species is characterized by the narrow, lobulate lobes. It is closely related to another South American species, *X. ulcerosa*, which has broader lobes without laciniae but so far has been collected only in Ecuador.

Xanthoparmelia crassilobata

FIGURE 34*f*

Xanthoparmelia crassilobata Hale, 1986b:570. [Type collection: 21 km NW of Sutherland on Hwy R354, elev. 1500 m, Cape Province, South Africa, Grid 3220 BC, *Hale* 74053, 29 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock (difficult to remove intact) to nearly free growing on soil and loose pebbles, leathery and firm, 4–8 cm broad, bright yellowish green; lobes broadly sublinear, 3–7 mm wide, broadly convoluted, separate to imbricate; upper surface continuous, emaculate, shiny, rugose with age, isidia and soredia lacking; medulla white; lower surface plane, pale to darker brown, rugose, moderately rhizinate, the rhizines pale brown, simple to furcate, 1–2 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia substipitate, 5–14 mm in diameter, the rim rolled inward; spores 6–7 × 9–11 µm.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 9.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The thallus of this conspicuous lichen is large, leathery, and bright yellow. At first it is easily mistaken for an aberrant terricolous specimen of *X. colorata*, a very common saxicolous lichen in the karoo. The lower surface is clearly brown, however, not at all blackened, and the only medullary substance is salazinic acid (without norstictic acid). It is much larger, broader lobed, and more coriaceous than *X. taractica*, a soil-inhabiting or saxicolous lichen in Australasia and South and Central America.

Xanthoparmelia cravenii

Xanthoparmelia cravenii Elix and Johnston in Elix, Johnston, and Armstrong, 1986:223. [Type collection: Rodgers Pass, 48 km W of Stuart Highway along road to Kings Canyon, N.T., Australia, *Elix* 11118 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 3–8 cm broad, light yellowish green; lobes sublinear, 0.8–1 mm wide, contiguous and separate at the margin but becoming crowded and bullate at the center; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown, sparsely rhizinate, the rhizines pale brown, simple, 0.3–0.6 mm long. Pycnidia poorly developed. Conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 1–4 mm in diameter; spores 5–6 × 8–10 µm.

FIGURE 34.—Species of *Xanthoparmelia*: *a*, *X. contrasta* (*Hale* 78367, holotype in US); *b*, *X. convoluta* (*Hale* 58398); *c*, *X. cordilleriana* (Standaert s.n., lectotype in BP); *d*, *X. coreana* (*Kurokawa* 1279); *e*, *X. coriacea* (*Hale* 76870, holotype in US); *f*, *X. crassilobata* (*Hale* 74053, holotype in US). Scale in mm.

CHEMISTRY.—Scabrosin 4,4′-dibutyrate, scabrosin 4-acetate-4′-butyrate, scabrosin 4-acetate-4′-hexanoate and scabrosin 4,4′-diacetate, constipatic (±), protoconstipatic (±), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 12.

DISTRIBUTION.—Australia (NSW, SA, NT, WA).

COMMENTS.—This is one of the commonest species in arid central Australia. Chemically related *X. bungendorensis* is adnate to loosely adnate with lobes 0.9–3 mm wide and lacks accessory fatty acids.

Xanthoparmelia cumberlandia

Xanthoparmelia cumberlandia (Gyelnik) Hale, 1974b:487.

Parmelia subconspersa var. *cumberlandia* Gyelnik, 1934c:164. [Type collection: Cumberland, Maine, *Chamberlain* s.n. (BP, lectotype; isotype designated in Bouly de Lesdain herbarium destroyed).]

Parmelia cumberlandia (Gyelnik) Hale, 1967:416.

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 6–12 cm broad, yellowish green; lobes subirregular to sublinear, 1–2 mm wide, contiguous to imbricate and often becoming densely laciniate at the center; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown or darkening, moderately isidiate, the rhizines pale brown, simple, 0.3–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–7 µm. Apothecia numerous, substipitate, 2–10 mm in diameter; spores 4–5 × 9–10 µm.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

DISTRIBUTION.—North America, Mexico, Dominican Republic, Venezuela, Brazil, Uruguay, South Africa (Cape Province).

COMMENTS.—This is the nonisidiate morph of *X. plittii*. Both are very common in northeastern USA, where they were first described, and range southward into tropical America. Gyelnik (1934c:164) described the lower surface as "subtus niger" but the type is unmistakably brown.

Xanthoparmelia cylindriloba

FIGURE 35*a*

Xanthoparmelia cylindriloba Knox in Knox and Brusse, 1983:147. [Type collection: Teleki Valley, Mt. Kenya, Kenya Colony, Kenya, *Hedberg* s.n., *Flora Africana* 1705 (UPS, holotype; US, isotype).]

DESCRIPTION.—Thallus free growing on pebbles and soil, soft, pulvinate, 3–10 cm broad, dark yellowish green and blackening with age; lobes linear-elongate, almost completely terete, 0.5–1.5 mm wide, brown or mottled brown at the tips; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, mottled brown or black, rugulose, very sparsely rhizinate, the rhizines black, coarse, 0.2–0.7 mm long, concentrated in small patches. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, norstictic (trace), and usnic acids.

ILLUSTRATION.—Knox and Brusse, 1983, fig. 3.

DISTRIBUTION.—Kenya.

COMMENTS.— Unique terete lobes with very little dorsiventrality distinguish this high elevation species. The medulla is composed of very loosely packed hyphae. A related species, *X. kiboensis*, lacks terete lobes and contains norstictic acid as the major metabolite. Another species from Kenya, *X. salkiboensis*, also has salazinic acid but lacks terete lobes.

Xanthoparmelia darlingensis

Xanthoparmelia darlingensis Elix and Johnston, 1987:363. [Type collection: Serpentine Dam, Darling Ranges, W.A., Australia, *Elix* 10796, 28 Oct 1982 (CBG, holotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, 2–3 cm broad, yellowish green but blackening with age at the center; lobes sublinear, 0.3–0.8 mm wide, sparingly dichotomously branched, irregularly constricted, black-rimmed, separate to contiguous; upper surface continuous, emaculate, becoming transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, black, densely rhizinate, the rhizines black, simple, robust, 0.1–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic (major), barbatic (major), 4-*O*-demethylbarbatic (trace), constictic, norstictic, cryptostictic (trace), and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1987, fig. 5.

DISTRIBUTION.—Australia (WA).

COMMENTS.—Known only from the type collection, this tightly adnate lichen appears to be a hybrid between *X. xanthomelaena* (stictic acid) and *X. louisii* (barbatic acid). A South African species with the same chemistry, *X. umtamvuna*, is also tightly adnate but has globose isidia and a pale brown lower surface.

Xanthoparmelia dayiana

FIGURE 35*b*

Xanthoparmelia dayiana (Elix and Armstrong) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:225.

Parmelia dayiana Elix and Armstrong, 1983:468. [Type collection: Kalgoorlie, W.A., Australia, *Day* s.n. in vi.1982 (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, rather fragile, 2–4 cm broad, dark yellowish green; lobes subirregular to sublinear, 0.5–1.5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia short, globose (Figure 14*d*), 0.1–0.3 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, hollow and erumpent apically, sometimes subsorediate, unbranched; medulla white; lower surface plane, pale brown,

moderately rhizinate, the rhizines pale brown, simple, 0.1–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, protocetraric (trace), and usnic acids.

ILLUSTRATION.—Elix and Armstrong, 1983, fig. 2.

DISTRIBUTION.—Australia (NT, WA).

COMMENTS.—This rare Australian desert species is the only erumpent-isidiate one with fumarprotocetraric acid. It is morphologically close to *X. praegnans,* which contains salazinic acid.

Xanthoparmelia denudata

FIGURE 35*c*

Xanthoparmelia denudata Hale, 1986b:570. [Type collection: 1 km S of Nuwerus on Hwy R363, east of N7, elev. ca. 500 m, Cape Province, South Africa, Grid 3118 AB, *Hale* 72041, 26 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate on rocks, forming continuous mats 5–8 cm broad or discrete, nearly umbilicate colonies 2–4 cm broad, coalescing into mats up to 15 cm broad, fragile, dark yellowish green; lobes sublinear, 0.6–1.3 mm wide, separate, ascending at the tips; upper surface distinctly white-maculate, shiny, transversely cracked with age, isidia and soredia lacking; upper medulla white, lower medulla in part ochre; lower surface plane, rugose, brown but eroding toward the center to expose the ochraceous medulla, black at the lobe tips, sparsely rhizinate, the rhizines brown or blackening, coarse, simple, up to 1 mm long. Pycnidia poorly developed; conidia not found. Apothecia rarely developed, substipitate, 3–6 mm in diameter; spores 6–7 × 8–10 µm.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids, skyrin and chalybaeizans unknown (±).

ILLUSTRATION.—Hale, 1986b, fig. 10.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The pale ochraceous orange lower surface is easily recognizable in the field. The lower cortex erodes away with age to reveal the heavily pigmented lower medulla. The lobe configuration and nearly bare, rugose lower surface resembles *X. subcolorata,* which has a stronger tendency to form umbilicate thalli, broader lobes (1.5–4 mm wide) and produces protocetraric acid. *Xanthoparmelia hyporhytida,* also restricted to Namaqualand, has salazinic acid and a similar rugose lower surface eroding with age but lacks skyrin and maculae. Also common in Namaqualand, *X. springbokensis* differs in having shorter, subirregular lobes and closer adnation.

Xanthoparmelia desertorum

FIGURE 35*d*

Xanthoparmelia desertorum (Elenkin) Hale, 1988b:402.

Parmelia conspersa ssp. *molliuscula* var. *vagans* f. *desertorum* Elenkin, 1901:21. [Type collection: Cherulun River, Mongolia, Palibin s.n. in 1899, *Elenkin, Lichenes Florae Rossiae* (LE, lectotype (not seen); HBG, UPS, isolectotypes).]

Parmelia desertorum (Elenkin) Gyelnik, 1938b:6.

Parmelia desertorum f. *neodesertorum* Gyelnik, 1938b:6. [Illegitimate name for f. *typica* (= f. *desertorum*).]

Parmelia taractica var. *vagans* f. *desertorum* (Elenkin) Poelt and Vězda, 1981:223. [Illegitimate combination; basionym not cited.]

DESCRIPTION.—Thallus vagrant, free growing on soil, leathery, 2–5 cm broad, breaking apart into separate, contorted lobes, dull yellowish green; lobes sublinear, 2–8 mm wide (to 10 mm when unrolled), little branched; upper surface continuous to weakly white-maculate, dull, strongly rugose with age, isidia and soredia lacking; medulla white; lower surface strongly convoluted and inrolled, light brown, lacking a marginal rim when unrolled, moderately rhizinate, the rhizines papillose to short and fine, simple, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

ILLUSTRATION.—Elenkin, 1901b, pl. 3 (as *Parmelia conspersa* ssp. *molliuscula* var. *vagans* f. *desertorum*).

DISTRIBUTION.—USSR, Mongolia.

COMMENTS.—This unusual vagrant lichen is related to *X. camtschadalis,* which has smaller, convoluted rather than inrolled lobes (see further discussion above under *X. camtschadalis*). I have seen only a few specimens from the USSR.

Xanthoparmelia diacida

FIGURE 35*e*

Xanthoparmelia diacida Hale, 1986b:572. [Type collection: 33.8 km W of Dordrecht on Hwy R56, elev. 800 m, Cape Province, South Africa, Grid 3126 BC, *Hale* 73015, 8 Feb 1986 (US, holotype; PRE, isotype).]

Parmelia diacida (Hale) Brusse, 1988:539.

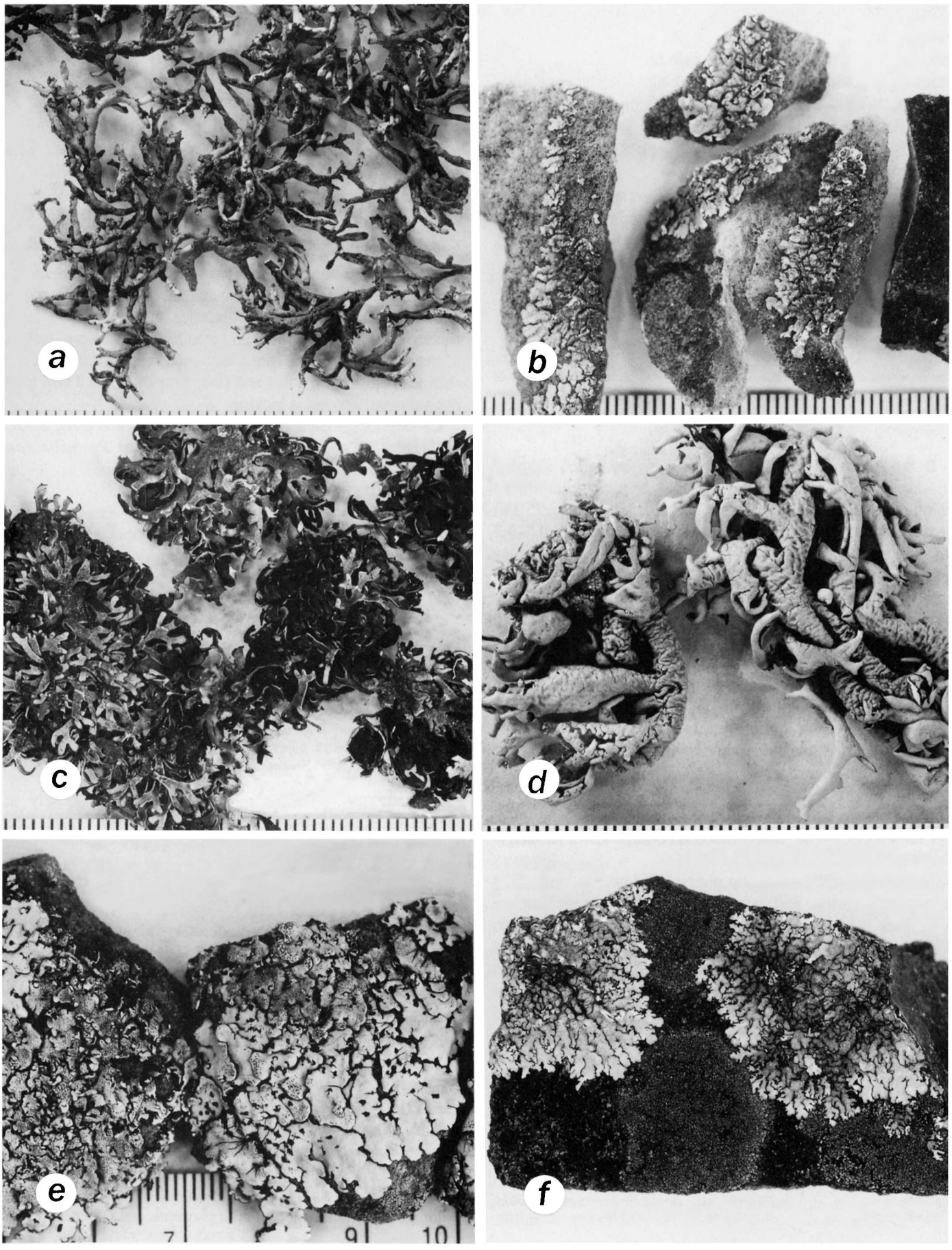
DESCRIPTION.—Thallus adnate to somewhat loosely attached on rock, 5–8 cm broad, bright yellow green; lobes subirregular, apically rotund, 3–7 mm wide, imbricate and short lobulate with age; upper surface continuous, emaculate, shiny or rarely white pruinose at the tips, isidia and soredia lacking; upper medulla white, lower medulla often dull reddish; lower surface plane, black, moderately rhizinate, the rhizines black, simple, 0.5–1 mm long. Pycnidia rare; conidia bifusiform, 0.5×4–5 µm. Apothecia adnate, 4–8 mm in diameter; spores 5–7 × 8–12 µm.

CHEMISTRY.—Psoromic, protocetraric, caperatic (±), and usnic acids, "schenckiana" pigment (±).

ILLUSTRATION.—Hale, 1986b, fig. 11.

DISTRIBUTION.—South Africa.

COMMENTS.—This rather rare member of the *X. schenckiana* group is confined to the Cave and Molteno sandstone formations in eastern Cape Province. Of the 10 specimens examined, 8 have the schenckiana pigment and half of these produce caperatic acid. Two specimens lacked the pigment. Another nonisidiate species with psoromic acid, *X. psoromica,*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also occurs in South Africa. *Xanthoparmelia schenckiana*, which contains protocetraric and caperatic acids and the same unidentified dull rusty colored pigment (forming a pale yellow streak near norstictic acid on TLC plates and reacting UV+ yellow fluorescent), is superficially similar but lacks psoromic acid and is usually heavily pruinose. See further discussions under *X. schenckiana*.

Xanthoparmelia diadeta

FIGURE 35*f*

Xanthoparmelia diadeta (Hale) Hale, 1974b:487.

Parmelia diadeta Hale, 1971a:346. [Type collection: 2 mi NE of Potsdam, Distr. East London, Cape Prov., South Africa, *Almborn* 10683 (LD, holotype; US, isotype).]

DESCRIPTION.—Thallus very tightly adnate to tightly adnate on rock, 2–5 cm broad, dull yellowish green, darkening at the center; lobes subirregular to sublinear, 0.7–1.3 mm wide, contiguous to imbricate; upper surface continuous, maculate, shiny, densely isidiate, the isidia cylindrical (Figure 14*e*), 0.06–0.10 mm in diameter, 0.2–0.3 mm high, the tips syncorticate, darkening, unbranched; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple, 0.1–0.3 mm long. Pycnidia lacking. Apothecia rarely developed, substipitate, 1–2 mm in diameter; spores 5 × 8–9 µm.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

ILLUSTRATION.—Hale, 1971a, fig. 1c.

DISTRIBUTION.—Kenya, Uganda, South Africa (Transvaal, Natal, Cape Province).

COMMENTS.—This is the tightly adnate member of the *X. australasica* series. It is very common on the eastern slopes of the Drakensbergs.

Xanthoparmelia dichotoma

FIGURE 36*a*

Xanthoparmelia dichotoma (Müller Argoviensis) Hale, 1974b:487.

Parmelia dichotoma Müller Argoviensis, 1886:257. [Type collection: Braidwood Distr., Australia, *Bauerlen* 204 (G, lectotype; BM, FH, FH-Tayl, M, isolectotypes).]

DESCRIPTION.—Thallus loosely adnate to subascending on rocks, pulvinate, firm, 4–10 cm broad, dull yellowish green; lobes sublinear, 1.5–3 mm wide, elongate, irregularly dichotomously branched, loosely imbricate and subascending, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane to weakly convoluted, dark brown to mostly black, rhizines sparse, brown to black, 0.5–1 mm long. Pycnidia rarely developed; conidia not found. Apothecia rare, substipitate, 2–5 mm in diameter; spores 6 × 8–9 µm.

CHEMISTRY.—Norlobaridone, loxodin, and usnic acid.

ILLUSTRATIONS.—Kurokawa, 1969, pl. 1: fig. 1; Galloway (1980), fig. 5B.

DISTRIBUTION.—New Zealand, Australia (NSW, ACT, Vic, Tas, WA).

COMMENTS.—This is one of the first lichens discovered in Australasia. It is very close to *X. furcata*, which has a brown lower surface. A chemotype, *X. rupestris*, contains the scabrosin derivatives.

Xanthoparmelia dichromatica

FIGURE 36*b*

Xanthoparmelia dichromatica (Hale) Hale, 1974b:487.

Parmelia dichromatica Hale, 1971a:348. [Type collection: Mt. Thabanchu, Orange Free State, South Africa, *Hoeg* s.n. (TRH, holotype; LD, isotype).]

DESCRIPTION.—Thallus adnate on rock, 4–8 cm broad, light yellowish green; lobes subirregular, 1.5–4 mm wide, apically rotund, contiguous to imbricate; upper surface continuous or at times very weakly white-maculate, shiny, weakly to strongly rugose with age, isidia and soredia lacking; medulla white with scattered deep purple inclusions; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, rather coarse, 0.5–1.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–7 µm. Apothecia commonly developed, substipitate, 2–5 mm in diameter; spores 6 × 9–10 µm.

CHEMISTRY.—Protocetraric and usnic acids, anthraquinone pigment (identical with one (#2) in *X. endomiltoides*).

ILLUSTRATION.—Hale, 1971a, fig. 1D.

DISTRIBUTION.—South Africa (OFS, Cape Province), Lesotho.

COMMENTS.—The wine-colored to deep purple inclusions in the medulla are only visible when the thallus is cut open. This widespread but not commonly collected lichen occurs both in very arid karoo with tightly adnate *X. applicata* and *X. worcesteri* and in moist high-elevation localities in Lesotho.

Xanthoparmelia dierythra

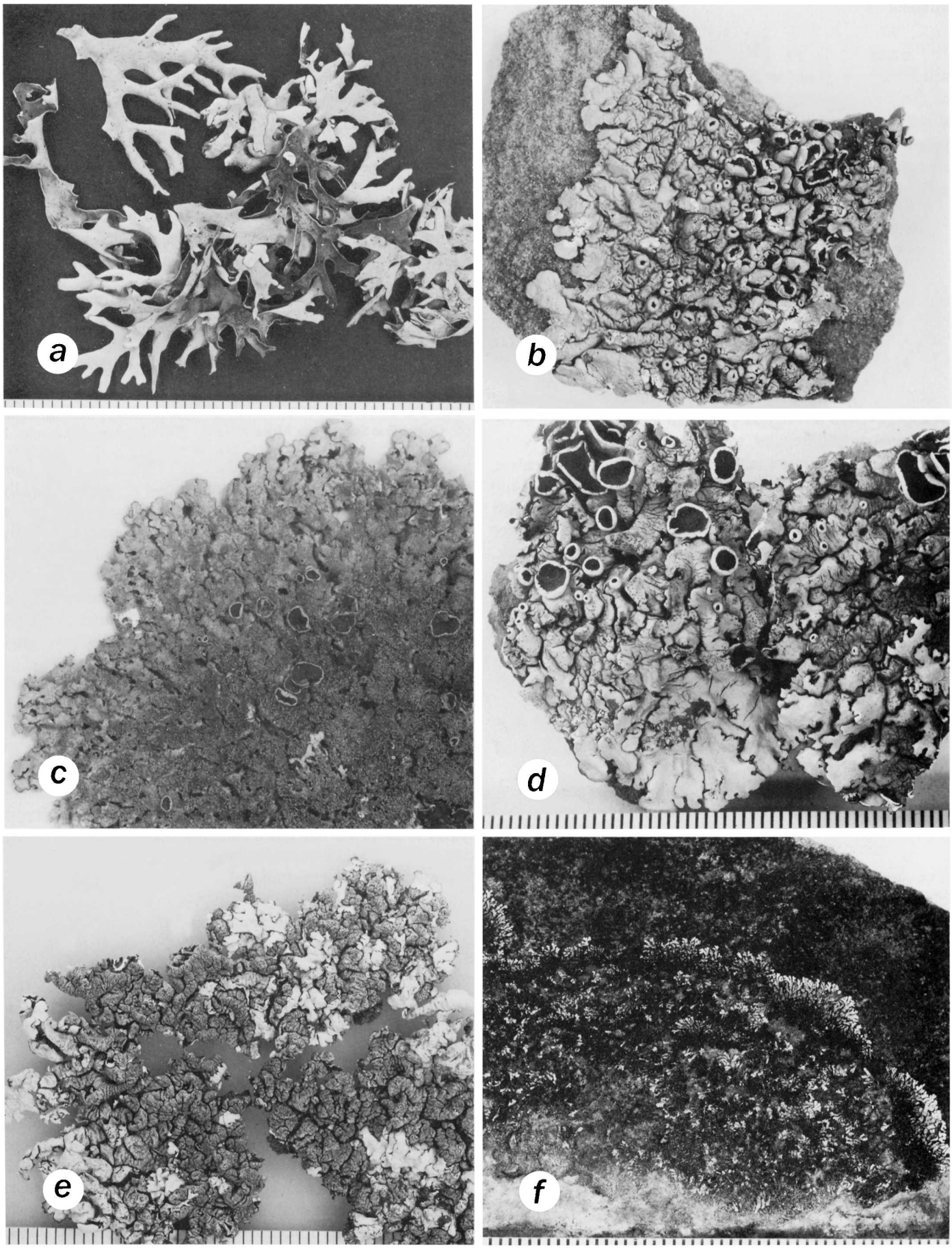
FIGURE 36*c*

Xanthoparmelia dierythra (Hale) Hale, 1974b:487.

Parmelia dierythra Hale, 1964:470. [Type collection: Mill Bluff Roadside Park, Juneau Co., Wisconsin, USA, *Hale* 23622 (US, holotype; DUKE, UPS, WIS, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather fragile, 4–8 cm broad, yellowish green; lobes subirregular, 1–2 mm wide, imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia cylindrical (Figure 14*f*), 0.07–0.12 mm in diameter, 0.1–0.3 mm high, the tips weakly epicorticate, darkening, simple to sparingly branched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple

FIGURE 35.—Species of *Xanthoparmelia*: *a*, *X. cylindriloba* (*Hedberg* 1705, isotype in US); *b*, *X. dayiana* (*Hale* 68829); *c*, *X. denudata* (*Hale* 72041, holotype in US); *d*, *X. desertorum* (in KW); *e*, *X. diacida* (*Hale* 73015, holotype in US); *d*, *f*, *X. diadeta* (*Almborn* s.n.). Scale in mm.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or sparsely branched, 0.1–0.5 mm long. Pycnidia lacking. Apothecia rare, substipitate, 1–3 mm in diameter; spores 4–5 × 9–10 µm.

CHEMISTRY.—Norstictic, connorstictic, and usnic acids (det. C. Culberson).

ILLUSTRATION.—Hale, 1964, fig. 2.

DISTRIBUTION.—North-central USA.

COMMENTS.—This rather rare species is differentiated from *X. plittii* by lack of stictic acid. *X. maricopensis* from the western USA contains hyposalazinic acid in addition to norstictic acid and is more adnate.

Xanthoparmelia diffractaica

FIGURE 36*d*

Xanthoparmelia diffractaica Hale, 1987a:254. [Type collection: Naudesnek, elev. 2180 m, Cape Province, South Africa, Grid 3028 CB, *Hale* 76885, 9 Oct 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, leathery, 6–8 cm broad, dark yellowish green; lobes subirregular, 2–3.5 mm wide, apically rotund, contiguous to subimbricate, black rimmed; upper surface continuous, emaculate, shiny, irregularly cracked with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown, moderately to densely rhizinate, the rhizines pale brown, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia abundantly developed, adnate to substipitate, 2–7 mm in diameter; spores 5–6 × 9–11 µm.

CHEMISTRY.—Salazinic (major), diffractaic (minor), barbatic (trace), 4-*O*-demethylbarbatic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 6.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.— Another high elevation species with this chemistry, *X. lesothoensis*, from the nearby high Drakensberg escarpment in Lesotho, is smaller and more closely adnate with narrow lobes 1–2 mm wide. It also has higher concentrations of diffractaic acid.

Xanthoparmelia digitiformis

Xanthoparmelia digitiformis (Elix and Armstrong) Filson, 1984:205.

Parmelia digitiformis Elix and Armstrong, 1983:470. [Type collection: Booroomba Rocks, 11 km SW of Tharwa, A.C.T., Australia, *Elix* 6173 (MEL, holotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 10–20 cm broad, dark yellowish green; lobes sublinear to subirregular, 1.5–3 mm wide, imbricate, becoming densely laciniate at the center, the secondary lobes digitately divided, 0.4–0.8 mm wide, subascending, black-rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, brown, rugulose toward the tips, sparsely to moderately rhizinate, the rhizines pale brown, simple to furcate, 0.3–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–6 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic (major), consalazinic, norstictic (±trace), protocetraric (±trace), and usnic acids.

ILLUSTRATION.—Elix and Armstrong, 1983, fig. 3.

DISTRIBUTION.—Australia (NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—This member of the *X. taractica* group resembles some forms of *X. elixii*, which contains predominantly norstictic acid. It is known only in Australasia.

Xanthoparmelia dissensa

FIGURE 36*e*

Xanthoparmelia dissensa (Nash) Hale, 1974b:487.

Parmelia dissensa Nash, 1973:214. [Type collection: 17 km S of Safford, Pinaleno Mountains, Graham Co., Arizona, USA, *Nash* 4168 (ASU, holotype; US, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather firm, 4–8 cm broad, yellowish green but darkening with age; lobes subirregular, 1–2 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, strongly rugose with age, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, simple, coarse, 0.5–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Hypoprotocetraric and usnic acids.

ILLUSTRATION.—Nash, 1973, fig. 1.

DISTRIBUTION.—Southwestern USA.

COMMENTS.—This rare lichen is one of only two species in North America with hypoprotocetraric acid, the other being *X. weberi*. The South African *X. domokosii* is a smaller more closely adnate species lacking any rugosity. *Xanthoparmelia tablensis*, also from South Africa, is loosely adnate and has sublinear lobes.

Xanthoparmelia dissitifolia

FIGURE 36*f*

Xanthoparmelia dissitifolia Kurokawa ex Elix and Johnston in Elix, Johnston, and Armstrong, 1986:228. [Type collection: 18 mi S of Collie, W.A., Australia, *Kurokawa* 6642 (TNS, holotype; MEL, isotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, 2–5 cm broad, the center appearing areolate, yellow green but darkening with age; lobes sublinear, 0.2–0.5 mm wide dichotomously divided, contiguous to subimbricate, black rimmed; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, black, moderately rhizinate, the

FIGURE 36.—Species of *Xanthoparmelia*: *a*, *X. dichotoma* (*Weber and McVean* 322); *b*, *X. dichromatica* (*Hög* s.n., holotype in LD); *c*, *X. dierythra* (Hale 23622, holotype in US); *d*, *X. diffractaica* (*Hale* 76885, holotype in US); *e*, *X. dissensa* (*Nash* 4171); *f*, *X. dissitifolia* (*Elix* 10662). Scale in mm.

rhizines, black, simple, about 0.2 mm long. Pycnidia lacking. Apothecia rare, substipitate, 1–2 mm in diameter; spores 5–6 × 8 µm.

CHEMISTRY.—Norstictic, connorstictic, salazinic (trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 13.

DISTRIBUTION.—Australia (ACT, Tas, WA).

COMMENTS.—This typically centrally areolate species is known from five widely dispersed localities in Australia. *Xanthoparmelia olifantensis* from South Africa is quite similar but contains norstictic and salazinic acids in nearly equal concentration and has very fine rhizines.

Xanthoparmelia domokosii

FIGURE 37*a*

Xanthoparmelia domokosii (Gyelnik) Hale, 1974b:487.

Parmelia domokosii Gyelnik, 1938a:277. [Type collection: Lainsburg, South Africa, *v.d. Byl* 1091 (W, lectotype; BP, isolectotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, sometimes appearing areolate in the center, 3–8 cm broad, light yellowish green; lobes subirregular to sublinear, 0.6–2 mm wide, contiguous to subimbricate; upper surface continuous, emaculate, shiny to dull, transversely cracked and rugose with age, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, simple, 0.1–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, adnate, 1–1.5 mm in diameter; spores 6 × 9 µm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, notatic (trace), hypostictic (±trace), hyposalazinic (±trace), and usnic acids.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Lobe width is quite variable in this very common South African lichen. It occurs in the Little Karoo and moister southern parts of the Great Karoo. It is externally similar (except for broader, more irregular lobes) to *X. worcesteri*, another equally common karoo lichen, which contains lecanoric acid. Some specimens have been misidentified as *Parmelia perspersa* Stizenberger, a subcrustose species in *Karoowia* (Hale, 1989a).

Xanthoparmelia donneri

Xanthoparmelia donneri Elix and Johnston in Elix, Johnston, and Armstrong, 1986:231. [Type collection: Section B, SE end of Marble Range, SW corner, Eyre Peninsula, S.A., Australia, *Donner* 2086 (AD, holotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, 0.5–2 cm broad, yellowish green but darkening at the center; lobes sublinear, 0.2–0.5 mm wide, dichotomously branched, separate to contiguous; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple, 0.1–0.2 mm long. Pycnidia poorly developed; conidia bifusiform, 0.5 × 5–6 µm. Apothecia adnate, 0.5–1 mm in diameter; spores 5–6 × 7–11 µm.

CHEMISTRY.—Barbatic, norstictic, connorstictic, hyposalazinic (±trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 14.

DISTRIBUTION.—Australia (SA, WA).

COMMENTS.—Morphologically, *X. donneri* is not unlike *X. dissitifolia* and other centrally areolate Australian species, but the combination of chemicals is unique for this group.

Xanthoparmelia dubitata

FIGURE 37*b*

Xanthoparmelia dubitata Elix and Johnston in Elix, Johnston, and Armstrong, 1986:233. [Type collection: 1 km N of Tallarook, Vict., Australia, *Elix* 4871 (CBG, holotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, appearing areolate at the center, 2–7 cm broad, dull yellowish green; lobes sublinear, 0.3–0.7 mm wide, crowded, short, contiguous to imbricate; upper surface continuous, emaculate, shiny, transversely cracked and areolate-bullate with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, sparsely rhizinate, the rhizines pale brown, delicate, simple, about 0.2 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5 µm. Apothecia 1–4 mm in diameter; spores 4–6 × 7–9 µm.

CHEMISTRY.—Norlobaridone, loxodin (±trace), and usnic acid.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 15.

DISTRIBUTION.—Australia (NSW, Vic, SA, NT).

COMMENTS.—This widespread but rarely collected Australian species is related morphologically to the *X. xanthomelaena* group. It may also be considered to be a tightly adnate relative of *X. filarszkyana*.

Xanthoparmelia duplicata

FIGURE 37*c*

Xanthoparmelia duplicata Hale, 1986b:572. [Type collection: 19.5 km NNW of Vanrhynsdorp on east side of Hwy N7, elev. 200 m, Cape Province, South Africa, Grid 3118 BC, *Hale* 73102, 26 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely attached on pebbles to nearly free growing on soil, 3–5 cm broad but coalescing into larger colonies, yellowish green; lobes sublinear, 1.5–4 mm wide, separate to imbricate, more or less subascending and

weakly convoluted; upper surface weakly to distinctly white-maculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla ochre in part; lower surface plane, brown with ochre spots, sparsely rhizinate, the rhizines brown, 1–2 mm long, coarse, simple to furcate with splayed tips. Pycnidia immature; conidia not found. Apothecia well developed, substipitate, 4–8 mm in diameter; spores 6–7 × 9–12 µm.

CHEMISTRY.—Protocetraric (major), 4-*O*-demethyldiffractaic (major), 4-*O*-demethylbarbatic (trace), squamatic (trace), and usnic acids, skyrin (det. J.A. Elix).

ILLUSTRATION.—Hale, 1986b, fig. 12.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This unique soil-inhabiting lichen is alone among the convoluted species in having this series of acids and the pigment skyrin. It occurs only in the knersvlakte region of Namaqualand, growing on quartzite pebbles.

Xanthoparmelia durietzii

FIGURE 37*d*

Xanthoparmelia durietzii Hale, 1987b:322. [Type collection: Kansu, China, *Potanin* s.n., 10 Apr 1885 (UPS, holotype; US, isotype).]

DESCRIPTION.—Thallus loosely adnate on soil or mossy humus, 6–8 cm broad but brittle and breaking apart when collected, dull yellowish green; lobes sublinear, 2–3 mm wide, relatively short and irregularly dichotomously branched, contiguous to imbricate, becoming apically laciniate with age toward the center, the laciniae 0.3–0.5 mm wide, digitately branching, appressed to suberect and terete at maturity; upper surface white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, light brown to brown, moderately to densely rhizinate, the rhizines brown, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 5–6 µm long. Apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

ILLUSTRATION.—Hale, 1987b.

DISTRIBUTION.—China.

COMMENTS.—This obvious member of the *X. somloensis* group is easily distinguished by the well developed terete laciniae. It is known only from China.

Xanthoparmelia dysprosa

FIGURE 37*e*

Xanthoparmelia dysprosa Brusse and Knox in Knox and Brusse, 1983:148. [Type collection: Platteklip, Vlottenberg, Cape Province, South Africa, Grid 3318 AD, *Garside* 5035a (BOL, holotype; US, isotype).]
Parmelia dysprosa (Brusse and Knox) Brusse, 1984:321.

DESCRIPTION.—Thallus loosely adnate on rock, rather fragile and congested, 4–8 cm broad, dull yellowish green; lobes sublinear to linear, 0.5–1.5 mm wide, dichotomously divided, the tips subascending, black rimmed, separate to subimbricate; upper surface strongly effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, smooth to rugulose, very sparsely rhizinate, the rhizines black, coarse, simple, 0.3–1 mm long. Pycnidia common; conidia not found. Apothecia substipitate, 1–4 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Evernic (major), lecanoric (trace), and usnic acids.

ILLUSTRATION.—Knox and Brusse, 1983, fig. 4.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This is another chemical variant in the *X. hypoleia* group. While evernic acid was reported in the type description, the vast bulk of the type collection contains lobe fragments with hypoprotocetraric acid and can be identified as *X. hypoprotocetrarica* or unidentifiable scraps. One fragment 5 mm long contains evernic acid (det. J. Johnston). I was able to make a second much larger pure collection with evernic acid near Clanwilliam in southern Namaqualand but was unable to recollect it at the type locality near Stellenbosch.

Xanthoparmelia effigurata

FIGURE 37*f*

Xanthoparmelia effigurata Hale, 1986b:573. [Type collection: Meiringspoort, 18 km N of De Rust on east side of Hwy R29, elev. 690 m, Cape Province, South Africa, Grid 3322 BC, *Hale* 73016, 1 Feb 1986 (US, holotype; PRE, isotype).]

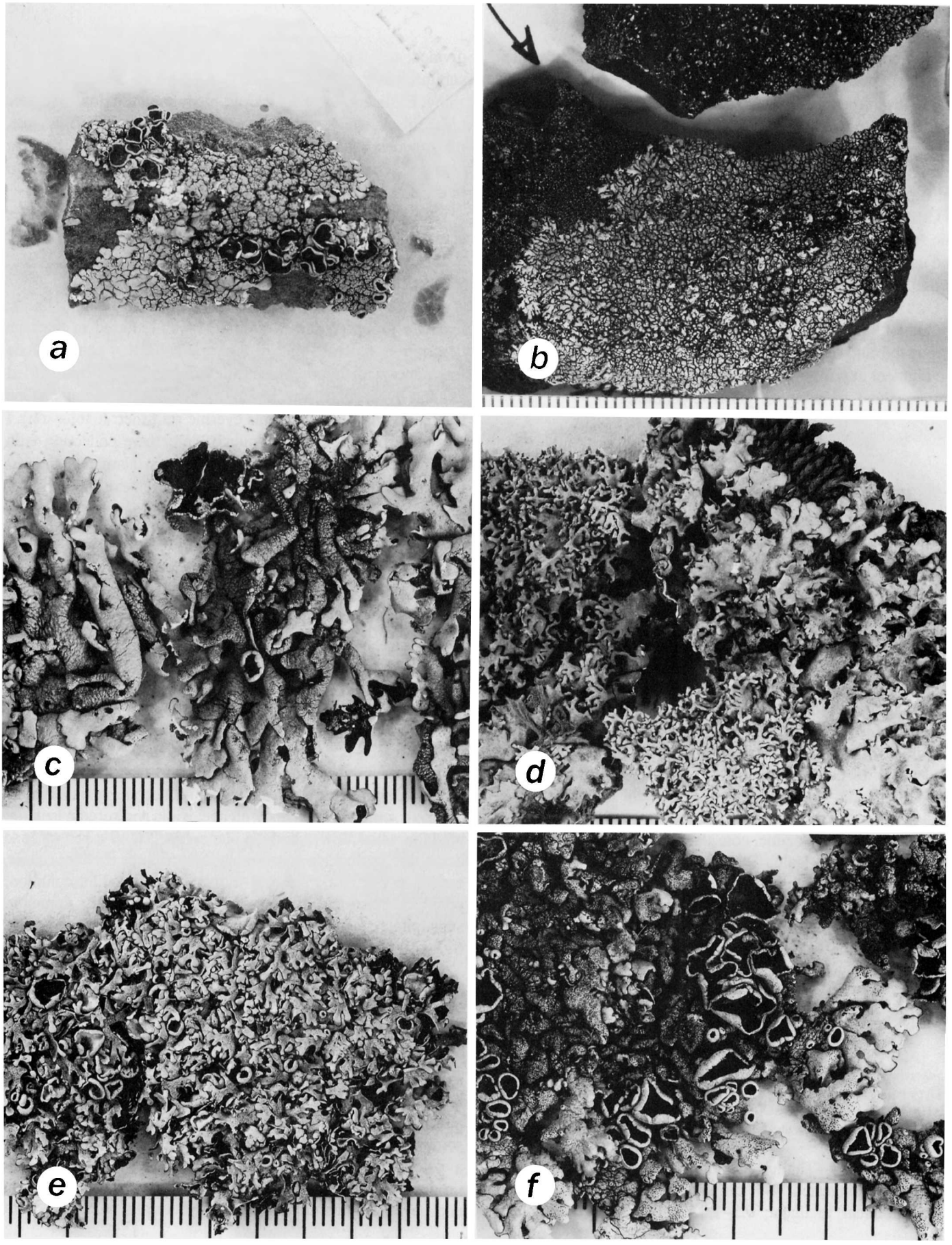
DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm and leathery, pale yellowish green, 6–12 cm broad; lobes sublinear, 1.5–2.5 mm wide, dichotomously branched; upper surface strongly effigurate-maculate, the maculae irregularly elongate, sometimes coalescing, shiny, becoming transversely cracked, somewhat convex with age, isidia and soredia lacking; medulla white; lower surface plane, black with a brown zone at the tips, sparsely to moderately rhizinate, the rhizines coarse, brown to black, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 µm. Apothecia common, substipitate, the rim upturned, 3–7 mm in diameter; spores 6–7 × 9–11 µm.

CHEMISTRY.—Salazinic, norstictic (±trace), and usnic acids, chalybaeizans unknown.

ILLUSTRATION.—Hale, 1986b, fig. 13.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This lichen is distantly related to the *X. hypoleia* group by reason of the effigurate maculae. It is, however, not as loosely adnate, is almost always collected attached to the rock substrate, and has more leathery, separate somewhat convex lobes. *Xanthoparmelia namakwa*, which has a pale brown lower surface, differs chemically in usually producing salazinic and norstictic acids in equal concentration and only rarely containing the chalybaeizans unknown. Both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species are common in Namaqualand and the southern end of the Great Karoo in Cape Province.

Xanthoparmelia eilifii

Xanthoparmelia eilifii Elix and Johnston in Elix, Johnston, and Armstrong, 1986:235.

Parmelia dahlii Kurokawa, 1982:36. [Type collection: Sturt Highway about 7 mi E of Mildura, NSW, Australia, *Dahl* s.n. (O, holotype; TNS, isotype). Not *Parmelia dahlii* (Hale) A. Singh, 1980:59 (= *Relicinopsis dahlii* (Hale) Elix and Verdon).]

DESCRIPTION.—Thallus loosely adnate to nearly free-growing on soil, firm, 3–7 cm broad, light yellowish green; lobes sublinear, 1–2.5 mm wide, weakly convoluted, secondary laciniae developing at the center with age and becoming convoluted; upper surface continuous, emaculate, shiny but becoming dull with age, isidia and soredia lacking; medulla white; lower surface plane, brown to dark brown, moderately rhizinate, the rhizines pale, fine, simple, 0.4–0.8 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norlobaridone, loxodin, and usnic acid.

ILLUSTRATION.—Kurokawa, 1982, fig. 2 (as *Parmelia dahlii*).

DISTRIBUTION.—Australia (Qld, NSW, SA, WA).

COMMENTS.—Near *X. terrestris* in external appearance, this rare terricolous lichens is distinguished by the presence of norlobaridone.

Both species occur on sandy lateritic soils, especially in mallee shrubland.

Xanthoparmelia elaeodes

FIGURE 38*a*

Xanthoparmelia elaeodes (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:236.

Parmelia elaeodes Elix, 1981:354. [Type collection: 13 km S of Countegany along Nimmitabel Road, NSW, Australia, *Elix* 1980 (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, fragile, 4–7 cm broad, dull yellowish green; lobes subirregular, 0.8–1.5 mm wide, short, sometimes tangentially cracked, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, moderately to densely rhizinate, the rhizines black, coarse, simple, 0.3–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 1–3.5 mm in diameter; spores 5 × 8 µm.

CHEMISTRY.—Norlobaridone, loxodin and usnic acid.

ILLUSTRATION.—Elix, 1981, fig. 4.

DISTRIBUTION.—Australia (ACT, NSW, SA).

COMMENTS.—*X. elaeodes* appears to be the black lower surface morphotype of *X. filarszkyana*, but it is much less common.

FIGURE 37.—Species of *Xanthoparmelia*: *a*, *X. domokosii* (*Byl* 1091, lectotype in BP); *b*, *X. dubitata* (*Elix* 4871); *c*, *X. duplicata* (*Hale* 73102, holotype in US); *d*, *X. durietzii* (*Potanin* s.n., isotype in US). *e*, *X. dysprosa* (*Hale* 80119); *f*, *X. effigurata* (*Hale* 73016, holotype in US). Scale in mm.

Xanthoparmelia elixii

Xanthoparmelia elixii Filson, 1984:203. [Type collection: 3 km N of Carey Gully, Mt. Lofty Range, S.A., Australia, *Elix* 2290 (MEL, holotype; CBG, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 4–16 cm broad, dark yellowish green; lobes sublinear, 0.7–2 mm wide, contiguous to imbricate, with short subascending laciniae toward the center, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale or darker brown, sparsely rhizinate, the rhizines pale brown, simple, 0.5–2 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 µm. Apothecia common, substipitate, 3–10 mm in diameter; spores 6–7 × 9–10 µm.

CHEMISTRY.—Norstictic, connorstictic, salazinic acid (±trace), constipatic (±trace). Protoconstipatic (±trace), and usnic acids.

ILLUSTRATION.—Filson, 1984, fig. 1.

DISTRIBUTION.—Australia (NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—This is another of the numerous Australian species with norstictic acid, characterized by the loosely adnate thallus and the pale brown, sparsely rhizinate lower surface. It occurs widely in southern Australia.

Xanthoparmelia endochromatica

FIGURE 38*b*

Xanthoparmelia endochromatica Hale, 1986b:574. [Type collection: along trail from Platteklip Gorge to Woodhead Reservoir, Table Mountain Nature Reserve, elev. 950 m, Cape Province, South Africa, Grid 3318 CD. *Hale* 72081, 23 Jan 1986 (US, holotype; LD, PRE, isotypes).]

Parmelia endochromatica (Hale) Brusse, 1988:539.

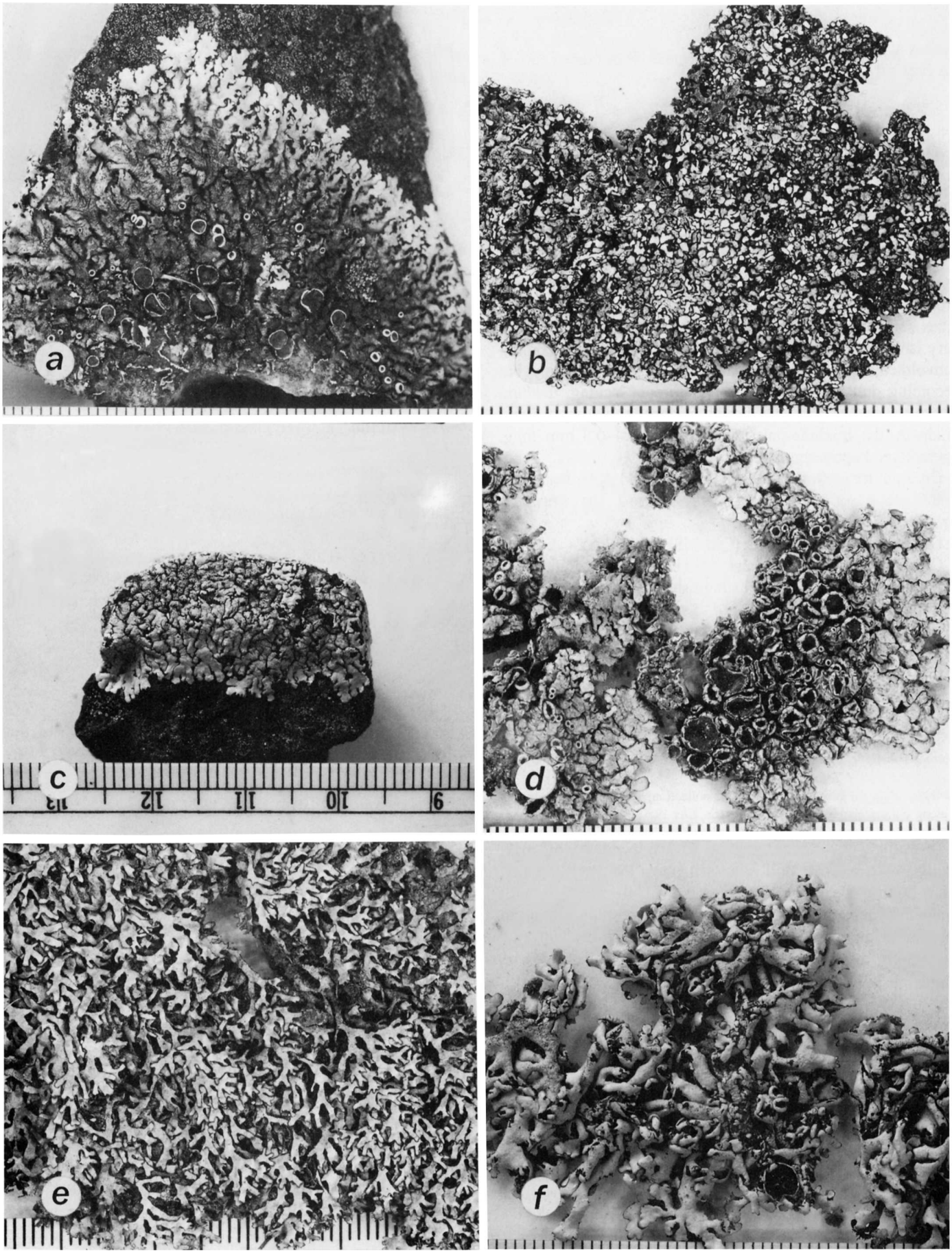
DESCRIPTION.—Thallus tightly adnate on rock, firm, 1–2 cm broad, yellowish green but blackening with age at the center; lobes sublinear at the margins, strongly black-rimmed, 0.3–0.9 mm wide, contiguous, crowded and becoming opuntioid-constricted at the center, upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla uniformly dull rusty orange-red; lower surface plane, black, shiny, sparsely rhizinate, the rhizines coarse, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Schenckiana pigment, secalonic acid derivatives, usnic acid, and faint unidentified spots.

ILLUSTRATION.—Hale, 1986b, fig. 14.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This brilliantly pigmented lichen, known from only two collections on Table Mountain, is characterized by both chemistry and morphology. It is, with *X. verecunda*, the only *Xanthoparmelia* with the schenckiana pigment as the main component. The strongly black-rimmed lobes are unusual in that they become opuntioid-constricted and appear quite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unlike any other species in the genus. *Xanthoparmelia verecunda* is a more fragile lichen with narrow dissected lobes. Although I originally reported gyrophoric acid, the spots on the TLC plates cannot be positively identified.

Xanthoparmelia endochrysea

FIGURE 38*c*

Xanthoparmelia endochrysea (Müller Argoviensis) Hale, 1988b:403.

Parmelia adpressa var. *endochrysea* Müller Argoviensis, 1879a:289. [Type collection: Gumango, distr. Bendo apud gentes Nyamnyam Africae centrali-orientalis, *Schweinfurth* s.n. (G, lectotype; BM, M isotypes).]

Parmelia endochrysea (Müller Argoviensis) Gyelnik, 1931b:288.

Xanthoparmelia hedbergii Knox in Knox and Brusse, 1983:152. [Type collection: Olkaria area, S of Lake Naivasha, Rift Valley, Kenya, *Hedberg* s.n., *Flora of Kenya* 6204d (UPS, holotype; US, isotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 3–6 cm broad, yellowish green; lobes subirregular, 0.7–1.3 mm wide, separate to imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia subglobose to cylindrical (Figure 14*g*), 0.07–0.12 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, pale, mostly unbranched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic (trace), and usnic acids.

ILLUSTRATION.—Knox and Brusse, 1983, fig. 7.

DISTRIBUTION.—Kenya, Zaire.

COMMENTS.—This species belongs to the *X. weberi* group and represents a tightly adnate morphotype. It is known only from two collections. The very poor type specimen has a yellowish medulla (Müller says "intus peculiariter coloratae"), apparently due to discoloration during preservation. It is mixed with a *Neofuscelia* species which has a deep orange-red medulla. Isolectotype specimens in BM and M, also in poor condition, have the same morphology but contain no lichen substances other than usnic acid, at least within the levels of detection with TLC.

Xanthoparmelia endomiltoides

FIGURE 38*d*

Xanthoparmelia endomiltoides (Nylander) Hale, 1974b:487.

Parmelia endomiltoides Nylander in Crombie, 1876a:19 and 1876b:168. [Type collection: Cape of Good Hope, South Africa, *Eaton* s.n. (BM, lectotype; H, Nyl. herb. no. 34793, isolectotype).]

Parmelia conspersa var. *endomiltoides* (Nylander) Müller Argoviensis, 1891:378.

DESCRIPTION.—Thallus adnate on rock, rather fragile, 4–6 cm broad, darkish yellow green; lobes subirregular, 0.8–2 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, rather fragile and breaking open to reveal the purple medulla, rugose with age, soredia and isidia lacking; medulla uniformly deep wine purple; lower surface plane, pale brown, moderately rhizinate, the rhizines pale, simple to sparsely furcate, 0.4–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–7 µm. Apothecia common, substipitate, 2–5 mm in diameter; spores 6–7 × 8–11 µm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids, 3–4 unidentified anthraquinone pigments.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The brilliant, deep wine purple-red pigments are distributed throughout the medulla and exposed as the fragile cortex is abraded off. This unusual species is locally abundant in southwestern Cape Province, often on shaded, moist rocks and occurring only as separate small orbicular thalli at a site.

Xanthoparmelia enteroxantha

FIGURE 38*e*

Xanthoparmelia enteroxantha Hale, 1986b:574. [Type collection: 22 km NW of Kango Caves, elev. ca 1000 m, Cape Province, South Africa, Grid 3322 AC, *Hale* 74044, 31 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate on rock or on soil over rocks, rather stiff and fragile, 6–10 cm broad, greenish yellow; lobes sublinear, elongate, 1–1.5 mm wide, dichotomously branched, separate to imbricate; upper surface clearly white-maculate, shiny, isidia and soredia lacking; medulla typically uniformly salmon orange or in part white; lower surface plane, dark brown or blackening with age, sparsely to moderately rhizinate, the rhizines brown to black, rather coarse, 0.5–1 mm long, simple to furcate. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic and usnic acids, skyrinol, oxyskyrin, skyrin (trace), zeorin, and a fourth unidentified anthraquinone (det. C. Culberson and A. Johnson).

ILLUSTRATION.—Hale, 1986b, fig. 15.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—No other species of *Xanthoparmelia*, excepting *X. endomiltoides*, *X. endochromatica*, *X. ianthina*, *X. rubropustulata*, and *X. verecunda* have a completely pigmented medulla. This species is the only one in the genus to produce zeorin. It is known from several mountain passes in extreme southwestern Cape Province.

Xanthoparmelia epigaea

FIGURE 38*f*

Xanthoparmelia epigaea Hale, 1986b:576. [Type collection: 19.5 km NNW of Vanrhynsdorp on east side of Hwy N7, elev. 200 m, Cape Province, South Africa, Grid 3118 BC, *Hale* 73020, 26 Jan 1986 (US, holotype; ANUC, LD, PRE, isotypes).]

FIGURE 38.—Species of *Xanthoparmelia*: *a*, *X. elaeodes* (*Elix* 1980); *b*, *X. endochromatica* (*Hale*, 72081, holotype in US); *c*, *X. endochrysea* (*Hedberg* 6204d, holotype of *X. hedbergii* in UPS); *d*, *X. endomiltoides* (*Hale* 74435); *e*, *X. enteroxantha* (*Hale* 74044, holotype in US); *f*, *X. epigaea* (*Stokoe* 7719). Scale in mm.

DESCRIPTION.—Thallus loosely attached on pebbles to nearly free growing over soil and pebbles, firm, covering extensive areas but breaking up into individual colonies 3–5 cm broad, light yellowish green; lobes sublinear, 1.5–5 mm wide, weakly convoluted, elongate and little branched; upper surface continuous, emaculate, shiny, rugose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, densely rhizinate, the rhizines pale brown, 0.5–1.5 mm long, simple to furcate. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia sparsely developed, adnate, 2–4 mm in diameter; spores 5–6 × 9–11 µm.

CHEMISTRY.—Fatty "subdecipiens" unknowns 33 and 37 (major), constipatic (±trace), protoconstipatic (±trace), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 16.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This soil-inhabiting lichen, endemic to the knersvlakte region of Namaqualand, is related to the Australian *X. condaminensis* but differs in being more distinctly convoluted and in having a different fatty acid profile.

Xanthoparmelia equalis

FIGURE 39*a*

Xanthoparmelia equalis Hale, 1986b:576. [Type collection: Laguneberg Mountains, NE of Mile 72, Distr. Omaruru, SWA/Namibia, Grid 2114 CC, *Hale* 75100, 8 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate to tightly adnate on rocks, soft, 5–8 cm broad, yellowish green to grayish white; lobes sublinear, 0.5–1.1 mm wide, rather crowded and imbricate to areolate-bullate at the center; upper surface continuous, emaculate, shiny to dull and white-pruinose, faintly reticulate white-maculate at the tips, becoming transversely cracked, isidia and soredia lacking; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines pale brown, 0.3–0.5 mm long, simple. Pycnidia and apothecia lacking.

CHEMISTRY.—Evernic, lecanoric (trace), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 17.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This common Namibian endemic is externally close to *X. lagunebergensis* (protocetraric acid present) and *X. serusiauxii* (lecanoric acid present). There is great variation in the development of pruina so that specimens may vary from light yellow-green to whitish mineral gray. The number of the holotype in the original publication (75101) was cited incorrectly.

Xanthoparmelia eradicata

FIGURE 39*b*

Xanthoparmelia eradicata (Nylander) Hale, 1974b:487.

Parmelia constrictans var. *eradicata* Nylander in Crombie, 1876a:19; 1876b:168. [Type collection: Cape of Good Hope, South Africa, *Eaton* s.n. (BM, lectotype; G, H, Nyl. herb. no. 34812, UPS, W, ZT, isolectotypes).]

Parmelia hypoleia var. *tenuifida* Nylander, 1860:393. [Type collection: Cape of Good Hope, South Africa, herb. *Carr* s.n. (BM, lectotype).]

Parmelia conspersa var. *eradicata* (Nylander) Müller Argoviensis, 1883:48.

Imbricaria constrictans var. *eradicata* (Nylander) Jatta, 1902:470.

Parmelia eradicata (Nylander) Gyelnik, 1938b:25.

Omphalodium hypoleium var. *tenuifidum* (Nylander) Dodge, 1959:190.

DESCRIPTION.—Thallus loosely adnate on rock or mosses over rocks, soft, somewhat pulvinate, 3–6 cm broad, dark yellowish green; lobes sublinear to linear, 0.2–0.5 mm wide, elongate, dichotomously branched and somewhat constricted at lobes bases, divaricate and somewhat subascending, black rimmed; upper surface continuous to very weakly white-maculate in patches, shiny, isidia and soredia lacking; upper medulla white, lower medulla in part orange; lower surface plane, smooth, black, very sparsely rhizinate, the rhizines black, coarse, simple, 0.2–0.6 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, protocetraric (trace), norstictic (trace), and usnic acids, and skyrin (±).

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This rarely collected species occurs in the extreme southwestern Cape region on or near Table Mountain. Elix's report from Australia (Elix, Johnston, and Armstrong, 1986) has been revised as *X. rubrireagens*. It has very narrow, elongate lobes and may rarely produce skyrin (the type contains traces of unidentified anthraquinone pigments). Gyelnik (1938a:288) placed it in his section *Endocoeruleae*.

Xanthoparmelia erosa

Xanthoparmelia erosa (Elix and Armstrong) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:241.

Parmelia erosa Elix and Armstrong, 1983:472. [Type collection: 40 km E of Kimba, Eyre Highway, S.A., Australia, *Filson* 11730a (MEL, holotype).]

DESCRIPTION.—Thallus vagrant, free growing on soil, 2–5 cm broad, leathery, usually fragmented into separate lobes, light yellowish green; lobes sublinear, 2–8 mm wide (to 10 mm unrolled), strongly convoluted, separate; upper surface continuous, emaculate, shiny, becoming fissured and rugulose and ultimately eroding with an extensive cover of soredia; medulla white; lower surface plane, pale to brown, sparsely rhizinate, the rhizines pale to brown, delicate, simple, 0.3–0.5 mm long. Pycnidia and apothecia lacking.

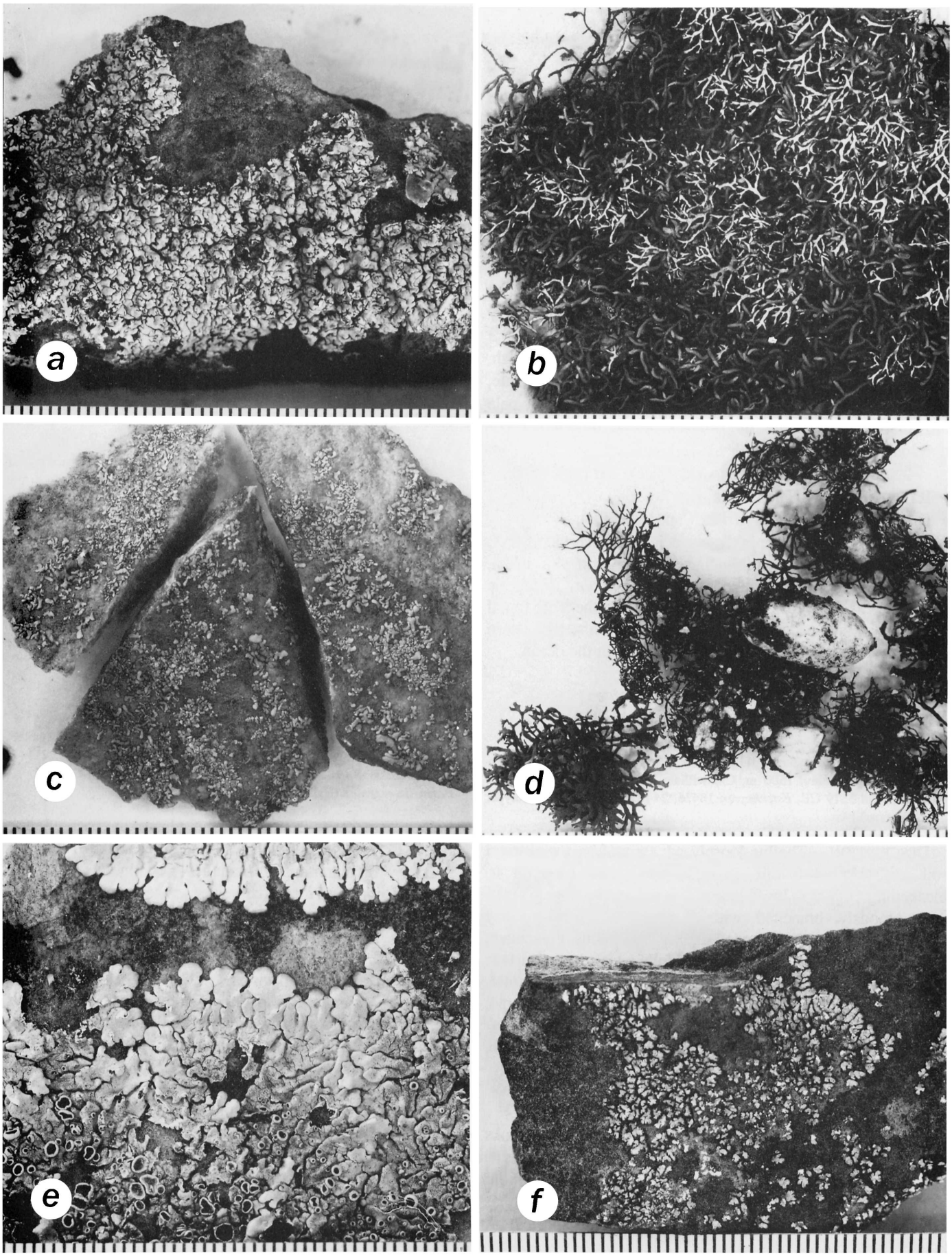
CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

ILLUSTRATION.—Elix and Armstrong, 1983, fig. 4.

DISTRIBUTION.—Australia (SA).

COMMENTS.—This is a very rarely collected sorediate species closely related to nonsorediate *X. convoluta*.

FIGURE 39.—Species of *Xanthoparmelia*: *a*, *X. equalis* (*Hale* 75100, holotype in US); *b*, *X. eradicata* (*Eaton* s.n., lectotype in BM); *c*, *X. eruptens* (Hale 78395, holotype in US); *d*, *X. esterhuyseniae* (*Esterhuysen* 18476, holotype in BOL); *e*, *X. everardensis* (*Hale* 68893); *f*, *X. evernica* (*Hale* 75016, holotype in US). Scale in mm.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Xanthoparmelia eruptens

FIGURE 39*c*

Xanthoparmelia eruptens Hale, 1987a:254. [Type collection: Uitkyk Pass, Cederberg Mountains, elev. 900 m, Cape Province, South Africa, Grid 3219 AC, *Hale* 78395, 29 Oct 1986 (US, holotype; PRE, isotype).]

Parmelia phyllodactylaris Brusse, 1989a:402. [Nomen novum based on *Xanthoparmelia eruptens* Hale.]

DESCRIPTION.—Thallus very tightly adnate to tightly adnate on rock, 2–4 cm broad, dull yellowish green; lobes sublinear, 0.3–0.7 mm wide, little branched, separate to contiguous, 1–2 mm long; upper surface continuous, emaculate, shiny, sparsely isidiate, the isidia coarse, pustular-bullate, globose, 0.2–0.3 mm in diameter, to 0.3 mm high, the tips epicorticate, whitish, fragile and erumpent apically but not becoming sorediate, unbranched; medulla white; lower surface plane, shiny, pale brown sparsely rhizinate, the rhizines simple, brown, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Evernic, lecanoric (trace), and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 7.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Another isidiate species with evernic acid, *X. evernica* from SWA/Namibia, has smaller erumpent isidia. This species is closely related to *X. coneruptens* (lecanoric acid) and *X. saleruptens* (salazinic acid). All of them are found on the lower side of large overhanging ledges in southwestern Cape Province where winter fogs come in from the ocean.

Xanthoparmelia esterhuyseniae

FIGURE 39*d*

Xanthoparmelia esterhuyseniae Hale, 1986b:577. [Type collection: Hexrivierberg Mountains, elev. 1500 m, Clanwilliam Div., Cape Province, South Africa, Grid 3319 CB, *Esterhuysen* 18476, 24 Mar 1951 (BOL, holotype; US, isotype).]

DESCRIPTION.—Thallus loosely adnate to free growing on soil or rocks, 4–6 cm broad, dark yellowish green to blackening with age; lobes linear, 0.1–0.3 mm wide, elongate, dichotomously branched with the ultimate lobes nearly subterete, subascending; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, rarely brown or mottled at the tips but black at the center, shiny, very sparsely rhizinate, the rhizines black, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, cryptostictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 18.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This finely branched species almost looks like a soil-inhabiting *Bryoria*. It is known only from the type collection. It has elongate, subterete ultimate branches, similar to those of *X. molliuscula*, which is pale brown below and has broader lobes. Another stictic acid-containing species, *X. suberadicata* from Madagascar, has broader lobes (to 1 mm wide) and lacks rhizines.

Xanthoparmelia everardensis

FIGURE 39*e*

Xanthoparmelia everardensis (Elix and Armstrong) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:242.

Parmelia everardensis Elix and Armstrong, 1983:473. [Type collection: Mt. Illbillee, Everard Ranges, S.A., Australia, *Filson* 15682 (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–5 cm broad, light yellowish green; lobes subirregular, 1–2 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–7 μm. Apothecia numerous, substipitate, 1–3 mm in diameter; spores 5–6 × 9–10 μm.

CHEMISTRY.—Diffractaic (major), barbatic (minor), 4-*O*-demethylbarbatic (trace), and usnic acids and atranorin (±).

ILLUSTRATION.—Elix and Armstrong, 1983, fig. 5.

DISTRIBUTION.—Australia (SA, NT, WA).

COMMENTS.—Chemically it is the same as *X. tucsonensis*, an American species with a pale brown lower surface that is rarely found in northern South Australia. It occurs rather rarely in semi-arid central and southwestern Australia.

Xanthoparmelia evernica

FIGURE 39*f*

Xanthoparmelia evernica Hale, 1986b:577. [Type collection: Laguneberg Mountains, NE of Mile 72, Distr. Omaruru, SWA/Namibia, Grid 2114 CC, *Hale* 75106, 8 Jan 1986 (US, holotype; LD, PRE, isotypes).]

Parmelia evernica (Hale) Brusse, 1989b:29.

DESCRIPTION.—Thallus tightly adnate on rock, 3–5 cm broad, darkish yellow green; lobes sublinear, 0.3–1 mm wide, sparsely dichotomously branched, contiguous, somewhat inflated; upper surface continuous, emaculate, shiny to white pruinose, transversely cracked and rugose with age, moderately isidiate, the isidia coarse, globose and basally constricted (Figure 14*h*), 0.15–0.25 mm in diameter, 0.5–1.5 mm high, the tips syncorticate, pruinose, hollow and erumpent but not sorediate, unbranched; medulla white; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines pale brown, 0.3–0.5 mm long. Pycnidia and apothecia not seen.

CHEMISTRY.—Evernic, lecanoric (trace), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 19.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This is another Namibian endemic, clearly distinguished by the large, hollow globose, erumpent but esorediate isidia. The pruinose surface and somewhat inflated aspect resemble *X. serusiauxii* but the lower surface color differs. These two species are the last lichen survivors 40–45

km inland along the Namib Coast at the extreme eastern edge of the fog zone.

Xanthoparmelia examplaris

FIGURE 40*a*

Xanthoparmelia examplaris Elix and Johnston in Elix, Johnston, and Armstrong, 1986:243. [Type collection: 8 km N of Pimba along Stuart Highway, N.T., *Elix* 11043A (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, firm, 5–8 cm broad, yellowish green; lobes sublinear, 0.8–1.5 mm wide, irregularly branched, the ultimate ones subascending; upper surface continuous, emaculate, shiny, strongly rugose-bullate at the center, isidia and soredia lacking; medulla white; lower surface of main lobes plane, secondary lobes weakly convoluted and subascending, pale but darkening toward the tips, sparsely to moderately rhizinate, the rhizines pale brown, thin, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–5 µm. Apothecia common, substipitate, 1–4 mm in diameter; spores 4–5 × 7 µm.

CHEMISTRY.—Salazinic, consalazinic, protocetraric (±trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 17.

DISTRIBUTION.—Australia (NT).

COMMENTS.—This rare Australian species is characterized by the strongly bullate-rugose thallus and partly uplifted, weakly convoluted lobes. Morphologically similar *X. incrustata* contains norlobaridone, and chemically similar *X. neorimalis* is very tightly adnate with lobes 0.3–0.8 mm wide. *Xanthoparmelia lineola* is less tightly adnate, broader lobed (1–2.5 mm), not strongly rugose, and never has weakly convoluted laciniae.

Xanthoparmelia exillima

FIGURE 40*b*

Xanthoparmelia exillima (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:245.

Parmelia exillima Elix, 1981:357. [Type collection: 13 km S of Countegany along Nimmitabel Road, NSW, Australia, *Elix* 1982 (MEL, holotype; CBG, H, isotypes).]

DESCRIPTION.—Thallus very tightly adnate on rock, somewhat areolate at the center, 4–7 cm broad, yellowish green but darkening with age; lobes sublinear, 0.3–0.5 mm wide, short, dichotomously branched, contiguous to subimbricate; upper surface continuous, emaculate, shiny, transversely cracked with age, densely isidiate, the isidia cylindrical (Figure 14*i*), 0.05–0.07 mm in diameter, 0.1–0.5 mm high, the tips syncorticate, blackening, simple to sparsely branched; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines pale brown, simple, 0.1–0.2 mm long. Pycnidia lacking. Apothecia rare, adnate, 1–2 mm in diameter; spores 4–6 × 7–9 µm.

CHEMISTRY.—Norlobaridone, loxodin (±), and usnic acid, atranorin (±), unknown $R_{fc}12$ (±).

ILLUSTRATION.—Elix, 1981, fig. 6.

DISTRIBUTION.—Australia (Qld, NSW, Vic, SA, WA), New Zealand.

COMMENTS.—This may be the tightly adnate morphotype of *X. amplexula*. Another related species, occurring in SWA/Namibia, *X. subamplexuloides*, has globose, pale-tipped isidia and always lacks loxodin. The Australian *X. immutata* is also closely related but contains the scabrosin complex.

Xanthoparmelia exuviata

Xanthoparmelia exuviata (Kurokawa) Hale, 1984:79.

Parmelia exuviata Kurokawa, 1982:36. [Type collection: 9 mi E of Cooma on Numeralla Road, NSW, Australia, *Kurokawa* 6449 (TNS, holotype; ANUC, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, fragile, 4–9 cm broad, yellowish green; lobes subirregular, 1–3 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia globose to subcylindrical (Figure 15*a*), 0.09–0.2 mm in diameter, 0.1–0.4 mm high, the tips weakly epicorticate, blackening, weakly erumpent, sparsely branched; medulla white; lower surface plane, pale brown, sparsely rhizinate, the rhizines pale brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, substipitate, 2–4 mm in diameter; spores absent.

CHEMISTRY.—Exuviatic A, exuviatic B, and usnic acids.

ILLUSTRATION.—Kurokawa, 1982, pl. 2: fig. 1.

DISTRIBUTION.—Australia (Qld, NSW, SA).

COMMENTS.—This rare but widespread species might be confused with *X. scabrosa*, which has more distinctly erumpent isidia and contains loxodin and norlobaridone. The only other species in the genus with exuviatic acid is *X. spargenosa*, a larger, more loosely adnate, nonisidiate lichen from Australia.

Xanthoparmelia farinosa

FIGURE 40*c*

Xanthoparmelia farinosa (Vainio) Nash, Elix, and Johnston, 1987:292.

Parmelia farinosa Vainio, 1890:62. [Type collection: Sitio, Minas Gerais, Brazil, *Vainio, Lich. Bras. Exs.* 551 (TUR, lectotype; BM, UPS, isolectotypes).]

Parmelia conspersa var. *rugulosa* Müller Argoviensis, 1888e:158. [Type collection: Flores Island, near Montevideo, *Hariot* 42 (G, lectotype).]

Parmelia rugulosa (Müller Argoviensis) Vainio, 1903:14.

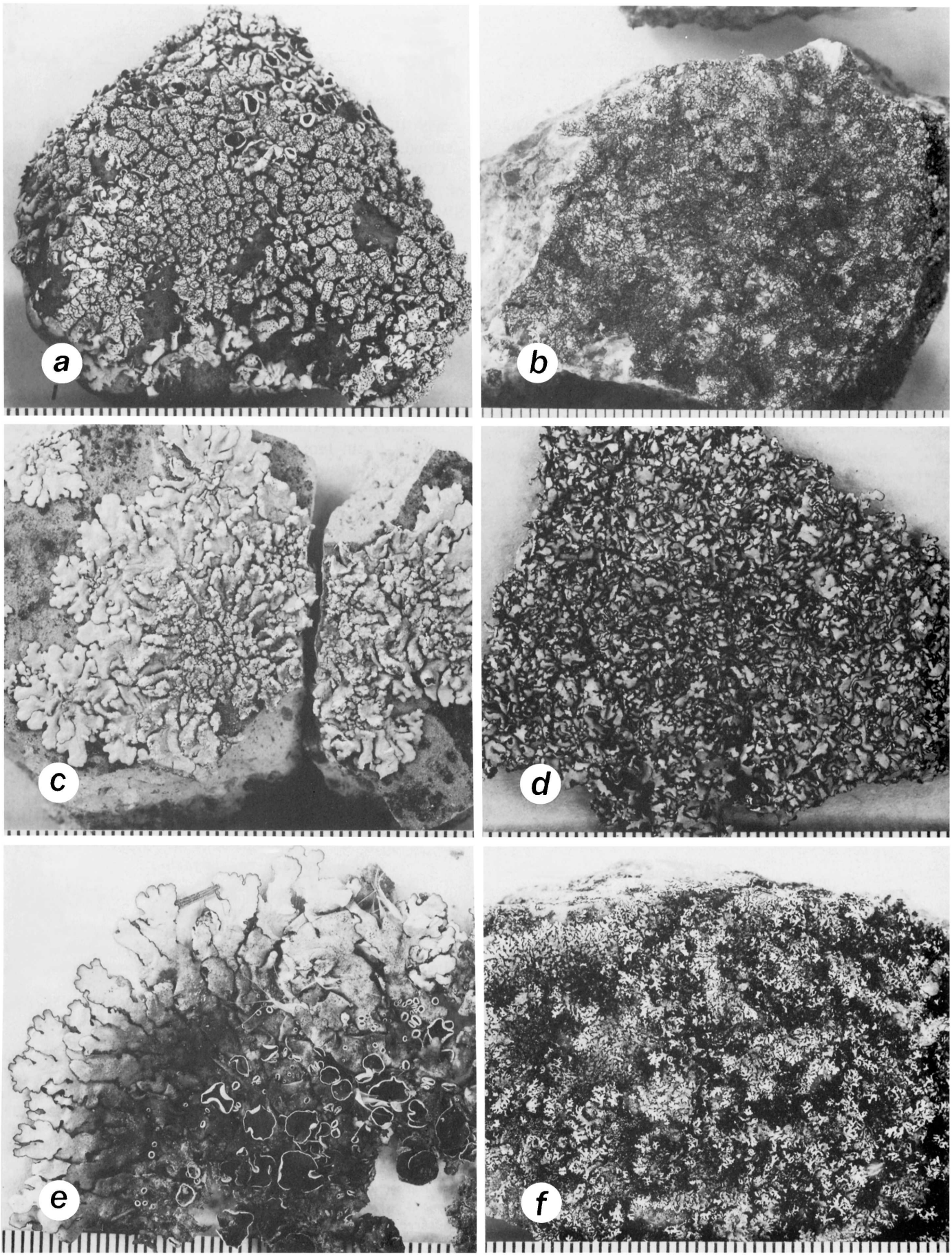
Parmelia soredians f. *lobulata* Gyelnik, 1934a:306. [Type collection: La Calera Sud, Argentina, *Hosseus* [22] (BP, lectotype).]

Parmelia soredians f. *muscicola* Gyelnik, 1934a:306. [Type collection: Capilla del Monte, Sierra Chica de Córdoba, Argentina, *Hosseus* [23] (BP, lectotype).]

Parmelia rugulosa (Müller Argoviensis) Gyelnik, 1934c:163. [Superfluous combination. Invalid combination without citing basionym.]

Parmelia soredians f. *farinosa* (Vainio) Gyelnik, 1938b:27.

Parmelia protosoredians Gyelnik, 1938c:85. [Type collection: Depto. Minas Cienega de Coro, Prov. Córdoba, Argentina, *Hosseus* 101 (BP, lectotype).]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DESCRIPTION.—Thallus adnate on rock, 2–4 cm broad, light yellowish green; lobes subirregular to sublinear, 1–2 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately sorediate, the soralia laminal, orbicular, 0.4–1 mm in diameter; medulla white; lower surface plane, shiny, pale brown, moderately rhizinate, the rhizines pale brown or darkening, simple, 0.3–0.6 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, norstictic, constictic, and usnic acids.

DISTRIBUTION.—Ecuador, Peru, Brazil, Uruguay, Argentina.

COMMENTS.—This rather infrequently collected member of the *X. ulcerosa* group has a unique chemistry among the sorediate species. Vainio (1890:62) proposed the epithet *Parmelia farinosa* (identical with *P. conspersa* var. *rugulosa* Müller Argoviensis published two years earlier) instead of raising var. *rugulosa* to species rank since "jam nuncupata est *P. rugulosa* (Nyl.) in Hook., 1860:348)." The species referred to in Hooker, however, is *Placodium rugosulum* Nylander (= *Xanthoria*), which Hooker later recombined as a *Parmelia*.

Xanthoparmelia felkaensis

FIGURE 40*d*

Xanthoparmelia felkaensis (Gyelnik) Hale, 1988b:403.

Parmelia conspersa var. *felkaensis* Gyelnik, 1930b:32. [Type collection: Felkai vizesés, Com. Szepes, Magas-Tátra, Hungary, *Timkó* 3618, 1 Aug 1917 (BP, lectotype).]

Parmelia conspersa f. *alpigena* Suza, 1930:26. [Type collection: Lake Batizovské, Vysoké Tatry, Czechoslovakia, *Suza* s.n., Aug 1924 (PRM, lectotype).]

Parmelia conspersa f. *felkaensis* (Gyelnik) Gyelnik, 1936:123.

DESCRIPTION.—Thallus loosely adnate on granitic rocks or on mosses over rocks, pulvinate, brittle, 5–10 cm broad, dark yellowish green; lobes sublinear, 0.6–1.2 mm wide, short and irregularly branched, almost appearing inflated, densely imbricate, the margins crenate and black rimmed, short lobulate with age; upper surface continuous to faintly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, brown, sparsely to moderately rhizinate, the rhizines brown, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

DISTRIBUTION.—Czechoslovakia, Hungary.

COMMENTS.—This highly restricted species grows at 1800–1900 m in exposed habitats in the Tatra Mountains. While Gyelnik published var. *felkaensis* without comment, Suza emphasized the pulvinate growth form, black rimmed lobes, and alpine habitat. It is apparently related to *X. somloensis* but lacks strong maculation and has relatively short, densely crowded, almost inflated lobes.

FIGURE 40.—Species of *Xanthoparmelia*: *a*, *X. examplaris* (*Elix* 11043A); *b*, *X. exillima* (*Elix* 1982); *c*, *X. farinosa* (*Paulo* s.n.); *d*, *X. felkaensis* (Gyelnik s.n., lectotype in BP); *e*, *X. filarszkyana* (*Hale* 66630); *f*, *X. filsonii* (*Elix* 16639). Scale in mm.

Xanthoparmelia ferraroiana

Xanthoparmelia ferraroiana Nash, Elix, and Johnston, 1987:289. [Type collection: 18 km south of Potrerillos, Prov. Mendoza, Argentina, *Nash* 23940 (ASU, holotype; ANUC, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, to 8 cm broad, yellow green; lobes subirregular, apically subrotund, 1.6–6 mm wide, contiguous to imbricate; upper surface dull, rugose at the center, sorediate, the soralia laminal to submarginal, orbicular and separate but coalescing with age; medulla white; lower surface pale brown to brown, densely rhizinate, the rhizines short, concolorous with the lower surface, simple, 0.3–0.6 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Psoromic, 2′-*O*-demethylpsoromic, and usnic acids.

ILLUSTRATION.—Nash, Elix, and Johnston, 1987, fig. 4.

DISTRIBUTION.—Argentina.

COMMENTS.—This common but previously overlooked sorediate species is externally similar to *X. farinosa*, which contains the stictic acid complex. It has been found only in Argentina.

Xanthoparmelia ferruma

Xanthoparmelia ferruma Elix and Johnston in Elix, Johnston, and Armstrong, 1986:247. [Type collection: 13 km SW of Quorn, S.A., Australia, *Hale* 58373 (US, holotype).]

DESCRIPTION.—Thallus adnate on rock, 4–8 cm broad, yellowish green; lobes subirregular, 1.5–3 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla ochre in part; lower surface plane, pale or darker brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.3 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 1–3 mm in diameter; spores 5 × 8–9 µm.

CHEMISTRY.—Salazinic, consalazinic, protocetraric (±), and usnic acids, skyrin.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 18.

DISTRIBUTION.—Australia (SA).

COMMENTS.—Superficially close to *X. lineola*, this species is known from two localities in South Australia.

Xanthoparmelia filarszkyana

FIGURE 40*e*

Xanthoparmelia filarszkyana (Gyelnik) Hale, 1974b:487.

Parmelia filarszkyana Gyelnik, 1938a:278. [Type collection: Round Swamp, Ogunbil, Jamworth [sic] (= Tamworth), NSW, Australia, *Gardner* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia praetermissa Kurokawa and Filson, 1975:41. [Type collection: Olive Grove Station, 14.48 km S of Quorn, S.A., Australia, *Filson* 11995 (MEL, holotype; TNS, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 4–10 cm broad, yellowish green; lobes subirregular, 1.5–2.5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, substipitate, 2–5 mm in diameter; spores 6–7 × 9–10 µm.

CHEMISTRY.—Norlobaridone, loxodin (±), conorlobaridone (±trace), conloxodin (±trace), constipatic (±), protoconstipatic (±), and usnic acids.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 3, fig. 1 (as *Parmelia praetermissa*).

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—This is one of the more common *Xanthoparmeliae* in Australia, a kind of vicariant of *X. cumberlandia* in eastern North America. It is usually quite closely adnate but may intergrade with loosely adnate *X. flaviscentireagens*.

Xanthoparmelia filsonii

FIGURE 40*f*

Xanthoparmelia filsonii Elix and Johnston in Elix, Johnston, and Armstrong, 1986:251. [Type collection: 1 km SW Heberton, Qsld., Australia, *Elix* 16639 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 5–7 cm broad, yellowish green but darkening at the center; lobes sublinear, 0.2–0.7 mm wide, contiguous to imbricate, the tips humping up, black rimmed; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia cylindrical (Figure 15*b*), 0.05–0.07 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, darkening, mostly unbranched; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate, the rhizines black, rather stout, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic, connorstictic acids, and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 19.

DISTRIBUTION.—Australia (Qld, WA).

COMMENTS.—This rare Australian lichen is externally similar to stictic acid-containing *X. mougeotina* in having a centrally areolate thallus.

Xanthoparmelia flaviscentireagens

FIGURE 41*a*

Xanthoparmelia flaviscentireagens (Gyelnik) D. Galloway, 1980:533.
Parmelia flaviscentireagens Gyelnik, 1934c:154. [Type collection: Booroomba Rocks, NSW [A.C.T.], Australia, *Barker* s.n. (BP, lectotype).]
Parmelia samoensis var. *flaviscentireagens* (Gyelnik) Gyelnik, 1935:46.

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rarely also on soil, rather firm but usually breaking apart when collected, 4–10 cm broad, light yellowish green or darkening with age; lobes variable, subirregular to sublinear, 1–3 mm wide, nearly separate to imbricate, sometimes elongate-laciniate, the laciniae 0.2–0.5 mm wide, at times subterete, prostrate to subascending; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane to vaguely subcanaliculate, smooth to rugose, brown, often darkening in the marginal zone, sparsely to moderately rhizinate, the rhizines pale brown or darkening, simple, 0.2–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common. substipitate, 2–8 mm in diameter; spores 4 × 8–9 µm.

CHEMISTRY.—Norlobaridone, loxodin, scabrosin 4,4′-diacetate (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±), scabrosin 4,4′-dibutyrate (±), conloxodin (±), conorlobaridone (±), and usnic acid.

ILLUSTRATION.—Galloway, 1980, fig. 4.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, Tas, SA, WA), New Zealand, Peru.

COMMENTS.—An extremely variable species, often weakly channelled below and suberect at the margins, *X. flaviscentireagens* is one of the most common lichens in Australia and New Zealand (with a single disjunct record in Peru). It is often difficult to key because the great variability is not easily accommodated in a dichotomous key.

Xanthoparmelia flindersiana

Xanthoparmelia flindersiana (Elix and Armstrong) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:253.
Parmelia flindersiana Elix and Armstrong, 1983:474. [Type collection: 1.6 km from Narrina River, Flinders Ranges, *Filson* 15570 (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 2–8 cm broad, dark yellowish green; lobes sublinear, 1–2 mm wide, contiguous to subimbricate; upper surface continuous, emaculate, shiny, transversely cracked, moderately isidiate, the isidia globose, somewhat bloated, 0.10–0.15 mm in diameter, 0.1–0.2 mm high, the tips epicorticate, bursting open and becoming pustulate, unbranched; medulla white; lower surface plane, brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.3 mm long. Pycnidia lacking. Apothecia rare, adnate, ~1.0 mm in diameter; spores absent.

CHEMISTRY.—Norstictic, connorstictic, salazinic (trace), hypostictic (trace), hypoconstictic (trace), hyposalazinic (trace), and usnic acids (det. J. Johnston).

ILLUSTRATION.—Elix and Armstrong, 1983, fig. 6.

DISTRIBUTION.—Australia (NSW, Vic, SA, WA), New Zealand.

COMMENTS.—Three other erumpent-isidiate species in Australia contain norstictic acid. *Xanthoparmelia alexandrensis* and *X. pustuliza* both have a black lower surface, and *X.*

norpraegnans has weakly erumpent isidia and lacks hypostictic and hyposalazinic acids.

Xanthoparmelia fucina

FIGURE 41*b*

Xanthoparmelia fucina Knox in Knox and Brusse, 1983:150. [Type collection: World's View, Matopos, Zimbabwe, *Schelpe* 1591 (BOL, holotype; US, isotype).]

DESCRIPTION.—Thallus adnate on rock, 3–6 cm broad, yellowish green; lobes subirregular, 0.8–1.5 mm wide, short, contiguous; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia cylindrical, 0.06–0.15 mm in diameter, 0.2–1 mm high, the tips syncorticate, pale branched, sparingly branched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple or branched, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Protocetraric and usnic acids.

ILLUSTRATION.—Knox and Brusse, 1983, fig. 6.

DISTRIBUTION.—Zimbabwe, SWA/Namibia.

COMMENTS.—The only other species in the genus with protocetraric acid and isidia is the Australian *X. stuartensis*, which has short, erumpent isidia. The original report of skyrin (as rhodophyscin) in this species is apparently incorrect; on careful reexamination the type collection lacks any pigmentation. The species is now known from Zimbabwe and the Waterberg Plateau in Namibia.

Xanthoparmelia fumigata

FIGURE 41*c*

Xanthoparmelia fumigata (Kurokawa) Elix and Johnston, 1987:371.

Parmelia fumigata Kurokawa, 1985:81. [Type collection: 18 km E of Kondinin, WA, Australia, *S. Nakanishi* 17 (TNS, holotype).]

Paraparmelia fumigata (Kurokawa) Elix and Johnston in Elix, Johnston, and Verdon, 1986:280.

DESCRIPTION.—Thallus tightly adnate on rock, 3–8 cm broad, dark yellowish green at the center but lighter at the tips; lobes sublinear, 0.6–1 mm wide, irregularly branched, crowded at the center, short laciniate, the laciniae 0.1–0.3 mm wide, imbricate; upper surface continuous, emaculate, shiny, rugose with age, isidia and soredia lacking; medulla white; lower surface plane, brown, sparsely rhizinate, the rhizines brown, simple, 0.2–0.5 mm long. Pycnidia poorly developed; conidia not found. Apothecia well developed, substipitate, 1–3 mm in diameter; spores 5 × 7–8 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, protocetraric (±trace), conprotocetraric (±trace), and usnic acids, atranorin (trace).

ILLUSTRATION.—Kurokawa, 1985, fig. 4.

DISTRIBUTION.—Australia (WA).

COMMENTS.—This rare species is related to another from Australia, *X. pertinax*, which is adnate and has subirregular lobes 1–2.5 mm wide. It is also distantly related to the South African *X. phaeophana* group but lacks maculae and physodalic acid and has narrow crowded sublaciniate lobes. It is only known from western Australia.

Xanthoparmelia furcata

FIGURE 41*d*

Xanthoparmelia furcata (Müller Argoviensis) Hale, 1974b:487.

Parmelia furcata Müller Argoviensis, 1886:256. [Type collection: NSW, Australia, *Leichhardt* s.n. (G, lectotype; M, W, isolectotypes).]

Parmelia subconspersa var. *substenophylla* Gyelnik, 1930a:60. [Type collection: s.l., s.c. (H, Nyl. herb. no. 34717, lectotype; BP, isolectotype).]

Parmelia foliosa Krempelhuber ex Gyelnik, 1935:35. [Type collection: Australia, *Leichhardt* s.n. (W, lectotype; M, isolectotype).]

DESCRIPTION.—Thallus loosely adnate on rock, firm, 5–8 cm broad, yellowish green; lobes sublinear, 0.8–3 mm wide, irregularly dichotomously branched, divaricate-imbricate, subascending, black rimmed; upper surface continuous, shiny, isidia and soredia lacking; medulla white; lower surface plane to weakly canaliculate, more or less uniformly brown, blackening only at the tips, shiny, rugulose, sparsely rhizinate, the rhizines brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia not commonly developed, substipitate, 2–5 mm in diameter; spores 5 × 8–9 µm.

CHEMISTRY.—Norlobaridone, loxodin, norlobariol methyl ester (±trace), and usnic acid.

ILLUSTRATIONS.—Kurokawa, 1969, pl. 1: fig. 2; Galloway (1980), fig. 5A.

DISTRIBUTION.—Australia, New Zealand.

COMMENTS.—This rather common Australasian lichen is close to *X. dichotoma*, which has a distinctly black lower surface and generally occurs in moister habitats (Elix et al., 1986). Gyelnik (1935:35) cited *P. foliosa* as the type of *Parmelia* subgenus *Omphalodium* section *Xanthomphalodium* Gyelnik and included it with *Parmelia convoluta* (Hue) Zahlbruckner (= *Xanthomaculina convoluta* (Hue) Hale). When describing *P. subconspersa* var. *stenophylla* he added a note on the label to the effect that the locality was unknown, but in my opinion the specimen must have come from Australia because of the chemistry.

Xanthoparmelia geesterani

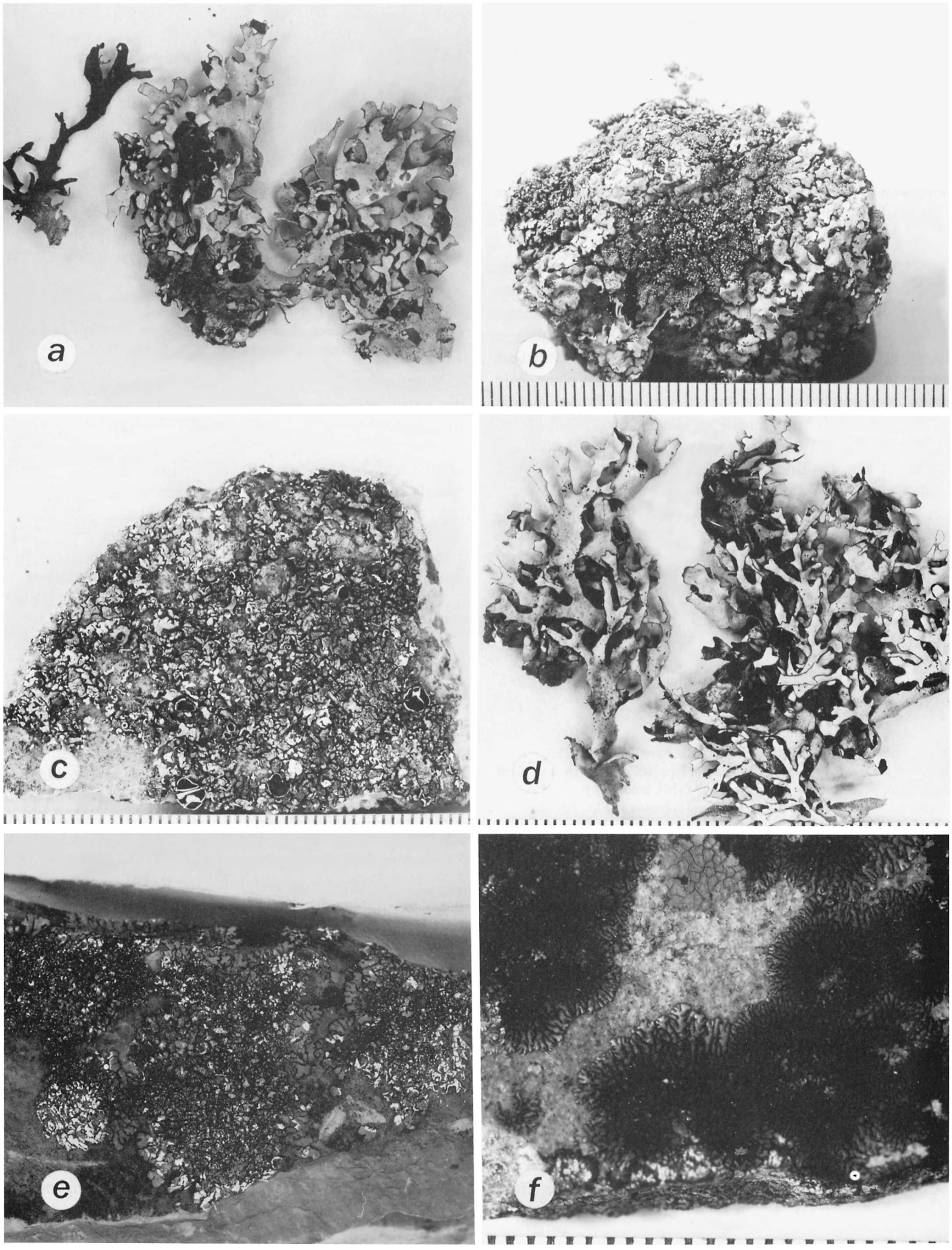
FIGURE 41*e*

Xanthoparmelia geesterani (Hale) Hale, 1988b:403.

Parmelia geesterani Hale, 1972:344. [Type collection: Waterkloof, Pretoria, Transvaal, South Africa, *Maas Geesteranus* 6405, 2 Oct 1949 (L, holotype; LD, US, isotypes).]

Pseudoparmelia geesterani (Hale) Hale, 1974a:190.

DESCRIPTION.—Thallus tightly adnate on rock, somewhat areolate at the center, 2–4 cm broad, dull yellowish green; lobes subirregular, 0.7–1.1 mm wide, short, contiguous to imbricate; upper surface continuous, emaculate, shiny, densely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isidiate, the isidia globose (Figure 15*c*), 0.1–0.2 mm in diameter, 0.1–0.2 mm high, the tips weakly epicorticate, pale, mostly unbranched, more or less hollow and erumpent with age, sometimes becoming subsorediate; medulla white; lower surface plane, shiny, brown at the tips but blackening at the center, moderately rhizinate, the rhizines dark brown, slender, 0.3–0.5 mm long, simple or with splayed, furcate tips. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1972, fig. 4.

DISTRIBUTION.—South Africa (Transvaal).

COMMENTS.—Closely related *X. isidiosa* from Australia has the same general morphology and chemistry but is a larger lichen with fewer erumpent isidia. Another related species in Namibia, *X. tenacea*, has a brown lower surface.

Xanthoparmelia gerhardii

FIGURE 41*f*

Xanthoparmelia gerhardii Elix and Johnston, 1988b:355. [Type collection: Mt. Hassell, Stirling Ranges National Park, Western Australia, Australia, *Rambold* 5384 (M, holotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, 1–3 cm in diameter, yellow green but darkening in older lobes; lobes sublinear, 0.2–0.5 mm wide, linear-elongate, dichotomously but sparingly branched, contiguous to stellate or subimbricate; upper surface continuous, emaculate, dull, transversely cracked and appearing areolate in older lobes, soredia and isidia lacking; medulla white; lower surface plane, black except for a brown zone at the tips, sparsely rhizinate, the rhizines black, rudimentary, ~0.1 mm long. Pycnidia well developed; conidia elongate-bifusiform, 0.5 × 7–8 µm. Apothecia common, sessile, 0.5–1 mm in diameter, the margin involute at first, crenulate at maturity; spores 4–6 × 7–8 µm.

CHEMISTRY.—Constictic (major), stictic (trace), norstictic (trace), connorstictic (±trace), cryptostictic (±trace), and usnic acids, atranorin (±trace).

ILLUSTRATION.—Elix and Johnston, 1988b, fig. 4.

DISTRIBUTION.—Australia (WA).

COMMENTS.—This is the only species in *Xanthoparmelia* with constictic acid as the major component. Constictic acid is otherwise accompanied by large concentrations of stictic acid. Morphologically this species resembles other centrally areolate Australian species such as *X. louisii*. It is known only from the type collection.

FIGURE 41.—Species of *Xanthoparmelia*: *a*, *X. flaviscentireagens* (*Barker* s.n., lectotype in BP); *b*, *X. fucina* (*Schelpe* 1591, holotype in BOL); *c*, *X. fumigata* (*Nakanishi* 17, holotype in TNS); *d*, *X. furcata* (*Hale* 58260); *e*, *X. geesterani* (*Mass Geesteranus* 6405, holotype in LD); *f*, *X. gerhardii* (*Rambold* 5384, holotype in M). Scale in mm.

Xanthoparmelia glareosa

Xanthoparmelia glareosa (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:256.

Parmelia glareosa Kurokawa and Filson in Filson, 1982:536. [Type collection: 9 mi E of Cooma on Numeralla Road, NSW, Australia, *Kurokawa* 6447 (TNS, holotype; MEL, isotype).]

DESCRIPTION.—Thallus loosely adnate on pebbles on soil or on rocks, 5–12 cm broad, dull yellowish green; lobes sublinear to subirregular, 1–2.5 mm wide, irregularly constricted, contiguous to imbricate, with numerous secondary lobes 0.4–1 mm wide developing in the center; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, moderately to densely rhizinate, the rhizines black, simple to sparsely furcate at maturity, 0.2–0.8 mm long. Pycnidia lacking. Apothecia common, substipitate, 2–6 mm in diameter; spores 6 × 10–12 µm.

CHEMISTRY.—Norstictic, connorstictic, salazinic (±), and usnic acids.

ILLUSTRATION.—Filson, 1982, fig. 7.

DISTRIBUTION.—Australia (NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—*X. glareosa* is close to *X. congesta*, which has broader lobes and is sparsely rhizinate.

Xanthoparmelia globisidiosa

Xanthoparmelia globisidiosa Hale, 1986b:578. [Type collection: 25 km S of Clanwilliam along Hwy N7, elev. ca. 300 m, Cape Province, South Africa, Grid 3218 DD, *Hale* 72030, 25 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate on rock, fragile and easily breaking apart when collected, 4–8 cm broad, light yellowish green; lobes subirregular, 1–2 mm wide, short, imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia globose to irregularly inflated (Figure 15*d*), 0.10–0.15 mm in diameter, 0.1–0.3 mm high, the tips syncorticate to weakly epicorticate, shiny, pale, weakly erumpent but not becoming sorediate, sparsely short-branched; medulla white; lower surface plane, shiny, very pale tan, very sparsely rhizinate, the rhizines pale, coarse, simple, 0.2–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, and usnic acids, unknown substance.

ILLUSTRATION.—Hale, 1986b, fig. 20.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The most unusual features of this lichen are the very sparse rhizines (the original description incorrectly stated no rhizines present), the very pale brown lower surface color, and the globose isidia. It is known only from the type locality in southern Namaqualand. *Xanthoparmelia subplittii* from the Neotropics is uniformly moderately rhizinate below with more clearly erumpent isidia.

Xanthoparmelia globulifera

FIGURE 42*a*

Xanthoparmelia globulifera (Kurokawa and Filson) Hale, 1984:79.
Parmelia globulifera Kurokawa and Filson, 1975:38. [Type collection: Wynbring Rocks, 1.2 km N of Wynbring, S.A., Australia, *Filson* 11940 (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 2–5 cm broad; lobes sublinear, 0.4–1 mm wide, contiguous; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia 0.1–0.15 mm in diameter, 0.1–0.2 mm high, the tips epicorticate, bloated and erumpent, hollow, becoming subsorediate, unbranched; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Constipatic, protoconstipatic, and usnic acids.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 1: fig. 4.

DISTRIBUTION.—Australia (SA, WA).

COMMENTS.—A very rare species in arid Australia, *X. globulifera* has the same tightly adnate thallus and erumpent isidia as *X. dayiana* (fumarprotocetraric acid) and *X. praegnans* (salazinic acid).

Xanthoparmelia glomerulata

Xanthoparmelia glomerulata Krog and Swinscow, 1987:424. [Type collection: Mt. Meru, Arusha Distr., Northern Province, Tanzania, elev. 1900 m, *Krog and Swinscow* T10/119 (O, holotype; BM, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 2–7 cm broad, light yellowish green; lobes sublinear, 0.4–1 mm wide, dichotomously branched, separate to subimbricate; upper surface continuous, emaculate, shiny, transversely cracked with age, moderately to densely isidiate, the isidia subglobose, 0.08–0.1 mm in diameter, up to 2 mm high, becoming densely aggregated, the tips epicorticate, pale, erumpent and subsorediate with age, becoming richly branched; medulla white; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines brown, simple, rather coarse, unbranched, 0.2–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, and usnic acids.

ILLUSTRATION.—Krog and Swinscow, 1987, fig. 3.

DISTRIBUTION.—Kenya, Tanzania.

COMMENTS.—The tall, erumpent and subsorediate, clustered isidia are unique in the genus. The species is known from two localities in East Africa (Swinscow and Krog, 1987).

Xanthoparmelia gongylodes

FIGURE 42*b*

Xanthoparmelia gongylodes Elix and Johnston in Elix, Johnston, and Armstrong, 1986:258. [Type collection: Copley-Balcanoona Road, 33 km E of Copley, Flinders Ranges, S.A., Australia, elev. 520 m, *Elix* 18008, 30 Oct 1984 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–7 cm broad, darkish yellow green; lobes sublinear, 0.8–1.5 mm wide, contiguous to imbricate and crowded at the center; upper surface continuous, emaculate, shiny, transversely cracked with age, moderately to densely isidiate, the isidia subglobose to cylindrical or irregularly inflated (Figure 15*e*), 0.08–0.15 mm in diameter, to 1 mm high, the tips epicorticate, dull, in part weakly erumpent, sparsely branched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.6 mm long. Pycnidia rare; conidia cylindrical, 0.5 × 4–5 µm. Apothecia rare, substipitate, 2–4 mm in diameter; spores 3–5 × 6–8 µm.

CHEMISTRY.—Hypostictic, hyposalazinic, hypoconstictic (±), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 20.

DISTRIBUTION.—Australia (SA, WA).

COMMENTS.—This is the only isidiate species in Australia with the hypostictic acid series. There are four known localities in arid shrublands. The South American *X. kalbii* and the South African *X. saniensis*, both with the same chemistry, have erumpent globose isidia.

Xanthoparmelia granulata

FIGURE 42*c*

Xanthoparmelia granulata Hale, 1989a:545. [Type collection: On sheltered dolerite ledge, 56.1 km N of Mapholaneng on Sani Pass-Moteng Pass road, elev. ca. 3000 m, Lesotho, Grid 2828 DD, *Hale* 81540, 7 May 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate on rock (removed free when wetted), fragile and breaking into pieces, dull yellowish green, 4–6 cm broad; lobes subirregular, 0.8–1.3 mm wide, black rimmed, subimbricate; upper surface continuous, emaculate, dull to faintly white-pruinose, soon strongly rugose, the wrinkles becoming irregularly pustulate, erupting and forming coarse soredia; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines simple, 0.3–0.5 mm long. Pycnidia and apothecia lacking.

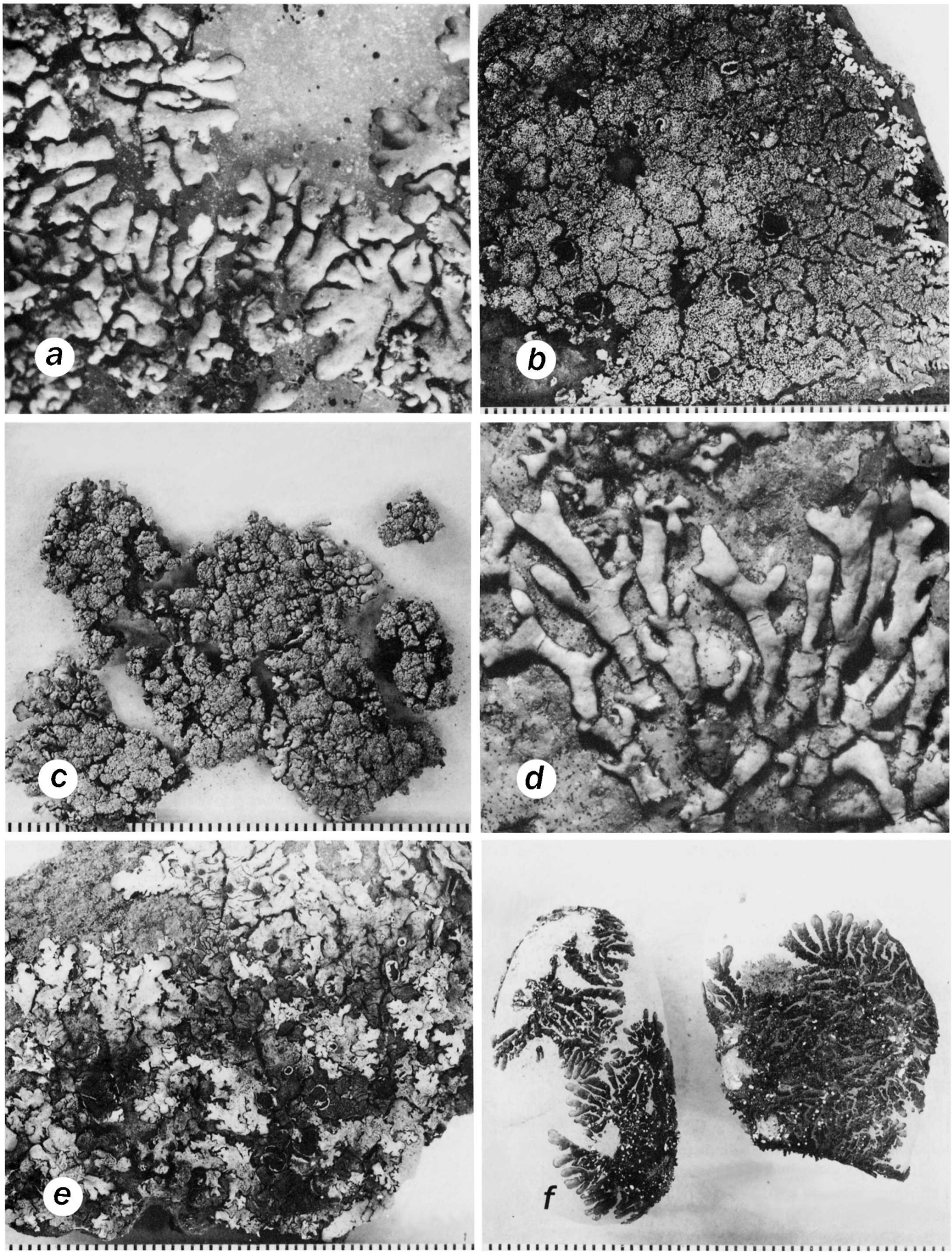
CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 10.

DISTRIBUTION.—Lesotho.

COMMENTS.—The granular pustules are vaguely similar to those of *Flavoparmelia caperata* (L.) Hale, but the narrow lobes and pale lower surface are typical of *Xanthoparmelia*. It is known only from the type collection at high elevation in

FIGURE 42.—Species of *Xanthoparmelia*: *a*, *X. globulifera* (*Day* 10848, holotype in MEL (×10); *b*, *X. gongylodes* (*Elix* 18008, holotype in CBG); *c*, *X. granulata* (*Hale* 81540, holotype in US); *d*, *X. greytonensis* (*Hale* 78151); *e*, *X. gyrophorica* (*Hale* 76856); *f*, *X. harrisii* (*Hale* 81203, holotype in US). Scale in mm.


a
b
c
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f

Lesotho.

Xanthoparmelia greytonensis, new species

FIGURE 42*d*

Thallus arctissime adnatus, saxicola, 4–7 cm latus, lobis sublinearibus, 0.3–0.5 mm latis, elongatis, superne continuus, emaculatus, transversim fissurinus, sorediis isidiisque destitutus, subtus planus, niger, modice rhizinosus.

DESCRIPTION.—Thallus very tightly to tightly adnate on rock, appearing somewhat areolate at the center, 4–7 cm broad, yellowish green but darkening somewhat at the center with age; lobes sublinear, 0.3–0.5 mm wide, elongate, sparsely dichotomously branched, short laciniate with age on the margins, separate to imbricate; upper surface continuous, emaculate, shiny, transversely cracked, soredia and isidia lacking; medulla white; lower surface plane, black, shiny, moderately rhizinate, the rhizines black, simple, rather fragile, 0.1–0.2 mm long. Pycnidia poorly developed; conidia more or less cylindrical, 0.5 × 5–6 µm. Apothecia poorly developed, sessile, 0.2–0.5 mm in diameter; spores lacking.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

TYPE COLLECTION.—Sandstone outcrops at head of ravine, Greyton Nature Reserve, north of Greyton, Riviersrand Range, Cape Province, South Africa, Grid 3418 BA, *Hale* 78151, 25 Oct. 1986 (US, holotype; PRE, isotype).

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This delicate species occurs on sandstone outcrops in coastal Fynbos in a small area of southeastern Cape Province. It is closely related to the Australian/South African *X. xanthomelaena*, which has a much darker thallus, more robust, discrete rhizines, black-rimmed lobes, and large conidia (7–9 µm long).

Xanthoparmelia gyrophorica

FIGURE 42*e*

Xanthoparmelia gyrophorica Hale, 1986b:578. [Type collection: Sani Pass, elev. 2875 m, Lesotho, Grid 2929 CB, *Hale* 74034, 19 Feb 1986 (US, holotype; LD, PRE, isotypes).]
Parmelia gyrophorica (Hale) Brusse, 1988:539.

DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm, 6–12 cm broad, bright yellowish green; lobes subirregular, apically rotund, contiguous to imbricate, 2–6 mm wide; upper surface continuous, emaculate, dull, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines brown to blackening, rather coarse, 0.5–1 mm. Pycnidia numerous; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, adnate, 5–8 mm in diameter; spores 6–7 × 9–10 µm.

CHEMISTRY.—Gyrophoric, lecanoric (trace), 2,4-di-*O*-methylgyrophoric (trace), 5-*O*-methylhiascic (trace), and usnic acids (det. J. Johnston).

ILLUSTRATION.—Hale, 1986b, fig. 21.

DISTRIBUTION.—South Africa (Cape Province, Natal), Lesotho.

COMMENTS.—Gyrophoric acid is extremely rare as a major metabolite in *Xanthoparmelia*, so far known only in two other South African species, effigurate-maculate *X. leucostigma* and tightly adnate *X. olivetorica*. This species is common in rock grasslands at high elevations in the Drakensberg escarpment.

Xanthoparmelia harrisii

FIGURE 42*f*

Xanthoparmelia harrisii Hale, 1989a:547. [Type collection: Gravel flats, 18.2 km NE of Cape Cross on E side of Hwy D2301, elev. 100 m, SWA/Namibia, Grid 2113 DB, *Hale* 81203, 22 Apr 1988 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate on quartz pebbles, light yellow green at the tips but darkening to blackish brown at the center, 1–2 cm broad; lobes sublinear, 0.5–1 mm wide, convex, little branched, separate to contiguous; upper surface continuous, emaculate, dull and light pruinose, sparsely to densely isidiate, the isidia coarse, cylindrical (Figure 15*f*), 0.1–0.2 mm in diameter, to 2 mm high, the tips syncorticate, dark, becoming richly branched; medulla white; lower surface plane, pale brown, sparsely rhizinate, the rhizines short, coarse, 0.1–0.2 mm long, unbranched. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypostictic, hyposalazinic, hypoconstictic, caperatic (±), and usnic acids, associated undetermined spots.

ILLUSTRATION.—Hale, 1989a, fig. 11.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This widespread, easily overlooked Namib desert lichen grows on the lower edge of quartzite pebbles. The center is almost black but the marginal lobes, especially where protected on the lower side of the rock, are bright yellow. It would otherwise be identified as a *Neofuscelia* and the actual relationship to that genus still needs clarification. It is confined to the coastal fog zone in Namibia and forms an important component of the terricolous lichen community.

Xanthoparmelia heinari

FIGURE 43*a*

Xanthoparmelia heinari Elix and Johnston, 1988b:357. [Type collection: Wauchope Trig, Broken Bago Range, Broken Bago State Forest, 6 km S of Wauchope, New South Wales, Australia, *Streimann* 38549 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 5–8 cm broad, dark yellow green toward the center; lobes sublinear, 0.3–1 mm wide, short and irregularly branched, black-rimmed, imbricate; upper surface continuous, emaculate, shiny, irregularly cracked with age, moderately to densely isidiate, the isidia subglobose to cylindrical, the tips syncorticate, eroding off but not sorediate, 0.07–0.1 mm in diameter, to 0.25 mm high, branching sparsely; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate,

the rhizines black, simple, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic (major), connorstictic, and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1988b, fig. 5.

DISTRIBUTION.—Australia (NSW).

COMMENTS.—Four other norstictic acid-containing species in Australasia have isidia and a black lower surface. *Xanthoparmelia alexandrensis* is loosely adnate and has weakly erumpent isidia, and *X. pustuliza* is tightly adnate and has strongly erumpent, pustular isidia. The fourth species, *X. filsonii*, is extremely close but has significantly narrower isidia (0.05–0.07 mm).

Xanthoparmelia heterodoxa

FIGURE 43*b*

Xanthoparmelia heterodoxa (Hale) Hale, 1974b:487.

Parmelia heterodoxa Hale, 1971a:349. [Type collection: Natal Table Mountain, Distr. Pietermaritzburg, South Africa, *Almborn* 8595 (LD, holotype; US, isotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, fragile, 1–3 cm broad, dark yellowish green; lobes sublinear, 0.3–0.6 mm wide, contiguous to imbricate, narrowly black rimmed; upper surface continuous, shiny, faintly reticulate-maculate at the tips, transversely cracked toward the center, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, simple, 0.1–0.2 mm long. Pycnidia rarely developed; conidia cylindrical, 0.5 × 11–14 µm. Apothecia poorly developed, adnate, 0.3–1 mm in diameter; spores 6 × 8 µm.

CHEMISTRY.—Caperatic, olivetoric, 4-*O*-demethylmicrophyllinic, and usnic acids.

ILLUSTRATION.—Hale, 1971a, fig. 2c.

DISTRIBUTION.—South Africa (Transvaal).

COMMENTS.—This species, the only one with olivetoric acid in the genus, has the largest conidia so far discovered in *Xanthoparmelia*. Externally it is identical with *X. stenosporonica*, another South African endemic with stenosporonic acid. It is common on Natal Table Mountain but can be found in other moist sandstone localities in Natal.

Xanthoparmelia huachucensis

FIGURE 43*c*

Xanthoparmelia huachucensis (Nash) Egan, 1975:221.

Parmelia huachucensis Nash, 1973:214. [Type collection: Parker Canyon Lake, Huachuca Mountains, Cochise Co., Arizona, USA, *Nash* 3981 (ASU, holotype; DUKE, MIN, US, isotypes).]

DESCRIPTION.—Thallus adnate on rock, 4–8 cm broad, dark yellowish green; lobes sublinear, 0.4–1 mm wide, elongate and narrow, dichotomously branched, imbricate, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines, black, simple, 0.3–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, substipitate, 3–7 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Psoromic, 2′-*O*-demethylpsoromic, and usnic acids.

ILLUSTRATION.—Nash, 1973, fig. 2.

DISTRIBUTION.—Western North America, Argentina.

COMMENTS.—This species, *X. psoromica* in South Africa, and *X. nigropsoromifera* in the Sonoran Desert of USA are the only psoromic acid-containing species with a black lower surface in the genus. *Xanthoparmelia psoromica* has much broader lobes 3–7 mm wide, and *X. nigropsoromifera* has lobes more than 1 mm wide.

Xanthoparmelia hybrida

FIGURE 43*d*

Xanthoparmelia hybrida Hale, 1986b:580. [Type collection: Treur River near Bourkes Luck, Pilgrims Rest, elev. 1200 m, Transvaal, South Africa, Grid 2430 DB, *Hale* 72083, 14 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate on rock, 6–9 cm broad, yellowish green; lobes subirregular to sublinear, 1–2.5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, becoming strongly transversely cracked toward the center, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately to rather densely rhizinate, the rhizines brown, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia adnate, 2–4 mm in diameter; spores not developed.

CHEMISTRY.—Protocetraric, pseudostictic (unknown K+ deep orange-red compound near stictic acid), and usnic acids (det. A. Johnson).

ILLUSTRATION.—Hale, 1986b, fig. 22.

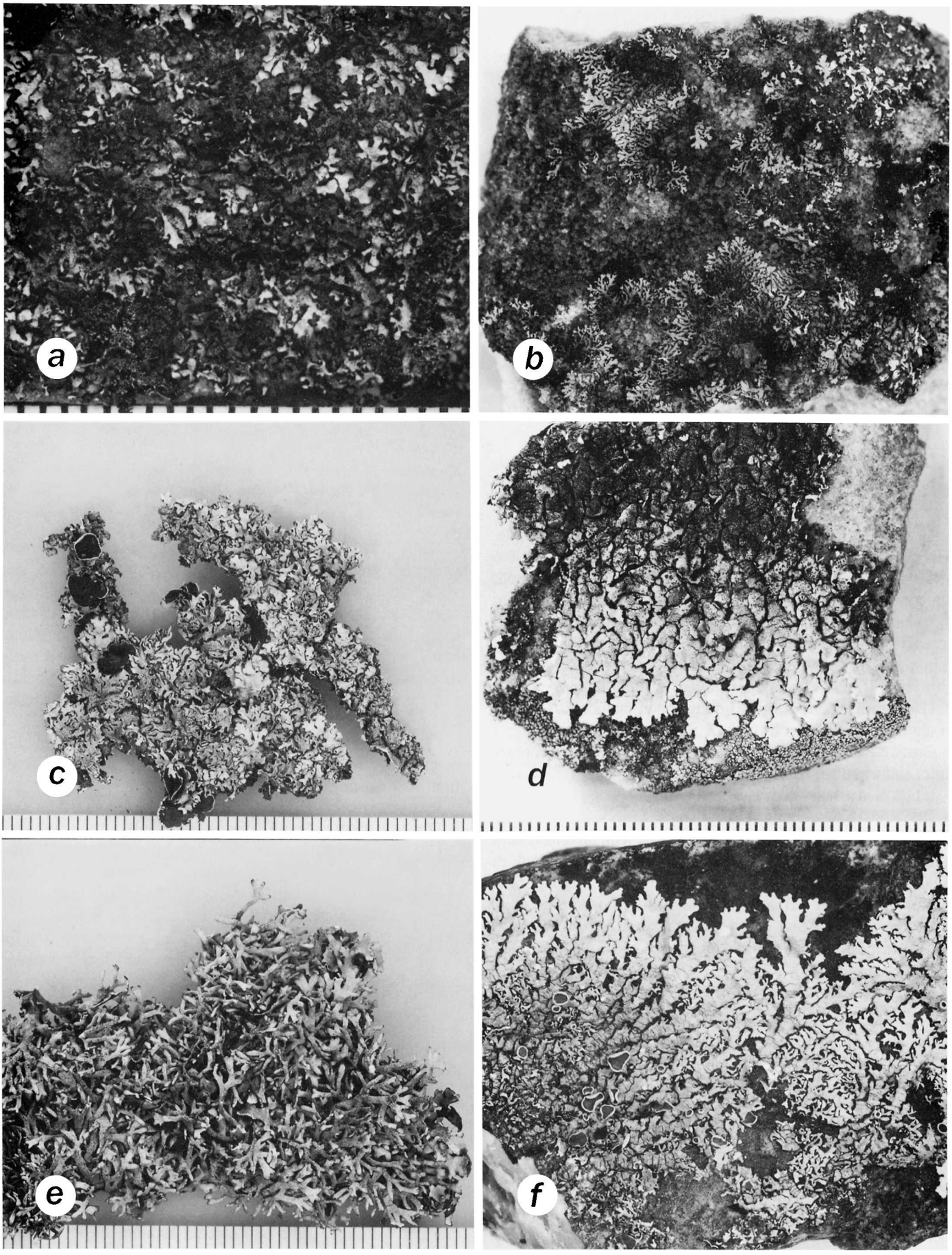
DISTRIBUTION.—South Africa (Transvaal).

COMMENTS.—This rare lichen in the Transvaal Drakensbergs is distinguished by the unique combination of a P+ and K+ acid, not previously reported in the genus. The original identification as stictic acid was incorrect; the K+ substance is pseudostictic acid. Morphologically it might be mistaken for an adnate specimen of *X. austroafricana*, which also contains protocetraric acid but is always K– in the medulla.

Xanthoparmelia hybridiza

Xanthoparmelia hybridiza Elix and Johnston, 1987:364. [Type collection: King George Beach, Kangaroo Island, S.A., Australia, *Elix* 19748, 30 Oct 1985 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 5–8 cm broad, yellowish green but darkening with age; lobes sublinear-elongate, 1–2 mm wide, contiguous to imbricate; upper surface continuous, emaculate, opaque, transversely cracked with age, isidia and soredia lacking; medulla white;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lower surface plane, pale tan to brown but darkening to blackish at lobe tips, moderately to densely rhizinate, the rhizines brown, simple, slender, 0.3–0.6 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia well developed, substipitate, 1–4 mm in diameter; spores 5–6 × 7–9 µm.

CHEMISTRY.—Barbatic (major), salazinic (major), 4-*O*-demethylbarbatic (trace), norstictic (±trace), consalazinic, and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1987, fig. 6.

DISTRIBUTION.—Australia (Tas, Vic, SA, WA).

COMMENTS.—This widespread species with a hybrid chemistry is superficially similar to *X. lineola,* which contains only salazinic acid as the major component and within Australia has a more northerly, eastern distribution.

Xanthoparmelia hypoleia

FIGURE 43*e*

Xanthoparmelia hypoleia (Nylander) Hale, 1974b:487.

Parmelia hypoleia Nylander, 1860:393. [Type collection: Cape of Good Hope, South Africa, s.c. (FH-Tuck, lectotype; H, Nyl. herb. no. 34824, isolectotype).]

Parmelia leonora var. *multifida* Flotow, 1843:27. [Type collection: Cape of Good Hope, South Africa, s.c. (BM, lectotype). Illegitimate name.]

Parmelia hypoleia var. *crenata* Nylander in Hue, 1890:[82]290. [Nomen nudum.]

Parmelia hypoleioides Vainio, 1926:1. [Type collection: Near Paarl, South Africa, *van Velden* 334 (TUR, Vainio no. 34578, lectotype).]

Parmelia hypoleia f. *hypoleioides* (Vainio) Gyelnik, 1938b:29.

Omphalodium hypoleium (Nylander) Dodge, 1959:189.

DESCRIPTION.—Thallus loosely adnate on rock, more or less pulvinate, stiff, 5–10 cm broad, dark yellowish green; lobes sublinear to linear, 0.6–2 mm wide, dichotomously branched, imbricate, subascending at the tips; upper surface effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane to weakly canaliculate with a yellow rim toward the tips, black, very sparsely rhizinate, the rhizines black, simple to furcate, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, substipitate, 3–7 mm in diameter; spores 6–7 × 10–12 µm.

CHEMISTRY.—Protocetraric, virensic (±trace), and usnic acids.

ILLUSTRATIONS.—Elix, Johnston, and Armstrong, 1986, fig. 21; Swinscow and Krog, 1988, fig. 182.

DISTRIBUTION.—Australia (WA), South Africa (Cape Province), Uganda.

COMMENTS.—*X. hypoleia* was one of the first described of the South African lichens. It is very common in Namaqualand and southwestern Cape Province but is very rare in western Australia. It is the parent species for the *X. hypoleia* group, characterized by linear lobes, an effigurate-maculate upper surface, and a jet black, often sparsely rhizinate lower surface. While most specimens in South Africa fit in these limits, there is great variation in rhizine density and lobe width, so much so that broad-lobed, densely rhizinate specimens, common in Namaqualand, may not even be identified at first as *X. hypoleia.*

Other species of this group in South Africa include the very common *X. hypoprotocetrarica* (also common in Australia), rare *X. burmeisteri* (also in Australia), *X. cedrus-montana,* and *X. dysprosa.* In Australia one will also find *X. mannumensis, X. pseudohypoleia,* and *X. notata.* There are subtle morphological and ecological differences between these species but none has been carefully studied in the field.

Nylander (1860) mentioned a specimen from the Cape of Good Hope with crenate apothecia and labeled one in his herbarium as *"hypoleia (crenata)"* (H-Nyl 34824) but did not formally propose a name, as Gyelnik (1938b:28) noted. Hue (1890:290) listed it as var. 1 *crenata* (var. 2 is *tenuifida*). This name is a nomen nudum.

Xanthoparmelia hypomelaena

FIGURE 43*f*

Xanthoparmelia hypomelaena (Hale) Hale, 1974b:487.

Parmelia hypomelaena Hale, 1967:416. [Type collection: S of Ouachita River, Jones Mill, Malvern, Hot Spring Co., Arkansas, USA, *Demaree* 34598 (US, holotype; DUKE, UPS, WIS, isotypes).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 4–10 cm broad, yellowish green; lobes subirregular to sublinear, 1–2 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate, the rhizines black, simple, coarse, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia numerous, substipitate, 1–2 mm in diameter; spores 5–6 × 10–12 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, physodalic (±trace), and usnic acids.

ILLUSTRATION.—Hale, 1967, fig. 4.

DISTRIBUTION.—South-central USA.

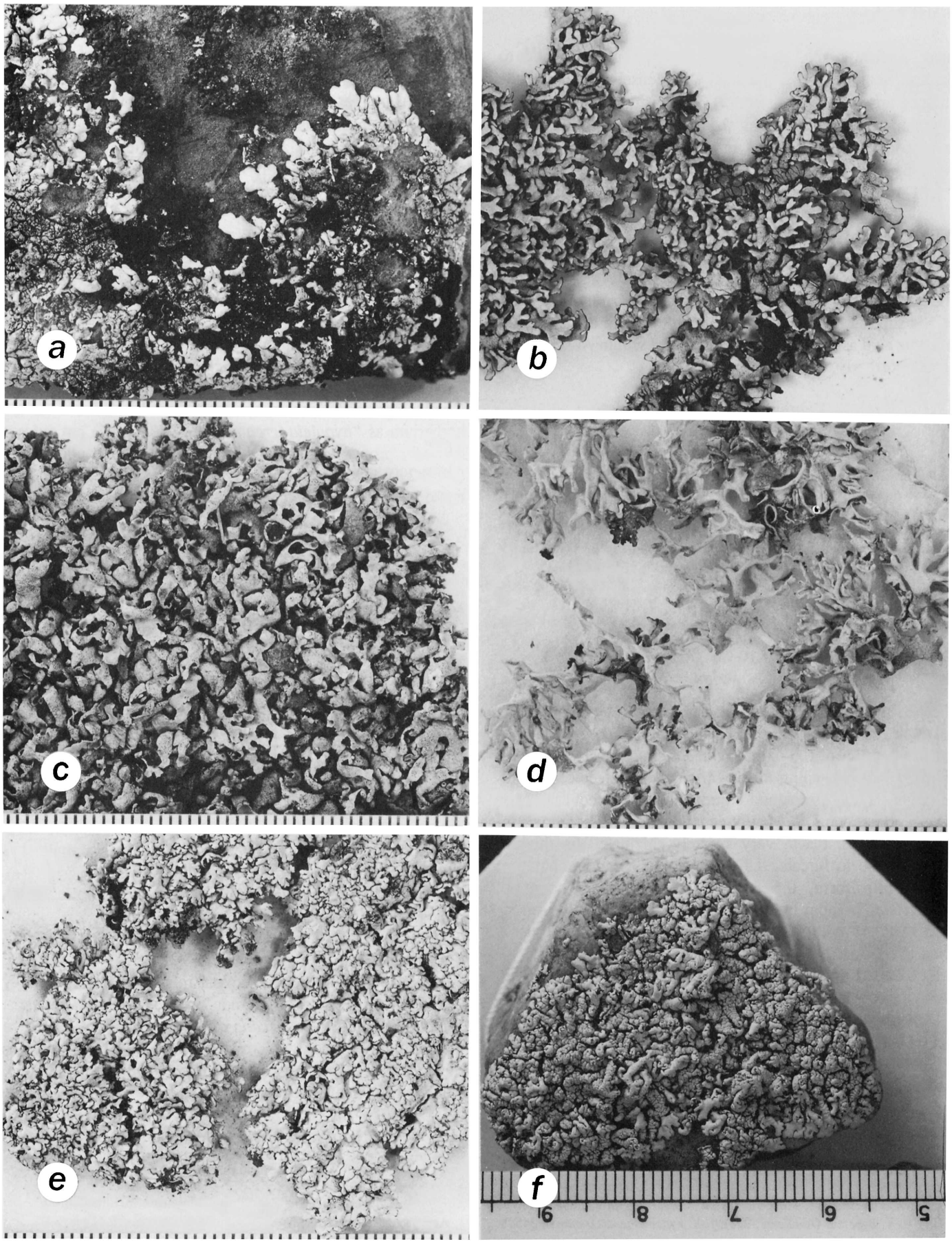
COMMENTS.—There are no close relatives for this narrowly endemic species, most common in the state of Arkansas. *Xanthoparmelia novomexicana* from western USA and Mexico is very tightly adnate with crowded lobes and lacks succinprotocetraric acid. The Australia *X. hypomelaenoides* has more apically rotund, subirregular lobes.

Xanthoparmelia hypomelaenoides

FIGURE 44*a*

Xanthoparmelia hypomelaenoides Elix and Johnston in Elix, Johnston, and Armstrong, 1986:263. [Type collection: 13 km E of Copley, Flinders Ranges, S.A., Australia, *Elix* 18004, 30 Oct 1984 (CBG, holotype).]

FIGURE 43.—Species of *Xanthoparmelia: a, X. heinari* (*Streimann* 38549, holotype in CBG); *b, X. heterodoxa* (*Almborn* 8595, holotype in LD); *c, X. huachucensis* (*Nash* 3981, isotype in US); *d, X. hybrida* (*Hale* 72083, holotype in US); *e, X. hypoleia* (*Almborn* 5278); *f, X. hypomelaena* (*Demaree* 34598, holotype in US). Scale in mm.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DESCRIPTION.—Thallus adnate on rock, 3–7 cm broad, pale yellowish green or darkening with age; lobes subirregular, 1–2.5 mm wide, short and irregularly branched, apically rotund, in part subascending, subrevolute, separate to subimbricate; upper surface continuous, emaculate, dull, becoming strongly rugulose, with age, transversely cracked; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, brown at the tips, simple, robust, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–5 µm. Apothecia lacking.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, protocetraric (trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 22.

DISTRIBUTION.—Australia (Qld, SA).

COMMENTS.—*Xanthoparmelia hypomelaena* in southeastern USA has the same combination of morphological and chemical characters but the lobes are uniformly tightly adnate and narrower. *Xanthoparmelia hypomelaenoides* is a rare species in southeastern Australia, known from four collections.

Xanthoparmelia hypoprotocetrarica

FIGURE 44*b*

Xanthoparmelia hypoprotocetrarica (Kurokawa and Elix) Hale, 1974b:487.

Parmelia hypoprotocetrarica Kurokawa and Elix, 1971:113. [Type collection: Coppins' Crossing, A.C.T., Australia, *Elix* 101 (TNS, holotype; CANB, MEL, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm, often pulvinate, 6–15 cm broad light yellowish green or darkening; lobes sublinear to linear, 1–1.5 mm wide, loosely imbricate, often subaescending; uepper surface effigurate-maculate, isidia and soredia lacking; medulla white; lower surface plane, black, rugulose, sparsely rhizinate, the rhizines black, simple to furcate, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–8 mm in diameter; spores 4–6 × 8–11 µm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic (±), 4-*O*-methylhypoprotocetraric (±trace), notatic (±trace), hypostictic (±trace), hyposalazinic (±trace), and usnic acids.

ILLUSTRATION.—Kurokawa and Elix, 1971, fig. 1.

DISTRIBUTION.—Australia (NSW, ACT, Vic, SA), South Africa (Cape Province).

COMMENTS.—A member of the *X. hypoleia* group, *X. hypoprotocetrarica* is very common on exposed rocks in the karoo in southern Africa, where it occurs often with *X. hypoleia*. Though common in Australia, it has a more limited distribution than *X. notata*, the most commonly collected species.

FIGURE 44.—Species of *Xanthoparmelia*: *a*, *X. hypomelaenoides* (*Elix* 18004, holotype in CBG); *b*, *X. hypoprotocetrarica* (*Almborn* 1904); *c*, *X. hypopsila* (*Reitz and Klein* 15724, holotype of *X. austroamericana* in US); *d*, *X. idahoensis* (*Rosentreter* 3828, holotype in US); *e*, *X. imbricata* (*Hale* 81541, holotype in US); *f*, *X. incrustata* (*Filson* 11958). Scale in mm.

Xanthoparmelia hypopsila

FIGURE 44*c*

Xanthoparmelia hypopsila (Müller Argoviensis.) Hale, 1974b:488.

Parmelia hypopsila Müller Argoviensis, 1887:317. [Type collection: Uruguay, *Arechavaleta* 12 (G, lectotype).]

Parmelia montevidensis Müller Argoviensis, 1891:379. [Type collection: Cerro Melones, Montevideo, Uruguay, *Felippone* 8 (BM, lectotype; G, isolectotype).]

Parmelia laxa f. *montevidensis* (Müller Argoviensis) Gyelnik, 1935:41.

Parmelia conspersa f. *montevidensis* (Müller Argoviensis) Gyelnik, 1936:123.

Parmelia subconspersa f. *lobulifera* Gyelnik, 1938a:290. [Type collection: Between Bitterfontein and Garies, Namaqualand, South Africa, *v.d. Byl* 1178 (W, lectotype; BP, isolectotype).]

Xanthoparmelia austroamericana Hale, 1985a:282. [Type collection: Morro do Pinheiro Seco, Lajes, Santa Catarina, Brazil, *Reitz and Klein* 15724 (US, holotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, less commonly on soil, rather brittle and often breaking apart when collected, 8–15 cm broad, yellowish green; lobes subirregular to sublinear, 1–2.5 mm wide, weakly convoluted at the tips, usually elongate, contiguous to crowded and imbricate, with some coarse subascending lobules; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, often with a weakly developed raised yellowish rim toward the tips, black, shiny, very sparsely rhizinate at the tips, sparsely rhizinate at the center, the rhizines black, simple. 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia substipitate, 2–5 mm in diameter;spores 5–6 × 9–12 µm.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1985, fig. 4.

DISTRIBUTION.—Brazil, Uruguay, Paraguay, Argentina, Chile, South Africa (Cape Province).

COMMENTS.—This species is rather common in southern South America. Previously the name had been used for northern hemisphere populations in North America, now considered to be a distinct species, *X. angustiphylla*, which is more loosely adnate and has a more densely rhizinate lower surface without any marginal rim. The isidiate morph is *X. catarinae*.

Xanthoparmelia hyporhytida

Xanthoparmelia hyporhytida (Hale) Hale, 1974b:488.

Parmelia hyporhytida Hale, 1971a:349. [Type collection: N of Clanwilliam, Cape Province, South Africa, *Kofler* s.n. (LD, holotype; US, isotype).]

DESCRIPTION.—Thallus loosely attached on small pebbles or rarely free growing on soil, firm, 3–8 cm broad, yellowish green; lobes sublinear to linear, 1.5–4 mm wide, dichotomously branched, separate to subimbricate, subascending; upper surface continuous, emaculate to faintly white-maculate, isidia and soredia lacking; medulla white; lower surface plane,

black at the tips but usually becoming dark to light brown at the center, the cortex eroding, strongly reticulately rugose, sparsely rhizinate except near the lobe tips, the rhizines coarse, black, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 6–7 µm. Apothecia rare, substipitate, 6–10 mm in diameter; spores 4–5 × 6–8 µm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids, "chalybaeizans" unknown (±).

ILLUSTRATION.—Hale, 1971a, fig. 3A.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—*X. hyporhytida* is most commonly found on quartzite pebbles in the knersvlakte region of Namaqualand. The lower surface is usually entirely black but a few specimens have a light brown area at the center. A sister species, *X. walteri*, the commonest lichen along the Namibian coast, is smaller with narrower lobes (0.5–1.5 mm wide), more distinct maculae, a more uniformly black lower surface, and contains only salazinic acid.

Xanthoparmelia ianthina

Xanthoparmelia ianthina Brusse in Knox and Brusse, 1983:152. [Type collection: Vanrhyn's Pass, 42 km NE of Vanrhynsdorp, Cape Prov., Republic of South Africa, *Brusse* 768-10-1-15 (PRE, holotype).]

DESCRIPTION.—Thallus adnate on rock, rather fragile, 3–8 cm broad, dull yellowish green; lobes subirregular, 0.7–1.5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla uniformly deep purple red; lower surface plane, shiny, pale brown, sparsely to moderately rhizinate, the rhizines pale, simple. 0.3–0.6 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, substipitate, 2–6 mm in diameter; spores 5–6 × 10–11 µm.

CHEMISTRY.—Unidentified anthraquinone pigments, two suspected, unidentified β-orcinol µ-depsides and usnic acid.

ILLUSTRATION.—Knox and Brusse, 1983, fig. 8.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Near *X. endomiltoides* and sharing with it the same brilliant anthraquinone pigments, this rare pigmented species lacks salazinic acid. This difference can only be detected with TLC, as the pigments obscure the results of spot tests in the medulla. It is known only from the sandstone escarpments above Namaqualand.

Xanthoparmelia idahoensis

FIGURE 44*d*

Xanthoparmelia idahoensis Hale, 1989a:547. [Type collection: On calcareous lacustrine ash soil, SE of Salmon, Lemhi County, Idaho, T 21 N, R 22 E, sect. 28, *R. Rosentreter* 3828, 4 Jan 1986 (US, holotype; Rosentreter herbarium, isotype).]

DESCRIPTION.—Thallus vagrant, free growing on soil, firm, breaking apart when collected, 2–4 cm broad, light yellowish green; lobes sublinear, 1.5–4 mm wide, contorted and twisted, the tips irregularly dilated and divided into subterete black-tipped laciniae ~0.5 mm wide, separate; upper surface strongly white-maculate, shiny, soredia and isidia lacking; medulla white; lower surface irregularly canaliculate with a raised rim, pale yellowish brown or turning brown toward the tips, foveolate-rugose, very sparsely rhizinate, the rhizines brown, coarse, 0.2-0.3 mm long, simple. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, protocetraric (trace), and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 12.

DISTRIBUTION.—Western USA.

COMMENTS.—This rare soil lichen with contorted lobes is unique in the genus. At first glance it seems more like a terricolous *Evernia* than a *Xanthoparmelia*. The generic position remains tentative, although I was able to find epicorticate pores (lacking in *Evernia*) with the scanning electron microscope.

Xanthoparmelia imbricata

FIGURE 44*e*

Xanthoparmelia imbricata Hale, 1989a:547. [Type collection: On sheltered dolerite ledges on hillside, 56.1 km N of Mapholaneng on Sani Pass-Moteng Pass road, elev. ca. 3000 m, Lesotho, Grid 2828 DD, *Hale* 81541, 7 May 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, subpulvinate, rather fragile and breaking apart, 8–10 cm broad, light yellowish green; lobes subirregular, 1–2 mm wide, short with digitate-laciniate branched tips, the tips black rimmed and often suberect and weakly subterete, strongly imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, dark brown at the tips with a yellowish rim, blackening at the center, very sparsely rhizinate, the rhizines black, simple, 0.4–0.8 mm long. Pycnidia numerous; conidia subbifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Fatty "subdecipiens" unknowns 33 and 37 (major), constipatic (±trace), protoconstipatic (±trace), and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 13.

DISTRIBUTION.—Lesotho.

COMMENTS.—The digitate-laciniate lobes and chemistry set this species apart from other fatty acid-containing species with a black lower surface. It is known only from high elevation dolerite ledges in Lesotho.

Xanthoparmelia immutata

Xanthoparmelia immutata Elix and Johnston in Elix, Johnston, and Armstrong, 1986:266. [Type collection: 3 km S of Barrow Creek along Stuart Highway, N.T., Australia, *Elix* 11209 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 2–8 cm broad, dark yellowish green; lobes sublinear, 0.2–1 mm wide,

short, crowded, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia initially subglobose, cylindrical at maturity, 0.06–0.12 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, blackening, becoming branched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.1–0.4 mm long. Pycnidia lacking. Apothecia rare, adnate, about 1 mm in diameter; spores 5–6 × 10–11 µm.

CHEMISTRY.—Scabrosin 4-acetate-4′-hexanoate, scabrosin 4-acetate-4′-butyrate, scabrosin 4,4′-dibutyrate, scabrosin 4,4′-diacetate (±), constipatic, protoconstipatic, and usnic acid.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 23.

DISTRIBUTION.—Australia (Qld, SA, NT).

COMMENTS.—This rare Australian species appears to be related to *X. remanens*, a larger species (lobes 1.5–2.5 mm wide) which lacks fatty acids and has globose erumpent isidia, and to *X. nonreagens*, which has cylindrical isidia and lacks the fatty acids.

Xanthoparmelia incerta

Xanthoparmelia incerta (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:268.

Parmelia incerta Kurokawa and Filson, 1975:39. [Type collection: Warren Gorge, Lower Flinders Ranges, S.A., Australia, *Curtis* 7 (MEL, holotype).]

DESCRIPTION.—Thallus adnate to tightly adnate on rock, 3–5 cm broad, yellowish green; lobes subirregular, 1–2.5 mm wide, crowded and imbricate, often black rimmed; upper surface continuous, emaculate, dull, rugulose with age isidia and soredia lacking; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines brown to black, coarse, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–8 mm in diameter; spores 5–7 × 7–11 µm.

CHEMISTRY.—Salazinic, consalazinic, constipatic (±), 4-*O*-methylhypoprotocetraric (±trace), and usnic acids.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 2: fig. 1.

DISTRIBUTION.—Australia (Qld, Vic, Tas, SA, NT, WA), New Zealand, Papua New Guinea, South Africa (Cape Province).

COMMENTS.—*X. incerta* could be confused with another Australian species, *X. parvoincerta*, which has narrower, more sublinear lobes.

Xanthoparmelia inconspicua

Xanthoparmelia inconspicua Hale, 1987a:256. [Type collection: On west side of hwy R43, 17.4 km N of N2, N of Floorshoogte, elev. 350 m, Cape Province, South Africa, Grid 3419 AB, *Hale* 78197, 26 Oct 1986 (US, holotype; PRE, isotype).]

Parmelia tantillum [sic] Brusse, 1989a:403. [Nomen novum based on *Xanthoparmelia inconspicua* Hale.]

DESCRIPTION.—Thallus very tightly adnate on rock, 3–5 cm broad, dull yellowish green; lobes sublinear, 0.3–0.6 mm wide, little branched, 1.5–2 mm long, separate to contiguous, isidia and soredia lacking; upper medulla white, lower medulla rusty red in older parts; lower surface plane, the cortex thin and fragile, brown, moderately rhizinate, the rhizines delicate, brownish translucent, simple, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypostictic, hyposalazinic, hypoconstictic, and usnic acids, unidentified dull reddish pigments.

ILLUSTRATION.—Hale, 1987a, fig. 8.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This rare species has no obvious relatives among the tightly adnate members of the genus. Not only is the hypostictic acid group ("quintaria unknowns") unusual here but the fragile, thin lower cortex with translucent rhizines is distinctive. The pigment is scattered mostly in the lower medullary area. The number of the type was given incorrectly as *Hale* 78097.

Xanthoparmelia incrustata

FIGURE 44*f*

Xanthoparmelia incrustata (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:269.

Parmelia incrustata Kurokawa and Filson, 1975:39. [Type collection: Wallabyng Range, 21 km N of Kingoonya, S.A., Australia, *Filson* 11958 (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock or pebbles, 2–6 cm broad; lobes subirregular to sublinear, 0.6–2 mm wide, imbricate, secondary ones towards the margins and the center becoming weakly canaliculate with a weakly developed marginal rim; upper surface continuous, emaculate, shiny, becoming cracked and rugulose at the center, isidia and soredia lacking; medulla white; lower surface plane, pale brown, darkening toward the margins, sparsely to moderately rhizinate, the rhizines pale brown, stout, simple, 0.2–0.4 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, substipitate, 2–4 mm in diameter; spores 5–6 × 10–12 µm.

CHEMISTRY.—Norlobaridone, loxodin, scabrosin 4,4′-dibutyrate (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±), and usnic acid.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 2: fig. 2.

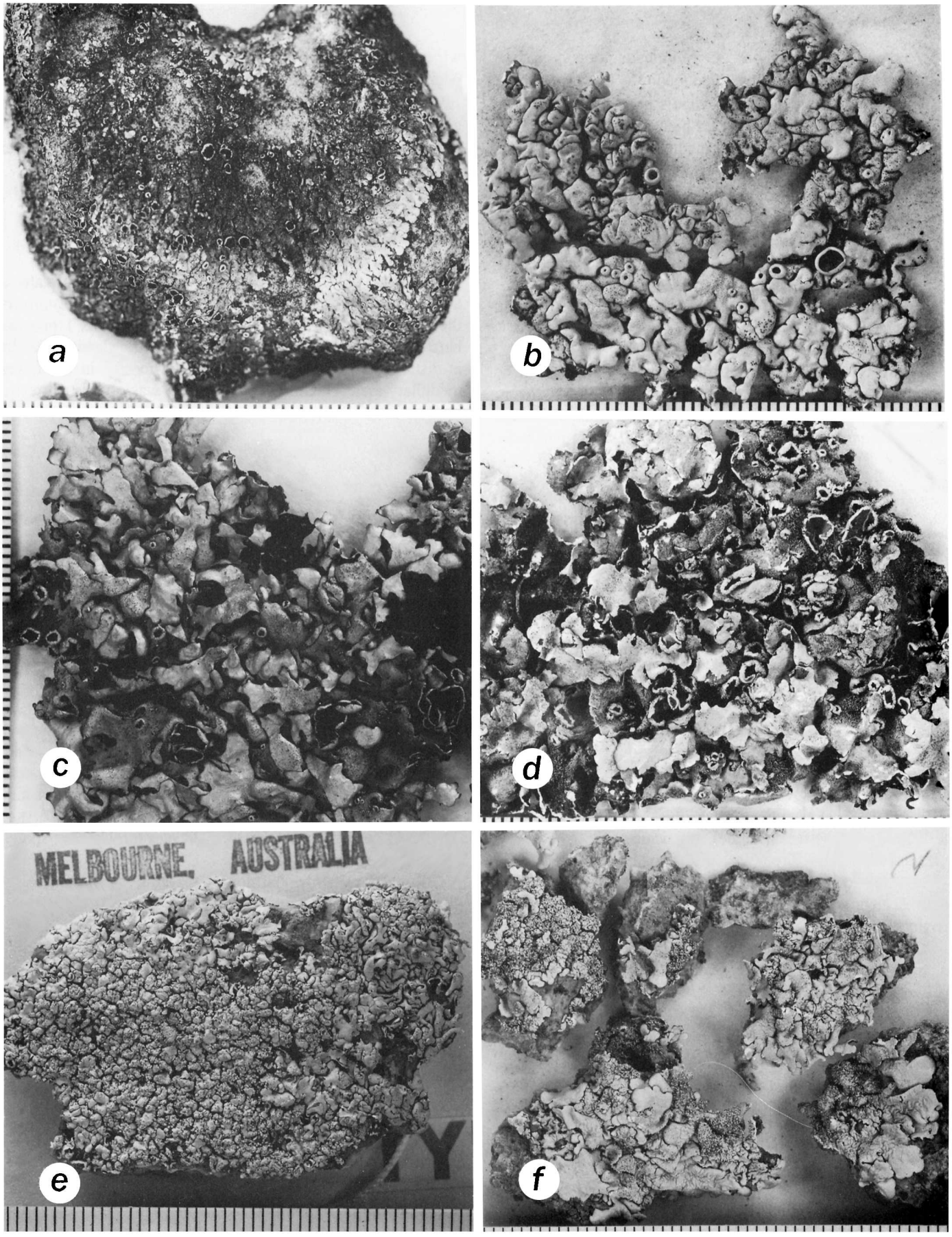
DISTRIBUTION.—Australia (SA, WA).

COMMENTS.—This species may be related to *X. filarszkyana*, but it differs in having well-developed, convex secondary lobes. The accessory scabrosin derivatives occur only rarely in this species.

Xanthoparmelia indumenica

FIGURE 45*a*

Xanthoparmelia indumenica Hale, 1986b:580. [Type collection: trail to Indumeni Forest/Rainbow Gorge, Cathedral Peak, elev. 1600 m, Natal, South Africa, Grid 2829 CC, *Hale* 75107, 22 Feb 1986 (US, holotype; PRE, isotype).]


a
b
c
d
MELBOURNE, AUSTRALIA
e
f

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 4–5 cm broad, yellowish green but becoming darker green toward the center; lobes sublinear, 0.5–1.5 mm wide, rather short, contiguous, sparsely short lobulate-laciniate along the margins; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, rather coarse, simple, 0.1–0.3 mm long. Pycnidia well developed; conidia bifusiform, 0.5 × 5–6 µm. Apothecia numerous, adnate, 0.6–1 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Stictic (major), diffractaic (major), constictic, cryptostictic, norstictic (trace), and usnic acids (det. C. Culberson and A. Johnson).

ILLUSTRATION.—Hale, 1986b, fig. 23.

DISTRIBUTION.—South Africa (Natal).

COMMENTS.—This inconspicuous lichen known from three localities in the moist foothills of the Natal Drakensbergs has an unusual in chemistry, this combination of acids being only known here.

Xanthoparmelia inflata

FIGURE 45*b*

Xanthoparmelia inflata Hale, 1989a:549. [Type collection: On small dolerite boulders on S-facing slope, east side of Kotisephola Pass, 11.3 km NW of Sani Pass, elev. 3200 m, Lesotho, Grid 2929 CB, *Hale* 81531, 6 May 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather leathery and appearing inflated, 5–10 cm broad, light yellowish green; lobes broadly sublinear, 2–3 mm wide, little branched, separate to contiguous; upper surface continuous, emaculate, dull, rugose at the center, isidia and soredia lacking; medulla white; lower surface plane, pale brown, densely rhizinate, the rhizines pale brown, simple to sparsely furcately branched, 0.5–1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 6–7 µm. Apothecia well developed, substipitate, 3–7 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 14.

DISTRIBUTION.—Lesotho.

COMMENTS.—*Xanthoparmelia inflata* represents another member of the hypoprotocetraric acid-containing *X. prodomokosii* group. The diagnostic features of this speycies are the high elevation habitat and the puffy, little branched lobes. During the long winter season the plants are shaded and covered with hoarfrost or snow.

FIGURE 45.—Species of *Xanthoparmelia: a, X. indumenica* (*Hale* 75107, holotype in US); *b, X. inflata* (*Hale* 81531, holotype in US); *c, X. isidiascens* (*McVaugh* 4588); *d, X. isidiigera* (*Harris* 52, lectotype in G); *e, X. isidiosa* (*Filson* 11940a, holotype of *P. refringens* in MEL); *f, X. joranadia* (*Nash* 7897). Scale in mm.

Xanthoparmelia iniquita

Xanthoparmelia iniquita Elix and Johnston in Elix, Johnston, and Armstrong, 1986:270. [Type collection: 25 km WSW of Grenfell, Weddin State Forest, NSW, Australia, *Elix* 4781 (CBG, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock, 4–8 cm broad, light yellowish green; lobes sublinear, 1–2 mm wide, more or less separate to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.4–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–8 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, protocetraric (±trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 24.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic), South Africa (Cape Province).

COMMENTS.—Another Australian species, *X. pertinax*, has the same chemistry but is adnate on rock. The American *X. monticola* is a somewhat smaller plant with physodalic and constipatic acids as additional metabolites.

Xanthoparmelia inuncta

Xanthoparmelia inuncta (Brusse) Hale, 1988b:403.

Parmelia inuncta Brusse, 1986:187. [Type collection: SW slope of Ruitersberg, Robinsons Pass, Cape Province, South Africa, *Brusse* 4810, 4 Feb 1986 (PRE, holotype; BM, LD, US, isotypes).]

DESCRIPTION.—Thallus tightly adnate on rock, 2–5 cm broad, dull to rather dark yellowish green; lobes sublinear, 0.2–0.7 mm wide, delicate, elongate and sparingly dichotomously branched, contiguous to subimbricate, irregularly constricted, black-rimmed; upper surface continuous, emaculate, shiny, weakly rugulose and transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, simple, 0.1–0.3 mm long. Pycnidia lacking. Apothecia poorly developed, adnate, 0.3–0.8 mm in diameter; spores not found.

CHEMISTRY.—Fatty "subdecipiens" unknowns 33 and 37, constipatic (±trace), and usnic acids.

ILLUSTRATION.—Brusse, 1986, fig. 5.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This is the only tightly adnate representative of the fatty acid-containing species with a black lower surface. *Xanthoparmelia subnigra*, for example, is much larger with lobes 1–2 mm wide. This species, in fact, has among the narrowest lobes so far found in the genus. It is known from two localities in southern Cape Province.

Xanthoparmelia isidiascens

FIGURE 45*c*

Xanthoparmelia isidiascens Hale, 1984:73. [Type collection: Near Blake's Ferry, Randolph Co., Alabama, *McVaugh* 4588 (US, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock, rather fragile, 6–13 cm broad, dull yellowish green; lobes sublinear, 1.5–4 mm wide, elongate and more or less separate to imbricate; upper surface continuous to faintly white-maculate or minutely reticulate foveolate at the tips, shiny, sparsely to moderately isidiate, the isidia cylindrical (Figure 15*h*), 0.08–0.15 mm in diameter, 0.1–0.4 mm high, the tips syncorticate, black, branching with age; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, coarse, simple, 0.5–1 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 µm. Apothecia substipitate, 2–6 mm in diameter; spores 5–6 × 7–9 µm.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1984, fig. 2.

DISTRIBUTION.—Southeastern USA.

COMMENTS.—Previously this American endemic was lumped with *X. conspersa*, but the lobes are sublinear and the thallus quite loosely adnate. It is especially common on the granite flats in the state of Georgia.

Xanthoparmelia isidiigera

FIGURE 45*d*

Xanthoparmelia isidiigera (Müller Argoviensis) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:272.

Parmelia conspersa var. *laxa* f. *isidiigera* Müller Argoviensis, 1883:48. [Type collection: King Georges Sound, Australia, *Harris* 52 (G, lectotype).]

Parmelia isidiigera (Müller Argoviensis) Gyelnik, 1935:27.

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rarely on wood, brittle, 4–8 cm broad, dull yellowish green; lobes subirregular to sublinear, 1.5–2.5 mm wide, contiguous to imbricate; upper surface continuous to faintly white-maculate, shiny, moderately to densely isidiate, the isidia cylindrical (Figure 15*i*), thin, 0.04–0.08 mm in diameter, 0.1–0.8 mm high, the tips syncorticate, darkening, mostly unbranched; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate, the rhizines black. coarse, 0.3–0.8 mm long. Pycnidia common; conidia cylindrical to bifusiform, 0.5 × 4–6 µm. Apothecia rare, substipitate, 2–6 mm in diameter; spores 5 × 7–9 µm.

CHEMISTRY.—Salazinic, consalazinic, protocetraric (trace), norstictic (±trace), ursolic, and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 25.

DISTRIBUTION.—Australia (all states), New Zealand, Papua New Guinea, Peru, South Africa (Cape Province).

COMMENTS.—This common species is close to *X. australasica* but with much thinner isidia and a more adnate thallus.

Xanthoparmelia isidiosa

FIGURE 45*e*

Xanthoparmelia isidiosa (Müller Argoviensis) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:274.

Parmelia conspersa var. *stenophylla* f. *isidiosa* Müller Argoviensis, 1892a:193. [Type collection: Everard Ranges, Australia, *Helms* 92 (G, lectotype).]

Imbricaria conspersa * *isidiosa* (Müller Argoviensis) Jatta, 1902:470.

Parmelia isidiosa (Müller Argoviensis) Hale, 1955:14.

Parmelia refringens Kurokawa and Filson, 1975:43. [Type collection: Wynbring Rocks, 1.2 km N of Wynbring, S.A., Australia, *Filson* 11940 (MEL, holotype).]

Xanthoparmelia refringens (Kurokawa and Filson) Hale, 1984:79.

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–7 cm broad, dark yellowish green; lobes subirregular, 0.8–1.5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, rugulose toward the center, moderately isidiate, the isidia globose (Figure 16*a*), 0.08–0.15 mm in diameter, 0.1–0.5 mm high, the tips syncorticate to epicorticate, darkening, erumpent and at length pustulate but not sorediate, mostly unbranched; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines black simple, 0.2–0.5 mm long. Pycnidia lacking. Apothecia rare, substipitate, 2–6 mm in diameter; spores 4–6 × 9–10 µm.

CHEMISTRY.—Salazinic (major), consalazinic, protocetraric (±trace), norstictic (±trace) and usnic acids.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 3: fig. 3 (as *Parmelia refringens*).

DISTRIBUTION.—Australia (Qld, NSW, Tas, SA, NT, WA).

COMMENTS.—The tightly adnate thallus and black lower surface of this desert lichen recall the South African *X. geesterani*, which has smaller lobes (0.7–1.1 mm wide) and more clearly erumpent, apically epicorticate isidia.

Xanthoparmelia joranadia

FIGURE 45*f*

Xanthoparmelia joranadia (Nash) Hale, 1974b:488.

Parmelia joranadia Nash, 1974a:72. [Type collection: 40 km N of Las Cruces, Joranada Experiment Station, New Mexico State University, Dona Ana Co., New Mexico, USA, *Nash* 7897 (ASU, holotype; COLO, DUKE, MIN, US, isotypes).]

DESCRIPTION.—Thallus adnate on rock, 3–8 cm broad, light yellow green; lobes subirregular, 1–2.5 mm wide, contiguous to imbricate and crowded; upper surface continuous, emaculate, shiny to dull, rugulose, sparsely to moderately isidiate, the isidia at first globose (Figure 16*b*), cylindrical to irregularly inflated at maturity, 0.1–0.2 mm in diameter, 0.2–0.4 mm high, the tips weakly epicorticate, darkening, mostly unbranched; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines pale, simple, 0.2–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Lecanoric and usnic acids.

ILLUSTRATION.—Nash, 1974a, fig. 1.

DISTRIBUTION.—Western North America.

COMMENTS.—This rare lichen is most closely related to nonisidiate *X. arida*.

Xanthoparmelia kalbii

FIGURE 46*a*

Xanthoparmelia kalbii Hale, 1984:74. [Type collection: Catimbal-Pe, Pernambuco, Brazil, *Xavier* 754 (US, holotype).]

DESCRIPTION.—Thallus adnate on rock, fragile, 3–4 cm broad, light yellowish green; lobes subirregular, 1–2 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia globose (Figure 16*c*), 0.08–0.12 mm in diameter, 0.1–0.2 mm high, the tips becoming epicorticate, eroding and erumpent, esorediate, unbranched; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines pale brown, simple or furcate, 0.2–0.6 mm long. Pycnidia rarely developed; conidia bifusiform, 0.5 × 5–6 µm. Apothecia rare, substipitate, 1–2 mm in diameter; spores 6 × 10–11 µm.

CHEMISTRY.—Hypostictic, hyposalazinic, hypoconstictic, and usnic acids.

ILLUSTRATION.—Hale, 1984, figs. 3, 4.

DISTRIBUTION.—Brazil.

COMMENTS.—Only two other isidiate species contain the hypostictic acid complex: *X. gongylodes* from Australia, a larger lichen with mostly cylindrical, sparsely erumpent isidia, and *X. harrisii* from Namibia, a mostly dark brown lichen with coarse isidia. *Xanthoparmelia kalbii* is known from two collections in semi-arid northeastern Brazil.

Xanthoparmelia karoo

FIGURE 46*b*

Xanthoparmelia karoo Knox and Brusse, 1983:154. [Type collection: Klipfonteinrand, 32 km NE of Clanwilliam, Cape Prov., Republic of South Africa, *Brusse* 768-10-3-7 (J, holotype).]
Parmelia karoo (Knox and Brusse) Brusse, 1984:321.

DESCRIPTION.—Thallus adnate on rock, firm, 3–6 cm broad, yellowish green; lobes subirregular, 1.2–2 mm wide, short and irregularly branched, imbricate; surface effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, rather coarse, unbranched, 0.5–1 mm long.

Pycnidia common; conidia bifusiform, 0.5 × 5–8 µm. Apothecia substipitate, 2–5 mm in diameter; spores 4–6 × 8–13 µm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-methylhypoprotocetraric, and usnic acids.

ILLUSTRATION.—Knox and Brusse, 1983, fig. 9.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This Namaqualand species is closely related to *X. hypoprotocetrarica*, a loosely adnate, sublinear-lobed lichen, because of the effigurate-maculate surface and identical chemistry.

Xanthoparmelia karooensis

FIGURE 46*c*

Xanthoparmelia karooensis Hale, 1986b:582. [Type collection: 8 km S of Lainsburg on Hwy R323, elev. 700 m, Cape Province, South Africa, Grid 3320 BB, 30 Jan 1986, *Hale* 75102 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate on rock, 4–7 cm broad, yellowish green; lobes subirregular, short, 0.8–1.5 mm wide, contiguous, becoming crowded and bullate at the center; upper surface continuous, emaculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla ochre; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, up to 0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–7 µm. Apothecia numerous, adnate, 2–3 mm in diameter; spores 6 × 9 µm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids, skyrin and several unidentified minor components.

ILLUSTRATION.—Hale, 1986b, fig. 24.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This is the only tightly adnate species in the genus with hypoprotocetraric acid and skyrin. It occurs over a wide area in Namaqualand and southwestern Cape Province. *Xanthoparmelia subdomokosii* has the same chemistry but is much larger and loosely adnate.

Xanthoparmelia kasachstania, new species

FIGURE 46*d*

Thallus vagans, terricola, coriaceus, 4–8 cm latus, lobis sublinearibus, 1.5–6 mm latis, valde convolutis, superne albo-maculatus, sorediis isidiisque destitutus. Pycnidia atque apothecia ignota.

DESCRIPTION.—Thallus free growing on soil, leathery, forming more or less discrete rosettes 4–8 cm broad, yellowish green; lobes sublinear, 1.5–6 mm wide, strongly convoluted but with some of the lower surface visible, dichotomously branched, separate to subimbricate; upper surface white-maculate, shiny, reticulately cracked with age, soredia and isidia lacking; medulla white; lower surface plane, pale brown but darkening at the tips, smooth to weakly foveolate, moderately to densely rhizinate, the rhizines pale brown, simple, thin, 0.2–0.6 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic, connorstictic, and usnic acids.

TYPE COLLECTION.—Kuczum, Lake Zayssan, Kazachstan orientalis, USSR, *Gonczarov and Borisova*, no. 46c in *Savicz, Lichenotheca Rossica* (US, holotype; KW, isotype).

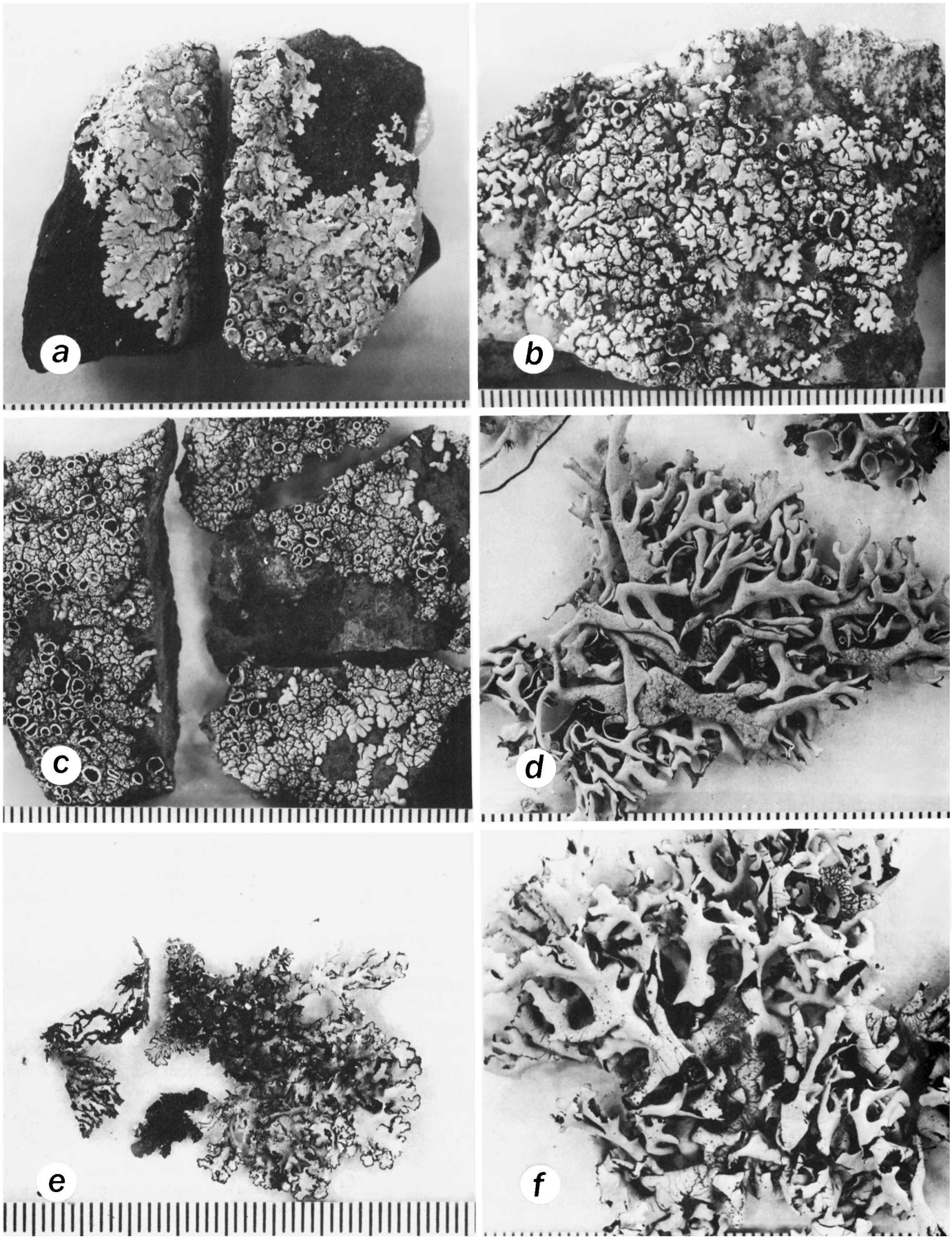
DISTRIBUTION.—USSR.

COMMENTS.—This white-maculate soil lichen is virtually indistinguishable from the far more common and widespread *X. camtschadalis*, which has coarse, sparse to moderate rhizines and contains salazinic acid. Parallel production of salazinic acid and norstictic acid is also known in the vicariant species *X. chlorochroa-X. neochlorochroa* from western North America and *X. convoluta-X. ncorconvoluta* from Australia.

Xanthoparmelia keralensis

Xanthoparmelia keralensis Hale, 1985a:282. [Type collection: 45 km from Munnar on the Munnar-Kodaikanal road, Kerala, India, elev. 1900 m, *Hale* 46480, 24 Jan 1976 (US, holotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, 4–8


a
b
c
d
e
f

cm wide, dark yellowish green; lobes sublinear, 0.2–0.5 mm wide, short, contiguous to subimbricate, black rimmed; upper surface shiny, continuous, emaculate, sparsely isidiate, isidia cylindrical (Figure 16*d*), 0.05–0.08 mm in diameter, 0.08–0.12 mm high, the tips syncorticate, black, unbranched; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines black, simple, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stenosporonic (major), colensoic (minor), norcolensoic (±trace), divaronic (trace), gyrophoric (trace), and usnic acids (det. J.A. Elix).

ILLUSTRATION.—Hale, 1985a, fig. 5.

DISTRIBUTION.—India, South Africa (Natal).

COMMENTS.—*X. keralensis* is one of the few *Xanthoparmeliae* found in both India and Africa. In South Africa it occurs in the moist foothills of the Natal Drakensbergs and in a similar habitat in the Palni Mountains in India. The nonisidiate parent morph, *X. stenosporonica*, occurs only in South Africa.

Xanthoparmelia khomasiana

Xanthoparmelia khomasiana Hale, 1989a:549. [Type collection: Khomas Highlands, 47 km W of Windhoek on Hwy R56, 3.4 km W of Neu Heusis, SWA/Namibia, Grid 2216 DA, *Hale* 80955, 25 Apr 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, 3–4 cm broad, dull yellowish green; lobes subirregular, 0.3–0.7 mm wide, short and irregularly branched, contiguous to subimbricate; upper surface continuous, emaculate, shiny, sparsely isidiate, the isidia subglobose (Figure 16*e*), 0.2 mm in diameter, to 0.2 mm high, the tips epicorticate, pale, hollow, pustular and erupting but without forming soredia; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, fragile, unbranched, 0.1–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 15.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This species is related to *X. weberi* but has a very tightly adnate thallus and unusually large globose isidia. Known from two collections in the arid Khomas highlands west of Windhoek, it occurs with *X. subamplexuloides* (norlobaridone present) and *X. weberi*. All of them grow on the lower surface of low tilted rock strata.

Xanthoparmelia kiboensis

FIGURE 46*e*

Xanthoparmelia kiboensis (Dodge) Krog and Swinscow, 1987:428.

Hypogymnia kiboensis Dodge, 1959:50. [Type collection: Between saddle and Kibo, Mt. Kilimanjaro, Tanzania, *Verdcourt and Wilkinson* 1228 (FH-Dodge, lectotype; holotype in EA not located [Krog and Swinscow, 1987]).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 3–4 cm broad, dark yellow-green; lobes subirregular to sublinear, 1–2 mm wide, irregularly branched with somewhat dissected, black-rimmed margins, imbricate; upper surface continuous, emaculate, shiny, transversely cracked with age, soredia and isidia lacking; medulla white; lower surface plane, dark brown at the margins to black at the center, becoming strongly rugose, dull with a velvety texture, moderately to densely rhizinate, the rhizines dark brown to black, coarse, 0.3–0.6 mm long, simple or apically splayed. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic (major), salazinic (trace), and usnic acids.

DISTRIBUTION.—Tanzania.

COMMENTS.—Although the designated holotype in EA has not been found (Krog, personal communication), a duplicate specimen in FH-Dodge can be used as the lectotype. Dodge regarded this rhizinate, noninflated species as a *Hypogymnia* but it is clearly a *Xanthoparmelia*, distinguished by the dull rugose lower surface and norstictic acid as the major component, a rare trait in African species. It is known from the single type collection. *Xanthoparmelia salkiboensis*, a common species at the same locality, has a shiny lower surface and salazinic acid as the major metabolite.

Xanthoparmelia kotisephola

FIGURE 46*f*

Xanthoparmelia kotisephola Hale, 1989a:549. [Type collection: On grassy humus in pasture, summit of Kotisephola Pass, 13.8 km NW of Sani Pass, elev. 3240 m, Lesotho, Grid 2929 CA, *Hale* 79519, 6 May 1988 (US, holotype; ANUC, ASU, LD, PRE isotypes).]

DESCRIPTION.—Thallus loosely adnate to mostly free growing and scattered on humus and soil, remaining mostly intact or fragmenting, firm and leathery, somewhat pulvinate, 4–12 cm broad, yellowish green or darkening; lobes sublinear, 1–3 mm wide, moderately to strongly convoluted, irregularly branched, separate to contiguous; upper surface continuous, emaculate, shiny, irregularly cracked with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown but darkening toward the tips, densely rhizinate, the rhizines brown or darkening, rather coarse and often projecting as a dense mat from below, simple, 0.5–1 mm long. Pycnidia poorly developed; conidia bifusiform, 0.5 × 5–6 μm. Apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, norstictic (trace), protocetraric (trace), and usnic acids (det. J.A. Elix).

ILLUSTRATION.—Hale, 1989a, fig. 16.

DISTRIBUTION.—Lesotho.

COMMENTS.—This convoluted species occurs in the dolerite

FIGURE 46.—Species of *Xanthoparmelia*: *a*, *X. kalbii* (*Xavier* 754, holotype in US); *b*, *X. karoo* (*Hale* 72513); *c*, *X. karooensis* (*Hale* 75102, holotype); *d*, *X. kasachstania* (*Gonczarov and Borisova* s.n., holotype in US); *e*, *X. kiboensis* (*Verdcourt and Wilkinson* 1228, lectotype in FH-Dodge); *f*, *X. kotisephola* (*Hale* 79519, holotype in US). Scale in mm.

highlands of Lesotho, widely scattered among mats of short grasses. It is distinguished from the American *X. chlorochroa* by the dense mat of dark rhizines below.

Xanthoparmelia krogiae

FIGURE 47*a*

Xanthoparmelia krogiae Hale and Elix in Hale, 1988b:403.

Pseudoparmelia endochromatica Krog and Swinscow, 1987:421. [Based on *Parmelia adplanata* Müller Argoviensis, 1885:502. Not *Parmelia applanata* Fée, 1825:126 (= *Dirinaria*) and not *X. endochromatica* Hale, 1986:254).]

Parmelia adplanata Müller Argoviensis, 1885:502. [Type collection: Near Mombossa, Zanzibar, [*Hildebrandt* 1962 p.p.] (G, lectotype; FH, isolectotype).]

Parmelia adplanata f. *isidiigera* Müller Argoviensis, 1885:502. [Type collection: Near Mombassa, Zanzibar, *Hildebrandt* 1962 p.p. (G, lectotype).]

Parmelia adplanata var. *isidiigera* (Müller Argoviensis) Dodge, 1959:59.

DESCRIPTION.—Thallus adnate on rock, 5–8 cm broad, yellowish green; lobes subirregular, 1–3 mm wide, short and irregularly branched with rotund tips, subimbricate; upper surface continuous to faintly white-maculate, shiny, moderately isidiate, the isidia cylindrical (Figure 16*f*), 0.06–0.09 mm in diameter, to 0.3 mm high, the tips pale, syncorticate, sparsely branched; medulla uniformly pale salmon yellow; lower surface plane, brown, shiny, moderately rhizinate, the rhizines pale brown to brown, simple, 0.5–1 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Succinprotocetraric (major), fumarprotocetraric (minor), protocetraric (major), and usnic acids, yellowish pigment in the secalonic acid group (det. J.A. Elix).

ILLUSTRATION.—Krog and Swinscow, 1987, fig. 1 (as *Pseudoparmelia endochromatica*).

DISTRIBUTION.—Kenya.

COMMENTS.—While this species closely resembles pantropical *X. subramigera*, the medulla is uniformly pigmented pale orange-yellow, as noted by both Müller Argoviensis and Vainio (1900), although at first one might suspect discoloration due to bad preservation. The same pigmentation occurs in the type of *X. mutabilis*. Krog (pers. comm.) has not been able to rediscover the species in eastern lowland Kenya.

Xanthoparmelia laciniata

FIGURE 47*b*

Xanthoparmelia laciniata Hale, 1987a:256. [Type collection: Trail to Pillar Caves in the Drakensberg Garden area, elev. 2000 m, Natal, South Africa, Grid 2929 CC, *Hale* 76648, 4 Oct 1986 (US, holotype; ANUC, LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, subpulvinate, 7–10 cm broad, dull yellowish green; lobes sublinear, 0.6–1.6 mm wide, short, dichotomously branched, imbricate, becoming densely laciniate, laciniae 0.3–0.5 mm wide; upper surface continuous, emaculate, shiny, rugulose with age, isidia and soredia lacking; upper medulla white, lower medulla dull reddish orange in older parts; lower surface plane, shiny, black, sparsely rhizinate, the rhizines coarse, black, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Fatty "subdecipiens" unknowns 33 and 37 (major), constipatic (±trace), protoconstipatic (±trace), and usnic acids, "schenckiana" pigment.

ILLUSTRATION.—Hale, 1987a, fig. 9.

DISTRIBUTION.—South Africa (Natal).

COMMENTS.—No other species with the "subdecipiens" constipatic acid complex have such narrow sublinear lobes or the unidentified anthraquinone which I have called the schenckiana unknown (first found in *X. schenckiana*). The pigment is usually not seen since it occurs in older decomposing parts of the thallus. It is known only from the type collection in the moist Drakensberg foothills. The number of the type collection was given incorrectly as *Hale* 76668 in the original publication.

Xanthoparmelia lagunebergensis

FIGURE 47*c*

Xanthoparmelia lagunebergensis Hale, 1986b:582. [Type collection: Laguneberg Mountains, NE of Mile 72, Distr. Omaruru, SWA/Namibia, Grid 2114 CC, *Hale* 75101, 8 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus tightly adnate on rock, light yellowish green, 2–4 cm broad; lobes sublinear, 0.5–1 mm wide, appearing somewhat inflated, separate to contiguous; upper surface continuous, emaculate, dull, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, very pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Protocetraric and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 25.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This Namibian endemic is externally close to *X. serusiauxii* but has a pale lower surface, a completely different chemistry, and lacks a black rim around the lobe margins. It is the rarest member of this group of Namib coastal fog zone species.

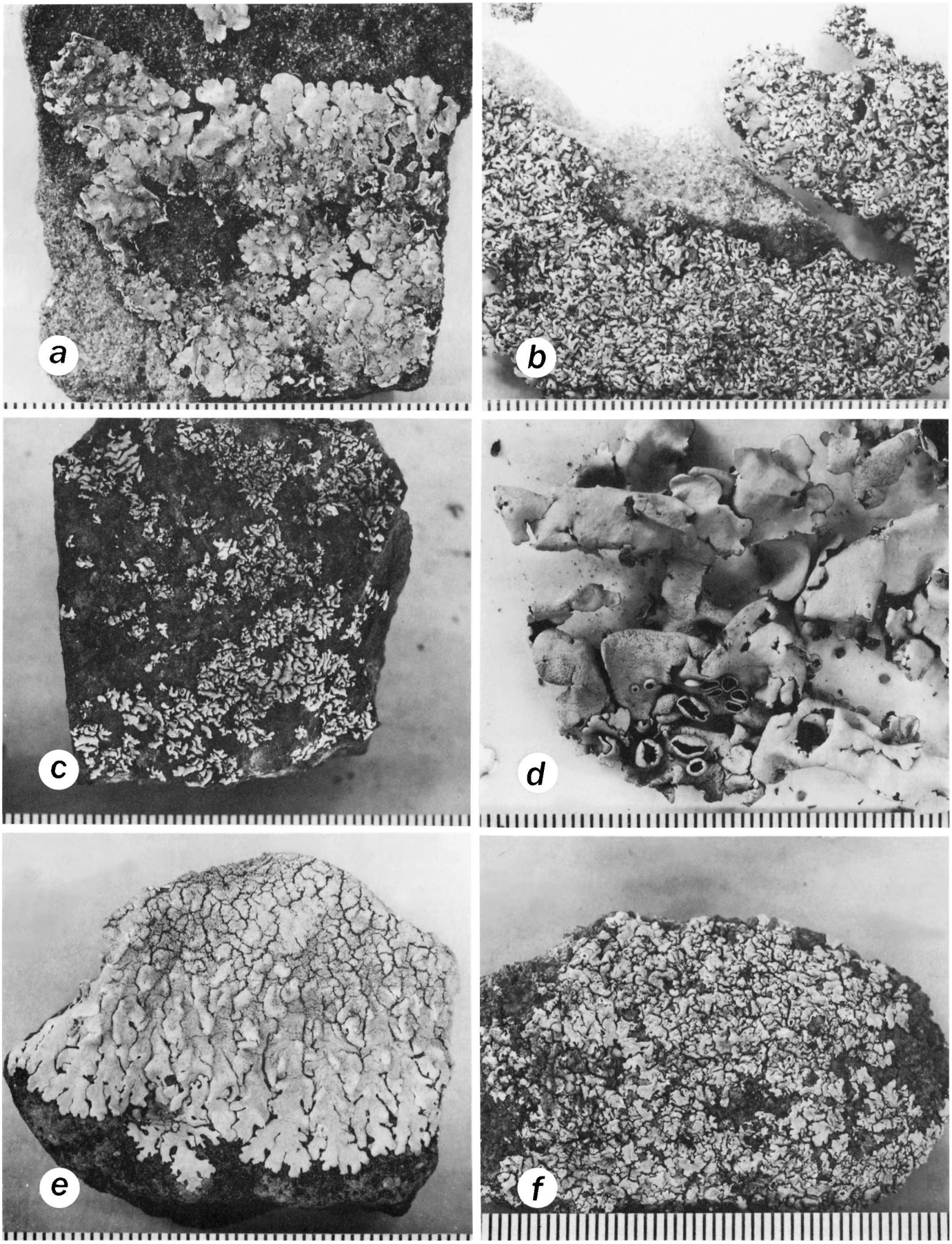
Xanthoparmelia latilobata

FIGURE 47*d*

Xanthoparmelia latilobata Hale, 1987a:258. [Type collection: 4.1 km NE of Dordrecht, elev. 1700 m, Cape Province, South Africa, Grid 3127 AC, *Hale* 73202, 9 Feb 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on soil and rock, firm and leathery, 6–10 cm broad, bright yellow green; lobes subirregular to broadly sublinear, apically rotund, 3–8 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, dull, dark brown in a broad zone at the tips but blackening at the center, finely rugulose, variably

FIGURE 47.—Species of *Xanthoparmelia*: *a*, *X. krogiae* (*Hildebrandt* s.n. in M); *b*, *X. laciniata* (*Hale* 76648, holotype in US); *c*, *X. lagunebergensis* (Hale 75101, holotype in US); *d*, *X. latilobata* (*Hale* 73202, holotype in US); *e*, *X. lavicola* (*Arvidsson* 4532); *f*, *X. laxencrustans* (*Hale* 68560). Scale in mm.


a
b
c
d
e
f

rhizinate, sparse to dense, the rhizines coarse, simple, black, 1–2 mm long. Pycnidia present but conidia not developed. Apothecia abundantly produced, substipitate, 2–5 mm in diameter; spores 6–7 × 12–13 µm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 10.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species of the Cave sandstone formation in eastern Cape Province is distinguished by the broad, bright yellow-green lobes. It may be allied to *X. tasmanica*, which has narrow sublinear lobes 2–5 mm wide. *Xanthoparmelia crassilobata* is very close in lobe configuration but is primarily a soil lichen and has a brown lower surface.

Xanthoparmelia lavicola

FIGURE 47*e*

Xanthoparmelia lavicola (Gyelnik) Hale, 1988b:404.

Parmelia lavicola Gyelnik, 1934c:157. [Type collection: La Estrella, environs of Mexico, Mexico, *Amable* 600 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia kurokawae Hale, 1967:418. [Type collection: 2.5 mi E of Piedmont Butte, Meade Co., South Dakota, USA, *Wetmore* 10360b (MSC, holotype; US, isotype).]

Xanthoparmelia kurokawae (Hale) Hale, 1974b:488.

DESCRIPTION.—Thallus adnate on rock, 5–7 cm broad, light yellowish green or darkening; lobes subirregular, 1.5–4 mm wide, contiguous to imbricate; upper surface continuous, emaculate, moderately to densely isidiate, the isidia initially globose to subcylindrical and irregularly inflated at maturity (Figure 16*g*), 0.07–0.1 mm in diameter, 0.1–0.5 mm high, the tips weakly to strongly epicorticate, brownish, more or less erumpent, unbranched to sparsely branched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.5 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Psoromic, 2′-*O*-demethylpsoromic, and usnic acids.

ILLUSTRATION.—Hale, 1967, fig. 5.

DISTRIBUTION.—Western North America, Mexico, Ecuador.

COMMENTS.—A chemically unusual species because of the presence of psoromic acid, *X. lavicola* may be the isidiate morphotype of *X. psoromifera*. A related species in southern Africa, *X. afrolavicola*, has tall, cylindrical isidia which are not erumpent.

Xanthoparmelia laxencrustans

FIGURE 47*f*

Xanthoparmelia laxencrustans Elix and Johnston in Elix, Johnston, and Armstrong, 1986:275. [Type collection: Everard Ranges, S.A., Australia, *Helms* 86 (G, lectotype; MEL, isotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 2–4 cm broad, yellowish green; lobes sublinear to subirregular, 0.7–1.5 mm wide short, contiguous to imbricate and crowded at the center; upper surface continuous, emaculate, shiny, subrugulose, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–5 µm. Apothecia common, adnate, 1–4 mm in diameter; spores 4–5 × 7–9 µm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic (±trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 26.

DISTRIBUTION.—Australia (SA, NT), South Africa (Cape Province).

COMMENTS.—This lichen occurs in extremely arid central Australia. It is closely related to *X. prodomokosii*, which is adnate with wider lobes. Elix and Johnston chose as the type one of the three syntypes of *Parmelia conspersa* var. *stenophylloides*.

Xanthoparmelia lecanorica

FIGURE 48*a*

Xanthoparmelia lecanorica (Hale) Hale, 1974b:488.

Parmelia lecanorica Hale, 1971a:351. [Type collection: NE of Clanwilliam, Pakhuis Pass, Cape Prov., South Africa, *Almborn* 4531 (LD, holotype; US, isotype).]

DESCRIPTION.—Thallus adnate on rock, 3–5 cm broad, yellowish green; lobes subirregular, 1–2 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny to dull, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, dark brown to black, moderately rhizinate, the rhizines black, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–5 mm in diameter; spores 5 × 9–10 µm.

CHEMISTRY.—Lecanoric and usnic acids.

ILLUSTRATION.—Hale, 1971a, fig. 3B.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—There is only one other lecanoric acid-containing species with a black lower surface, *X. namaquensis*, which is a larger, loosely adnate species also found in Namaqualand. The original report of *X. lecanorica* from North America was incorrect; the American material (as well as some specimens from Namaqualand) is *X. arida* (Egan and Derstine, 1978).

Xanthoparmelia leonora

FIGURE 48*b*

Xanthoparmelia leonora (Massalongo) Hale, 1988b:404.

Parmelia leonora Sprengel ex Massalongo, 1861:51.

Parmelia leonora var. *platyphylla* Flotow ex Massalongo, 1861:51 [= *P. leonora* var. *leonora*]. [Type collection: Cape of Good Hope, South Africa, *Wawra* s.n. (VER, specimen "B" (as *P. australis* var. *platyphylla*), lectotype; ZT, isolectotype).]

Parmelia leonora var. *multifida* Flotow ex Massalongo, 1861:51. [Type collection: Cape of Good Hope, South Africa, *Wawra* s.n. (VER, specimen "A" (as *P. australis* var. *stenophylla*), lectotype; ZT, isolectotype).]

Xanthoparmelia acrita Knox and Hale in Hale, 1986b:564. [Type collection: Ceres Nature Reserve at Michells Pass, about 1.5 km SW of Ceres on Hwy

R46, elev. ~600 m, Cape Province, South Africa, Grid 3319 AD, *Hale* 72031, 24 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus loosely attached to nearly free-growing on sandy soil, pebbles or soil over rocks, forming discrete orbicular colonies 5–10 cm broad, firm, somewhat darkish greenish yellow; lobes sublinear, quite variable, 1–4 mm wide, weakly to distinctly convoluted, dichotomously branched, separate to subimbricate, rarely with short laciniate lobe tips; upper surface weakly to moderately white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown to darker brown, moderately to densely rhizinate, the rhizines fine, brown or blackening, especially at lobe tips, 0.5–1.2 mm long, simple to furcate. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 µm. Apothecia rather rare, adnate to substipitate, 2–5 mm in diameter; spores poorly developed, 6 × 9 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric (±), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 1.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This rather common South African species is distinguished by the weakly convoluted lobes, uniformly dispersed rhizines, and chemistry. It is best developed on sheltered sandy soil in sparsely vegetated pastures and on open sandstone outcrops in the Little Karoo and southern parts of the Great Karoo. Some specimens contain only fumarprotocetraric acid. It is closely related to *X. phaeophana*, an extremely common saxicolous species with more distinct white maculae, broader, somewhat ascending lobes, and sparse rhizines interspersed with large bare areas on the lower surface.

The final typification of Massalongo's *P. leonora*, the earliest name for this lichen (see also the discussion under *X. concolor*), was relatively complicated. Massalongo took up the herbarium name *P. leonora* Sprengel (initially labeled as *Parmelia australis* in his herbarium and in the figure legend in *Lichenes Capenses*), a herbarium name which had been invalidly published by Flotow, gave it a Latin description, and included under it two varieties, var. *platyphylla* and var. *multifida*, both based on Wawra collections from the Cape and present in his herbarium at Verona. They are obviously the models for the color drawings in *Lichenes Capenses*. I consider var. *platyphylla* to be var. *leonora*. Variety *multifida* is a somewhat smaller plant but otherwise morphologically identical and with the same chemistry.

Xanthoparmelia lesothoensis

FIGURE 48*c*

Xanthoparmelia lesothoensis Hale, 1986b:582. [Type collection: Sani Pass, elev. 2875 m, Lesotho, Grid 2929 CB, *Hale* 74093, 17 Feb 1986 (US, holotype; LD, PRE, isotypes).]

Parmelia lesothoensis (Hale) Brusse, 1988:539.

DESCRIPTION.—Thallus adnate to tightly adnate on rock, leathery, 3–5 cm broad, dull yellowish green; lobes sublinear, 0.8–1.5 mm wide, short, dichotomously branched, black rimmed, contiguous to subimbricate; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, brown to dark brown, moderately to densely rhizinate, the rhizines coarse, brown, simple, 0.3–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 µm. Apothecia not seen.

CHEMISTRY.—Salazinic (major), diffractaic (major), barbatic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 26.

DISTRIBUTION.—Lesotho.

COMMENTS.—This small, coriaceous lichen has no close relatives except *X. brevilobata*, which contains the hypostictic acid series. The combination of salazinic and diffractaic acids is unusual in *Xanthoparmelia*, otherwise known only in *X. nana* from Australia and *X. diffractaica* from southern Africa. It is a rare, high-elevation species in the basaltic Drakensberg escarpment.

Xanthoparmelia leucostigma

Xanthoparmelia leucostigma Brusse in Knox and Brusse, 1983:155. [Type collection: Meiringspoort, 18 km N of De Rust, Cape. Prov., Republic of South Africa, *Brusse* 772-14-1-17 (PRE, holotype).]

Parmelia leucostigma (Brusse) Brusse, 1984:321.

DESCRIPTION.—Thallus adnate to loosely attached on rock, 3–6 cm broad, fragile and easily breaking apart, yellowish green; lobes sublinear, 0.5–2 mm wide, short and irregularly branched; upper surface effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, uniformly pale brown, sparsely rhizinate, the rhizines pale brown, coarse, simple, 0.2–0.3 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–8 µm. Apothecia common, substipitate, 1–3 mm in diameter; spores 6 × 9 µm.

CHEMISTRY.—Gyrophoric (major), 5-*O*-methylhiascic (minor), 2,4-di-*O*-methylgyrophoric/4,5-di-*O*-methylhiascic (trace), umbilicaric (trace), and usnic acids (det. G.A. Jenkins and J. Johnston).

ILLUSTRATION.—Knox and Brusse, 1983, fig. 10.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This is an unusual species, known from only two collections. The maculation is effigurate, as in the *X. hypoleia* group, but *X. leucostigma* stands apart from all other effigurate species because of the pale lower surface.

Xanthoparmelia lineola

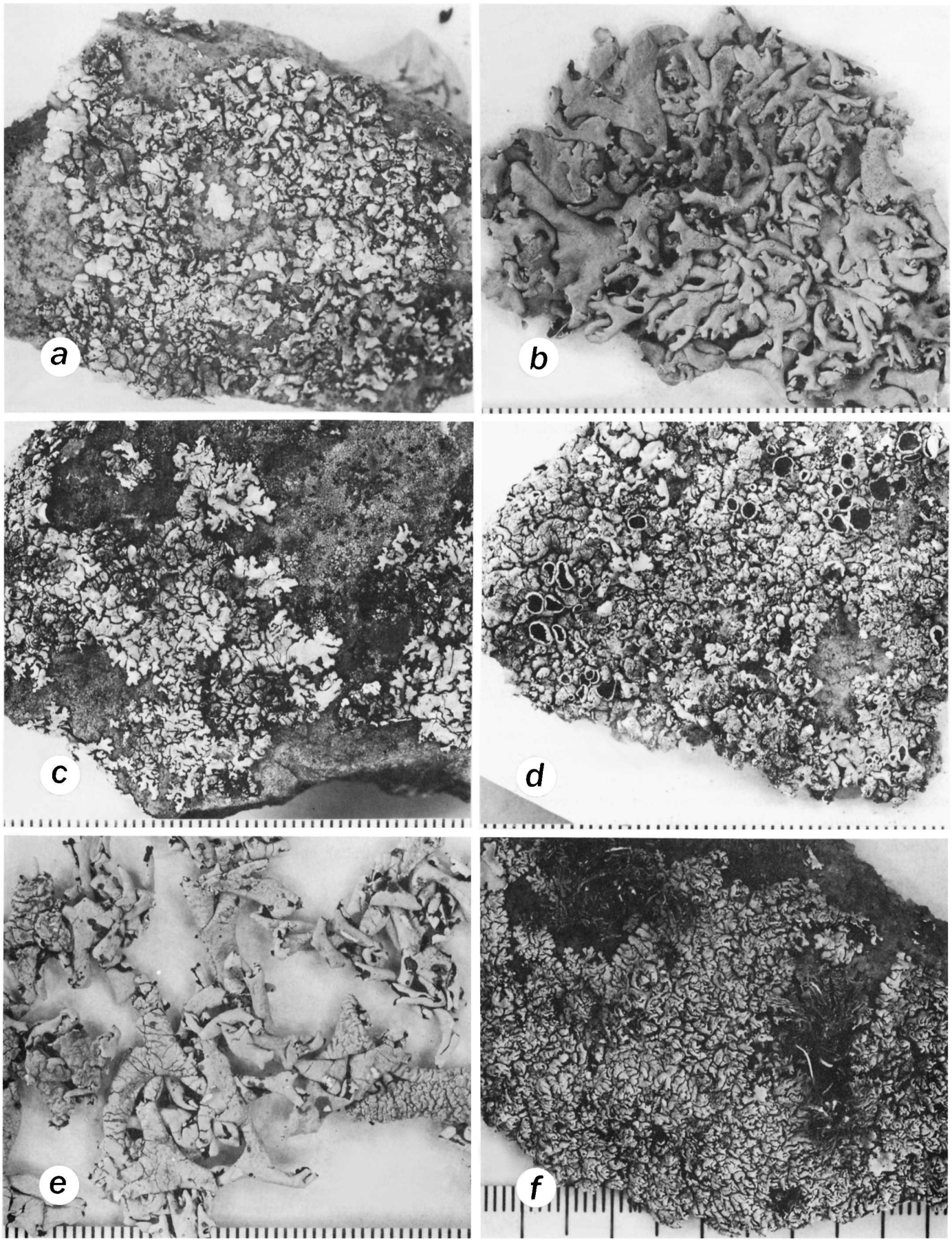
FIGURE 48*d*

Xanthoparmelia lineola (Berry) Hale, 1974b:488.

Parmelia lineola Berry, 1941:77. [Type collection: 3 mi NW of Ft. Defiance, Apache Co., Arizona, USA, *Hubricht* B1170 (US, holotype).]

Parmelia conspersa var. *diffracta* Mereschkowsky, 1920a:487. [Type collection: Southern Colorado, USA, s.c. (G, lectotype).]

Parmelia subcrustacea var. *chalybea* Gyelnik, 1938a:291. [Type collection: Heathcote, NSW, Australia, *Cheel* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]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Parmelia rimalis Kurokawa in Kurokawa and Filson, 1975:43. [Type collection: Wilgena Hill, 6.4 km N of Kingoonya-Tarcoola road, 67.5 km W of Kingoonya, S.A., Australia, *Filson* 11923 (MEL, holotype; TNS, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–10 cm broad, yellowish green; lobes subirregular, 0.8–2 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, pale, rhizines moderate, pale, unbranched, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia well developed, substipitate, 2–5 mm in diameter; spores 6–7 × 9–12 µm.

CHEMISTRY.—Salazinic, consalazinic, constipatic (±), protoconstipatic (±), and usnic acids.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 3: fig. 4 (as *Parmelia rimalis*).

DISTRIBUTION.—USA, Mexico, Australia (NSW, ACT, SA, NT, WA), New Zealand, South Africa (Cape Province).

COMMENTS.—There are few characters to highlight this common, pantemperate nonisidiate lichen, widespread in the western USA but also well represented in Australia and South Africa. In the western USA it is closely related to and intergrades with *X. coloradoensis*. Four additional species in North America seem to be chemotypes: *X. arida* (lecanoric acid), *X. barbatica* (barbatic acid), *X. subdecipiens* (constipatic acid series), and *X. tucsonensis* (diffractaic acid). The Australian *X. filarszkyana* (norlobaridone) falls in the same group. None of these species has been adequately studied in terms of distribution and habitat, however.

Xanthoparmelia lipochlorochroa

FIGURE 48*e*

Xanthoparmelia lipochlorochroa Hale and Elix in Hale, 1989a:551. [Type collection: On sandy soil, 15 mi S of Kammerer, Lincoln County, Wyoming, *B.J. Buckingham* S22155, in *Weber, Lichenes Exsiccati* 29 (HO, holotype; MEL, isotype).]

DESCRIPTION.—Thallus vagrant, free growing on soil, leathery, breaking apart into smaller colonies 3–5 cm broad, light yellowish green; lobes sublinear, 2–5 mm wide (to 10 mm when unrolled), strongly convoluted and tube-like, sparsely branched, separate; upper surface continuous, emaculate, shiny to mostly dull, transversely cracked and rugose with age, soredia and isidia lacking; medulla white; lower surface plane, smooth to foveolate-ridged, little of the lower surface visible, light brown or darkening, sparsely rhizinate, the rhizines brown, delicate, 0.3–0.6 mm long, simple. Pycnidia and apothecia lacking.

CHEMISTRY.—Traces of unidentified fatty acids, usnic acid.

FIGURE 48.—Species of *Xanthoparmelia*: *a*, *X. lecanorica* (*Almborn* 4531); *b*, *X. leonora* (*Wawra* s.n., lectotype in VER) *c*, *X. lesothoensis* (*Hale* 74093, holotype in US); *d*, *X. lineola* (*Hale* 51309); *e*, *X. lipochlorochroa* (Buckingham S22155, holotype in HO); *f*, *X. lobulifera* (*Hale* 72025, holotype in US). Scale in mm.

ILLUSTRATION.—Hale, 1989a, fig. 17.

DISTRIBUTION.—Western USA.

COMMENTS.—This is a rare fatty acid chemotype of *X. chlorochroa*, a common western North American vagrant lichen with salazinic acid. The exsiccate specimens (no. 29) of the type are mixed with *X. chlorochroa*. The correct number of the type is *Buckingham* 22155, not 22115 as given in the original publication.

Xanthoparmelia lobulifera

FIGURE 48*f*

Xanthoparmelia lobulifera Hale, 1986b:584. [Type collection: 37.4 km NW of Queenstown along Hwy R30, elev. ca. 1600 m, Cape Province, South Africa, Grid 3126 AC, *Hale* 72025, 8 Feb 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, firm, 5–8 cm broad, bright yellow green; lobes sublinear, 0.6–1 mm wide, imbricate and congested, branching into narrow secondary lobes 0.4–0.6 mm wide, appressed to subascending; upper surface continuous, emaculate, dull to shiny, convex, rugose and transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane to slightly grooved, black, dull, rhizines lacking. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 28.

DISTRIBUTION.—South Africa (Cape Province, Transvaal).

COMMENTS.—There seem to be no close relatives for this rare lichen. The black lower surface without rhizines and the leathery, crowded lobes are distinctive.

Xanthoparmelia louisii

FIGURE 49*a*

Xanthoparmelia louisii Elix and Johnston in Elix, Johnston, and Armstrong, 1986:279. [Type collection: Bluff Knoll, Stirling Ranges, W.A., Australia, *Elix* 10661 (CBG , holotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, 1–3 cm broad, coalescing, dark yellowish green; lobes sublinear, 0.2–0.5 mm wide, dichotomously branched, weakly constricted, black-rimmed, contiguous, sparsely marginally laciniate; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, dark brown to black, moderately rhizinate, the rhizines brown to blackish, simple, 0.1–0.2 mm long. Pycnidia common; conidia cylindrical to subbifusiform, 0.5 × 7–8 µm. Apothecia adnate, 0.5–1 mm in diameter; spores 5–7 × 8–10 µm.

CHEMISTRY.—Barbatic (major), 4-*O*-demethylbarbatic (trace), squamatic (trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 27.

DISTRIBUTION.—Australia (WA).

COMMENTS.—This rare western Australian lichen is charac-

terized by the tightly adnate thallus, narrow lobes, and chemistry.

Xanthoparmelia luderitziana

FIGURE 49*b*

Xanthoparmelia luderitziana Hale, 1989a:551. [Type collection: On pebbles in loose granite-schist desert pavement, 9 km S of Lüderitz, elev. 20 m, SWA/Namibia, Grid 2615 CA, *Hale* 80123, 28 Apr 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate on pebbles, rather brittle, 1–3 cm broad, dull yellowish green; lobes sublinear, 1–2 mm wide, separate to subimbricate with ascending tips; upper surface white-maculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, smooth to rugulose, black, shiny, in part yellow rimmed, very sparsely rhizinate, the rhizines black, coarse, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Diffractaic (major), barbatic (trace), squamatic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 18.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This species is very close to the Namibian *X. walteri* (salazinic acid present) but the lobes are quite short and brittle. It occurs on desert pavement in the fog zone south of Lüderitz.

Xanthoparmelia luminosa

FIGURE 49*c*

Xanthoparmelia luminosa (Elix) Hale, 1984:79.

Parmelia luminosa Elix, 1981:357. [Type collection: Gudgenby River Gorge, 4.5 km S of Tharwa, A.C.T., Australia, *Elix* 6118 (MEL, holotype; CBG, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm, 6–10 cm broad, bright yellowish green or darkening; lobes subirregular to broadly sublinear, 2–5 mm wide, contiguous to imbricate, brown rimmed at the tips; upper surface continuous, emaculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla ochre in part; lower surface plane, black, with orange coloration where lower medulla is partially exposed, sparsely to moderately rhizinate, the rhizines black, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, substipitate, 3–15 mm in diameter; spores 5 × 7–10 µm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids, skyrin.

ILLUSTRATION.—Elix, 1981, fig. 7.

DISTRIBUTION.—Australia (NSW, ACT, SA), South Africa (Cape Province).

COMMENTS.—In the field the thallus color is an intense yellow green. It resembles *X. tasmanica*, which is more loosely adnate and lacks any pigments. It is fairly rare in southeastern Australia and known from two collections near Cape Town in South Africa. Also in South Africa, *X. surrogata* is a rare, apparently closely related species with the same chemistry but with adnate, uniformly narrow lobes 1–2 mm wide.

Xanthoparmelia lynii

FIGURE 49*d*

Xanthoparmelia lynii Elix and Johnston, 1988b:358. [Type collection: Brett Creek, Harts Range, Northern Territory, Australia, *Craven* s.n., v.1985 (CBG, holotype; MEL, isotype).]

DESCRIPTION.—Thallus adnate on rock, 5–10 cm broad, yellow green; lobes subirregular to sublinear, 0.8–1.5 mm wide, irregularly branched, congested and imbricate, short laciniate, the laciniae revolute, more or less canaliculate below, 0.2–0.3 mm wide; upper surface continuous, emaculate, shiny to dull at the center, sparsely isidiate, the isidia globose at first, distorted cylindrical to irregularly inflated at maturity, clumped, the tips syncorticate to weakly epicorticate, pale, unbranched, 0.15–0.2 mm in diameter, to 0.2 mm high; medulla white; lower surface plane, ivory to pale tan, the tips often darkening, sparsely to moderately rhizinate, the rhizines brown, simple, slender, 0.3–0.5 mm long. Pycnidia and apothecia not seen.

CHEMISTRY.—Norlobaridone (major), loxodin, ursolic (trace), and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1988a, fig. 6.

DISTRIBUTION.—Australia (NT).

COMMENTS.—This rare desert species is distantly related to the familiar *X. scabrosa*, which has erumpent isidia and a larger thallus. Then globose isidia are sparsely developed and aggregated in small clumps, unlike any other species in the genus.

Xanthoparmelia mannumensis

Xanthoparmelia mannumensis (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:283.

Parmelia mannumensis Elix, 1981:359. [Type collection: Along Gorge Creek, 10 km W of Mannum, S.A., Australia, *Elix* 4215 (MEL, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock, forming thick mats at maturity, 7–10 cm broad; lobes sublinear to linear, 0.5–1.5 mm wide, dichotomously to irregularly branched, separate to imbricate; upper surface effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines black, coarse, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia substipitate, 2–5 mm in diameter; spores 4–5 × 8–9 µm.

CHEMISTRY.—Diffractaic (major), barbatic (trace), 4-*O*-demethylbarbatic, obtusatic, norobtusatic, and usnic acid.

ILLUSTRATION.—Elix, 1981, fig. 8.

DISTRIBUTION.—Australia (NSW, Tas, SA).

COMMENTS.—This rare chemotype in the *X. hypoleia* group is confined to southeastern Australia.

Xanthoparmelia mapholanengensis

FIGURE 49*e*

Xanthoparmelia mapholanengensis Hale, 1989a:551. [Type collection: On vertical dolerite ledge face, 23.4 km N of Mapholaneng on the Sani Pass-Moteng Pass road, elev. 3100 m, Lesotho, Grid 2928 BB, *Hale* 81487 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rarely on soil, rather firm, often forming a centrifugate pattern, 8–15 cm broad, light yellowish green; lobes sublinear, 0.8–2 mm wide, convex and in part appearing inflated, sublaciniate, the tips blunt, subterete, darkening, separate to subimbricate; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, shiny, brown at the tips but blackening at the center, sparsely rhizinate, the rhizines brown to black, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Salazinic (major), protocetraric (major), norstictic, consalazinic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 19.

DISTRIBUTION.—Lesotho.

COMMENTS.—This common high elevation species has a unique combination of acids with salazinic, protocetraric, and sometimes norstictic acids both forming strong spots on TLC plates. The lobes are inflated and subterete and are often arranged in a centrifugate growth pattern.

Xanthoparmelia maricopensis

Xanthoparmelia maricopensis Nash and Elix, 1986:453. [Type collection: Crater Mountains along route 85, elev. 425 m, Maricopa County, Arizona, USA, *Nash* 6059 (ASU, holotype; ANUC, BM, COLO, DUKE, F, LSU, MIN, NY, O, US, isotypes).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 2–5 cm broad, yellowish green; lobes subirregular to sublinear, 1–2 mm wide, short, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, isidia initially globose, then cylindrical to irregularly inflated (Figure 16*h*), 0.1–0.2 mm in diameter, 0.1–0.8 mm high, the tips epicorticate, dull brownish, occasionally erumpent, simple or sparingly branched; medulla white; lower surface plane, pale brown, moderately rhizinate, rhizines pale brown, 0.2–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic (major), hyposalazinic (minor), connorstictic, pertusaric (±), constipatic (±), protoconstipatic (±), and usnic acids.

DISTRIBUTION.—Western USA, Mexico.

COMMENTS.—This species had previously been identified as *X. dierythra*, which is less tightly adnate, lacks both fatty acids and hyposalazinic acid and occurs mainly in north-central USA.

Xanthoparmelia marroninipuncta

Xanthoparmelia marroninipuncta (Brusse) Hale, 1988b:404.

Parmelia marroninipuncta Brusse, 1984:315. [Type collection: On a low mudstone kranz, Uitspannings River Pass, 40 km NW of Merweville, Cape Province, South Africa, Grid 3221 CA, *Brusse* 3417 (PRE, holotype; COLO, LD, isotypes).]

DESCRIPTION.—Thallus adnate on rock, 3–8 cm broad, dull yellowish green; lobes sublinear, 1.2–3 mm wide, subimbricate; upper surface continuous, emaculate, quite rugose with age with numerous small dark spots visible with the naked eye, isidia and soredia lacking; medulla white with scattered deep purple patches; lower surface plane, pale brown, moderately rhizinate, rhizines pale brown, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–6 µm. Apothecia adnate, 5–10 mm in diameter, the rim breaking open to reveal a purple medulla; spores 4–6 × 8–10 µm.

CHEMISTRY.—Protocetraric and usnic acids, one unidentified anthraquinone in the "endomiltoides" series.

ILLUSTRATION.—Brusse, 1984, fig. 3.

DISTRIBUTION.—South Africa (Transvaal, OFS, Cape Province).

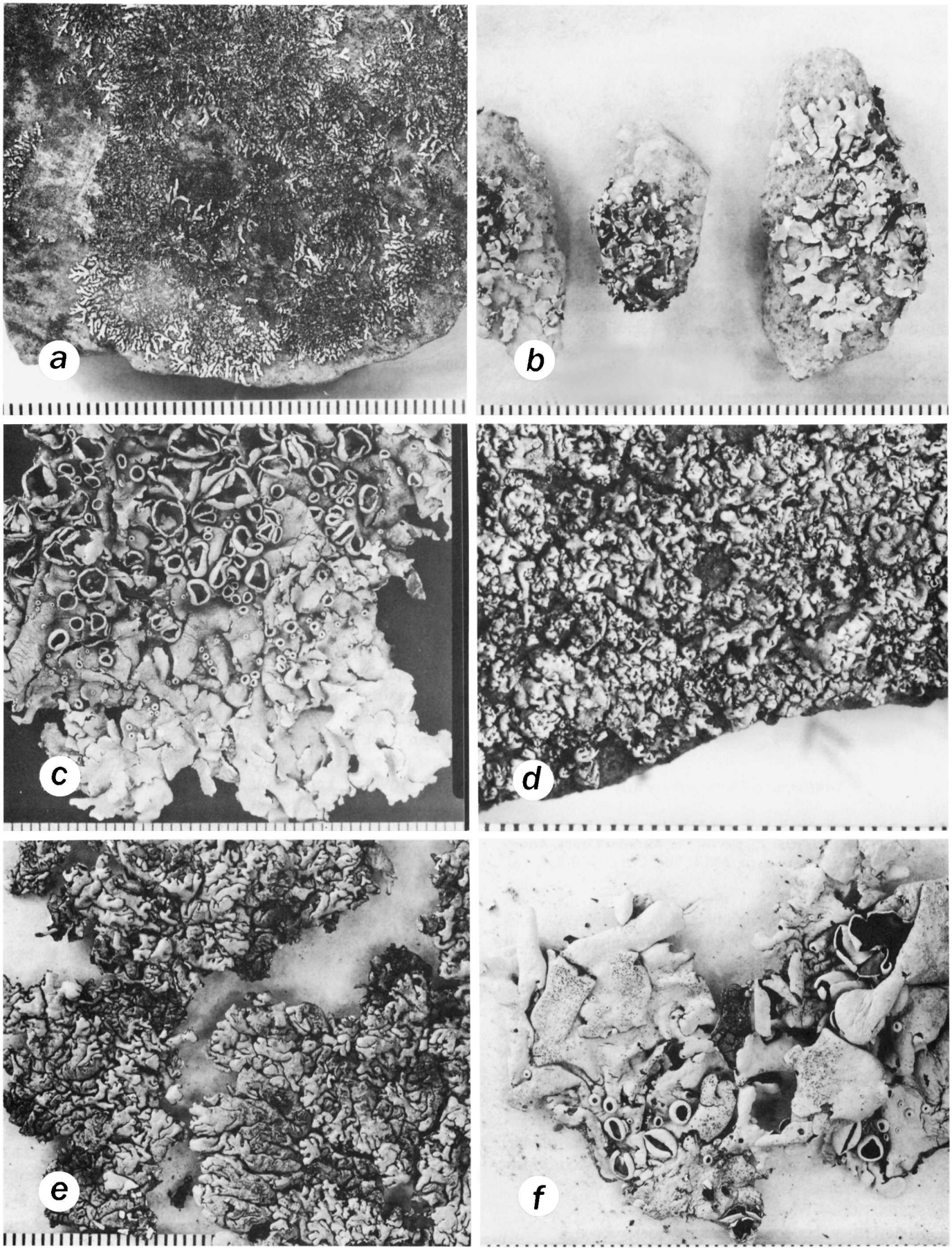
COMMENTS.—The black spots on the surface, below which the purple pigment is clearly visible, are unique in the genus and simplify identification of the species in the field. *Xanthoparmelia dichromatica* has the same chemistry but without black spotting (the pigment is scattered in the medulla below the cortex) and with a more easterly range in eastern Cape Province, Lesotho and Orange Free State. It has a remarkably broad ecological range from fairly moist sheltered sandstone canyons in southern Cape Province to barren dolerite outcrops in the arid Great Karoo.

Xanthoparmelia maxima

FIGURE 49*f*

Xanthoparmelia maxima Hale, 1989a:552. [Type collection: Mudstone outcrops along hwy R388, 32 km N of junction with R63 (S of Richmond), elev. 1400 m, Cape Province, South Africa, Grid 3124 CA, *Hale* 80651, 4 Apr 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, leathery but breaking apart when collected, 6–9 cm broad, light yellowish green; lobes subirregular and broadly rotund, 3–9 mm wide, subimbricate; upper surface continuous, emaculate, dull and in part white pruinose, rugose and transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, light brown, moderately to densely rhizinate, the rhizines pale brown, robust, simple to splayed or furcate, 0.5–1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 5–6 µm. Apothecia well developed, substipitate, 2–5 mm in diameter,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the disc becoming white pruinose, rarely perforate, the rim usually inrolled.

CHEMISTRY.—Norstictic (major), salazinic (minor), consalazinic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 20.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The unusually broad lobes resemble those of South African *X. colorata,* which is black below. It is also near *X. crassilobata,* which grows on soil and is more convoluted. The species is common at the type locality but not known elsewhere.

Xanthoparmelia mbabanensis

FIGURE 50*a*

Xanthoparmelia mbabanensis Hale, 1987b:322. [Type collection: Mbabane Nature Reserve, 10 km N of Mbabane, elev. 1000 m, Swaziland, Grid 2631AA, *Hale* 79071 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather brittle and falling apart when collected, 5–8 cm broad, darkish yellow green; lobes subirregular to sublinear, 2–3 mm wide, imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia cylindrical (Figure 16*i*), 0.08–0.1 mm in diameter, to 0.3 mm high, the tips syncorticate, darkening, simple to sparingly branched; medulla white; lower surface plane, dark brown toward the tips but blackening at the center, sparsely rhizinate, the rhizines brown to black, stout, simple, 0.3–0.5 mm long. Pycnidia not common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–4 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, physodalic, and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 5.

DISTRIBUTION.—South Africa (Natal), Swaziland.

COMMENTS.—Closely related to *X. subramigera,* which occurs commonly with it, *X. mbabanensis* has a distinctly black lower surface. The typical habitat is large granitic or sandstone boulders in the Drakensberg foothills.

Xanthoparmelia meruensis

Xanthoparmelia meruensis Krog and Swinscow, 1987:426. [Type collection: Mt. Meru Crater, Arusha Distr., Northern Province, Tanzania, elev. 2600 m, *Krog and Swinscow* T5/172 (O, holotype; BM, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate, rather brittle and somewhat pulvinate, 4–6 cm broad, darkish yellow green; lobes sublinear, 0.7–1.5 mm wide, irregularly branched, short, black rimmed and turning brown at the tips, sparsely laciniate, the laciniae about 0.3 mm wide; upper surface continuous, emaculate, dull, rugulose with age, densely isidiate, the isidia cylindrical (Figure 17*a*), coarse, 0.1–0.2 mm in diameter, to 2 mm high, the tips syncorticate, darkening, simple to coralloid branched; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, stout, simple, 0.2–0.6 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Unidentified fatty acids in the "subdecipiensk" series and usnic acid.

ILLUSTRATION.—Krog and Swinscow, 1987, fig. 5.

DISTRIBUTION.—Tanzania, Ethiopia, Kenya.

COMMENTS.—This East African species may be related to *X. atroventralis,* which occurs in southern Africa. The fatty acids in these two high elevation species seem to be different, however.

Xanthoparmelia metaclystoides

FIGURE 50*b*

Xanthoparmelia metaclystoides (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:284.

Parmelia metaclystoides Kurokawa and Filson, 1975:40. [Type collection: Kimba to Cowell Road, 18 km NW of Cowell, S.A., Australia, *Filson* 11783 (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 7–10 cm broad, dark yellowish green; lobes subirregular, 1–2 mm wide, imbricate and becoming crowded at the center; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6 µm. Apothecia common, substipitate, 2–7 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Norstictic (major), connorstictic, salazinic (±), constipatic (±), protoconstipatic (±), and usnic acids.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 2: fig. 3.

DISTRIBUTION.—Australia (NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—This is a fairly common lichen in drier areas throughout southern Australia. The recently described *X. wisangerensis* has equal concentrations of norstictic and salazinic acids and subterete secondary lobes. The American *X. californica* lacks any fatty acids.

Xanthoparmelia metamorphosa

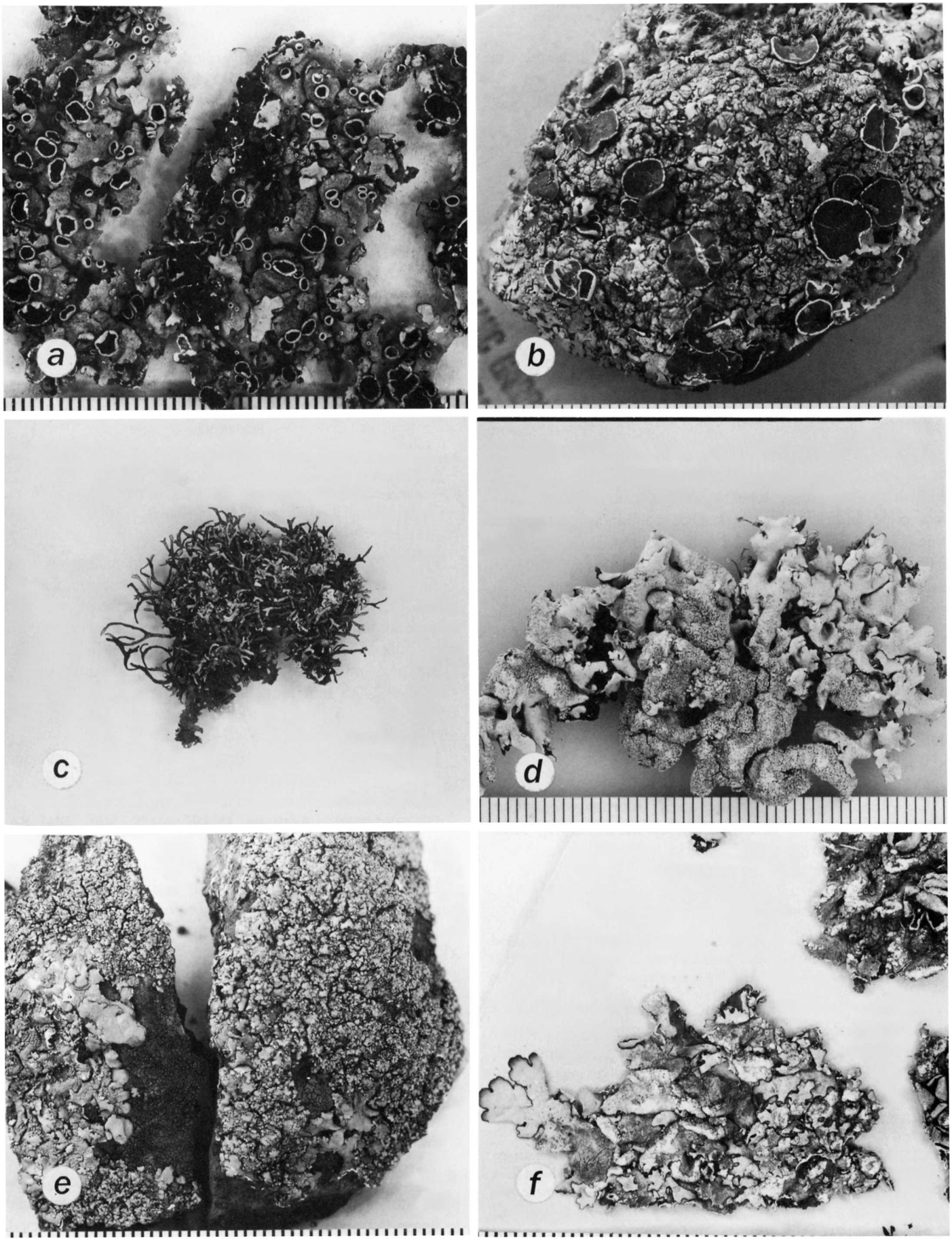
FIGURE 50*c*

Xanthoparmelia metamorphosa (Gyelnik) Hale, 1974b:488.

Parmelia metamorphosa Gyelnik, 1938a:284. [Type collection: Eden, NSW, Australia, *Cheel* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

DESCRIPTION.—Thallus loosely adnate on rock, often pulvinate, 2–6 cm broad, dark yellowish green; lobes sublinear to linear, 0.2–0.5 mm wide, somewhat irregularly constricted,

FIGURE 49.—Species of *Xanthoparmelia: a, X. louisii* (*Elix* 10661, holotype in CBG); *b, X. luderitziana* (*Hale* 80123, holotype in US); *c, X. luminosa* (Elix 2140); *d, X. lynii* (*Craven* s.n., holotype in CBG) *e, X. mapholanengensis* (*Hale* 81487, holotype in US); *f, maxima* (*Hale* 80651, holotype in US). Scale in mm.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divaricate and separate, black rimmed; upper surface continuous to faintly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown, rugulose with age, sparsely rhizinate, the rhizines brown, coarse, simple, to 0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia substipitate, 3–8 mm in diameter; spores 4–6 × 8–10 µm.

CHEMISTRY.—Norlobaridone, loxodin, and usnic acid.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 28.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, SA), New Zealand.

COMMENTS.—The most important features of this Australasian endemic are the very narrow stringy lobes and the rugose lower surface. Though chemically identical, *X. furcata* has much broader, sublinear, emaculate lobes. The South African *X. tenuiloba*, a smaller pulvinate plant, lacks maculae and loxodin.

Xanthoparmelia metastrigosa

Xanthoparmelia metastrigosa (Elix) Hale, 1984:79.

Parmelia metastrigosa Elix, 1981:360. [Type collection: NE slopes of Mt. Canobolas, near Orange, NSW, Australia, *Elix* 4627 (MEL, holotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rocks or rocky soil, 7–12 cm broad, dark yellowish green; lobes sublinear, 1.5–4 mm wide, contiguous to imbricate, black rimmed; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown or darkening at the tips, moderately to densely rhizinate, the rhizines long and often dichotomously furcate, pale brown, 0.2–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 3–12 mm in diameter; spores 4–6 × 9–11 µm.

CHEMISTRY.—Hypostictic, hypoconstictic, hyposalazinic, and usnic acids.

ILLUSTRATION.—Elix, 1981, fig. 9.

DISTRIBUTION.—Australia (NSW).

COMMENTS.—Known only from Mt. Canobolas, this lichen has a unique combination of morphology and chemistry. On a superficial examination it could be mistaken for *X. substrigosa*, which contains norstictic acid.

Xanthoparmelia mexicana

FIGURE 50*d*

Xanthoparmelia mexicana (Gyelnik) Hale, 1974b:488.

Parmelia mexicana Gyelnik, 1931b:281. [Type collection: San Jeronima, Mexico, *Amable* 676 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia ramigera f. *munita* Gyelnik, 1938a:287. [Type collection: San Angel Pedugal, Mexico, *Amable* 216 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 4–10 cm broad, yellowish green; lobes subirregular, 1.5–4 mm wide, apically rotund, rarely marginally laciniate, contiguous to imbricate; upper surface continuous to rarely in part white-maculate, shiny, densely isidiate, the isidia subglobose to cylindrical or irregularly inflated (Figure 17*b*), 0.1–0.2 mm in diameter, 0.1–0.5 mm high, the tips syncorticate, brownish to blackening, becoming coralloid branched with age; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale, simple, 0.2–0.5 mm long. Pycnidia rarely developed; conidia bifusiform, 0.5 × 6–7 µm. Apothecia rare, substipitate, 3–10 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

DISTRIBUTION.—Western USA, Mexico, Dominican Republic, Argentina, Kenya, Australia (Qld, NSW, ACT, Vic, Tas, SA, NT, WA), New Zealand, Japan, Korea, China, Nepal.

COMMENTS.—Remarkably, this common, widely distributed lichen has only one synonym. It forms the nucleus of a large group of 10 morphologically similar species with cylindrical isidia, adnate thallus, and a pale lower surface. This group is discussed in more detail in the introduction. There is great variation in isidial morphology, and some populations with nearly globose, in part erumpent isidia may well represent a distinct species.

Xanthoparmelia microlobulata

FIGURE 50*e*

Xanthoparmelia microlobulata Hale, 1987b:322 [Type collection: On basaltic outcrops at the escarpment, Naudesnek, elev. 2180 m, Cape Province, S. Africa, Grid 3028 CB, *Hale* 76859, 9 Oct 1986 (US, holotype; ANUC, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, rather fragile, 5–8 cm broad, dull yellowish green; lobes subirregular, 1–2.5 mm wide, contiguous to imbricate, becoming densely short-lobulate in the center and periphery, the lobules 0.1–0.5 mm wide, to 0.5 mm long, appressed and imbricated; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines pale brown, simple, 0.2–0.3 mm long but barely papillate at the lobe tips. Pycnidia well developed; conidia weakly bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Norlobaridone, isonorlobariol, unknown substance (fatty acid?), and usnic acid (det. J.A. Elix).

ILLUSTRATION.—Hale, 1987b, fig. 6.

DISTRIBUTION.—South Africa (Cape Province), Lesotho.

COMMENTS.—This high-elevation species, which occurs on sheltered dolerite ledges, is distinguished by its chemistry (norlobaridone being extremely rare in South African *Xantho-*

FIGURE 50.—Species of *Xanthoparmelia*: *a*, *X. mbabanensis* (*Hale* 79071, holotype in US); *b*, *X. metaclystoides* (*Filson* 11783); *c*, *X. metamorphosa* (Cheel s.n., lectotype in BP); *d*, *X. mexicana* (*Palmer* 275); *e*, *X. microlobulata* (*Hale* 76859, holotype in US); *f*, *X. microspora* (*André* 576, lectotype in G). Scale in mm.

parmeliae) and by the abundant production of marginal lobules, a unique trait in the genus.

Xanthoparmelia microspora

FIGURE 50*f*

Xanthoparmelia microspora (Müller Argoviensis) Hale, 1974b:488.

Parmelia microspora Müller Argoviensis, 1879b:170. [Type collection: Gauduas, near Bogotá, Colombia, *André* 576 (G, lectotype; BM, isolectotype).]

Parmelia conspersa f. *polita polyphylla* Meyen and Flotow, 1843:220. [Type collection: Tacora, Peru, *Meyen* (G, lectotype).]

DESCRIPTION.—Thallus adnate on rock, firm, 3–10 cm broad, yellowish green; lobes subirregular, 2–4 mm wide, contiguous to imbricate; upper surface continuous to faintly white-maculate, moderately to densely sorediate, the soralia orbicular, becoming diffuse with age; medulla white; lower surface plane, black with a brown zone around the tips, moderately to densely rhizinate, the rhizines black, fine, unbranched, 0.2–0.8 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 µm. Apothecia rare, substipitate, 2–8 mm in diameter; spores 5 × 9–10 µm.

CHEMISTRY.—Salazinic, gyrophoric (±), and usnic acids.

DISTRIBUTION.—Venezuela, Colombia, Ecuador, Peru, Bolivia, Argentina, Chile, Gough Island.

COMMENTS.—South America is the center of speciation for sorediate species of *Xanthoparmelia*, and *X. microspora* is both the oldest name and the most common species in the group, especially in the Andean chain at mid or higher elevations. *Xanthoparmelia ulcerosa* is morphologically similar except for the pale brown lower surface.

Xanthoparmelia minuta

Xanthoparmelia minuta Knox and Hale in Hale, 1986b:585. [Type collection: Mt. Sheba Nature Reserve, Pilgrims Rest, elev. 1965 m, Transvaal, South Africa, Grid 2430 DC, *Hale* 72108, 15 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus very tightly adnate on rocks, 1–2 cm broad, yellowish green; lobes sublinear, dichotomously branched, 0.4–0.8 mm wide, short, black rimmed, contiguous; upper surface continuous, emaculate, shiny, sparsely to moderately isidiate, the isidia cylindrical (Figure 17*c*), 0.05–0.07 mm in diameter, 0.09–0.1 mm high, the tips syncorticate, black, unbranched; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, 0.3–0.5 mm long, simple. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic (major), salazinic (major), consalazinic, gyrophoric (trace), protoconstipatic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 29.

DISTRIBUTION.—South Africa (Transvaal, Natal).

COMMENTS.—This inconspicuous species, highly localized on sandstone at higher elevations in the Transvaal Drakensberg escarpment, is reminiscent of *X. mougeotina*, but the lobes are consistently narrower and the chemistry is quite different (*X. mougeotina* has stictic acid). *Xanthoparmelia pseudocongensis* has similar morphology but contains stictic acid. The Australian *X. filsonii* is also very similar but contains only norstictic acid as the major metabolite.

Xanthoparmelia moctezumensis

Xanthoparmelia moctezumensis Nash in C. Culberson, Nash, and Johnson, 1979:155. [Type collection: 28 km E of Moctezuma, Sonora, Mexico, *Nash* 12548 (ASU, holotype; DUKE, US, isotypes).]

DESCRIPTION.—Thallus adnate on rock, 3–6 cm broad, yellowish green; lobes subirregular, 0.5–1.5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, densely isidiate, the isidia cylindrical (Figure 17*d*), 0.10–0.18 mm in diameter, 0.1–0.3 mm high, the tips weakly epicorticate, mostly unbranched; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—3-α-Hydroxybarbatic (major), barbatic (minor), baeomycesic (trace), squamatic (trace), 4-*O*-demethylbarbatic (±trace), and usnic acids.

ILLUSTRATION.—Culberson, Nash, and Johnson, 1979, fig. 2.

DISTRIBUTION.—Southwestern USA, Mexico.

COMMENTS.—This is a rare species in the *X. mexicana* group, chemosyndromic with *X. ajoensis* and *X. tucsonensis* (C. Culberson, Nash, and Johnson, 1979). It is the only one in *Xanthoparmelia* to contain 3-α-hydroxybarbatic acid as the major metabolite.

Xanthoparmelia mollis

FIGURE 51*a*

Xanthoparmelia mollis Hale, 1986b:585. [Type collection: Oribi Gorge Nature Reserve, elev. 300 m, Natal, South Africa, Grid 3030 CB, *Hale* 74043, 3 Feb 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate on flat rocks, soft, forming extensive centrifugate colonies 10–20 cm broad, yellowish green; lobes linear-elongate, dichotomously branched, 0.5–0.7 mm wide, the ultimate lobes nearly terete; upper surface white-maculate to effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, rugose, rhizines almost completely lacking except for a few at lobe tips, black, simple, stout, 0.1–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Protocetraric and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 30.

DISTRIBUTION.—South Africa (Natal).

COMMENTS.—This species falls in the *X. hypoleia* group but the thallus forms soft centrifugate colonies, the lobes are

uniformly narrow, and the surface is at most weakly effigurate-maculate. It is known only from collections at Oribi Gorge, a moist subtropical locality well east of the semi-arid range of *X. hypoleia*.

Xanthoparmelia molliuscula

FIGURE 51*b*

Xanthoparmelia molliuscula (Acharius) Hale, 1974b:488.
Parmelia molliuscula Acharius, 1810:492. [Type collection: Cape of Good Hope, South Africa, *Thunberg* s.n. (H-Ach, lectotype; UPS, H-Nyl. herb. no. 34791, isolectotypes).]
Parmelia thamnidiella Stirton, 1877:213. [Type collection: South Africa, *MacOwan* s.n. (BM, lectotype; PRE, isolectotype).]
Parmelia conspersa var. *thamnidiella* (Stirton) Stizenberger 1890:153.
Parmelia conspersa f. *molliuscula* (Acharius) Vainio, 1899a:280.
Parmelia conspersa ssp. *molliuscula* (Acharius) Elenkin, 1901b:20.
Parmelia pseudoconspersa Gyelnik, 1934c:162. [Type collection: Montague Pass, South Africa, *Breutel* s.n. (BP, lectotype).]
Parmelia steineri Gyelnik, 1938a:289. [Type collection: Wolseley, South Africa, *A.E. v.d. Byl* 1141 (W, lectotype; BP, isolectotype).]
Pseudevernia molliuscula (Acharius) Dodge, 1959:183.
Pseudevernia thamnidiella (Stirton) Dodge, 1959:182.
Parmelia subpumila Elix, 1981:372. [Type collection: 20 km W of Swan Reach along Sedan Road, S.A., Australia, *Elix* 2765 (MEL, holotype; CBG, isotype).]

DESCRIPTION.—Thallus loosely adnate to free growing on soil, very brittle, 4–6 cm broad, yellowish green; main lobes sublinear, 1–2 mm wide, becoming densely laciniate at the center, the laciniae subascending with ultimate tips terete, 0.2–0.6 mm wide; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface canaliculate with a pale yellowish rim, concolorous with the upper surface or darkening, sparsely rhizinate, the rhizines pale brown to black, thin, simple to furcate, 0.4–1 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–7 µm. Apothecia rarely found, substipitate, 2–5 mm in diameter; spores 4–6 × 6–9 µm, poorly developed.

CHEMISTRY.—Stictic, constictic, cryptostictic, norstictic (±), and usnic acids, lusitana unknown (±).

ILLUSTRATIONS.—Galloway, 1980, fig. 7; Elix, 1981, fig. 17 (as *Parmelia subpumila*).

DISTRIBUTION.—South Africa (Cape Province), Lesotho, Australia (SA, WA), New Zealand.

COMMENTS.—The densely developed, suberect terete laciniae resemble abnormally large, coarse isidia. This species occurs in very similar semi-arid habitats in South Africa and Australasia. For additional comments on the previous confusion surrounding the use of the epithet *molliuscula*, see *X. camtschadalis*.

After describing *Parmelia steineri*, Gyelnik (1935:40) asked Erichsen to examine the Acharian type of *P. molliuscula*. Erichsen noted the coralloid branched lobes and the canaliculate lower surface, later emphasized by Gyelnik (1938a:289). Still, Gyelnik described this distinctive species a second time in 1938 as *P. pseudoconspersa*.

Xanthoparmelia montanensis

FIGURE 51*c*

Xanthoparmelia montanensis Hale, 1984:76. [Type collection: Near Kootenai Falls, 6 mi E of Troy, Lincoln Co., Montana, USA, *McCune* 8863 (US, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–6 cm broad, dark yellowish green; lobes sublinear, 0.7–1.5 mm wide, contiguous to imbricate, crowded and becoming short laciniate at the center with age; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale, moderately rhizinate, the rhizines pale, simple, 0.2–0.5 mm long. Pycnidia poorly developed; conidia bifusiform, 0.5 × 5–7 µm. Apothecia numerous, substipitate, 1–3 mm in diameter; spores 5–6 × 9–11 µm.

CHEMISTRY.—Lichesterinic (?) and usnic acids (det. A. Johnson).

ILLUSTRATION.—Hale, 1984, fig. 5.

DISTRIBUTION.—Western North America.

COMMENTS.—This species occurs widely in the Rocky Mountains. It is the only *Xanthoparmelia* with a fatty acid that forms a strong visible spot under shortwave UV and reacts faint gray after spraying with sulfuric acid and heating.

Xanthoparmelia monticola

FIGURE 51*d*

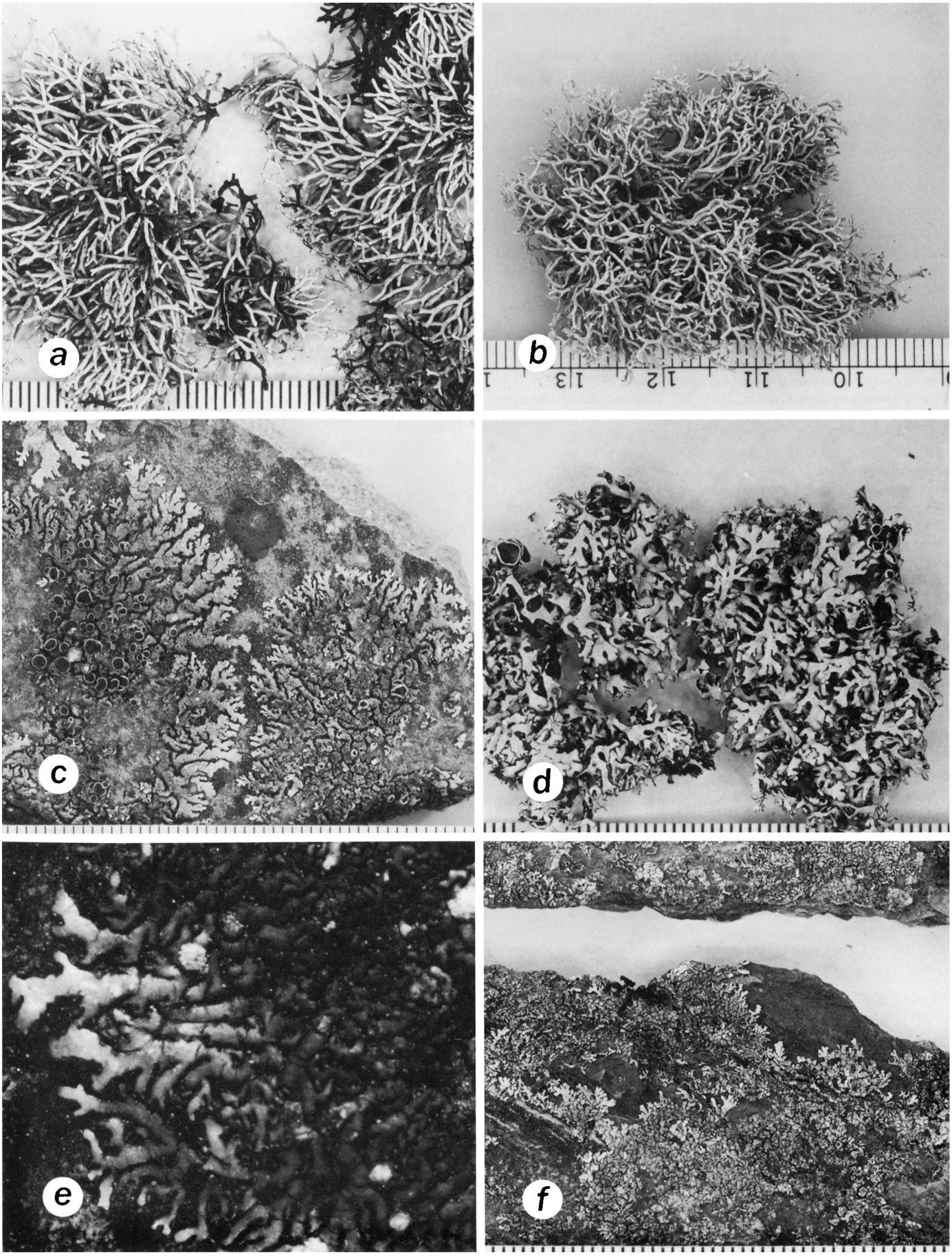
Xanthoparmelia monticola (Dey) Hale, 1988b:404.
Parmelia monticola Dey, 1974:361. [Type collection: Craggy Dome, Buncombe Co., North Carolina, USA, *Dey* 1509 (DUKE, holotype).]
Parmelia constrictans f. *inactiva* Bouly de Lesdain ex Gyelnik, 1935:31. [Type collection: Salazar, Mexico, *Amable* 257, 13 Apr 1925 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]
Xanthoparmelia monticola (Dey) Hale in Egan, 1987:162. [Invalid combination with no basionym cited.]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm, 5–8 cm broad, light yellowish green; lobes sublinear, 1–2.5 mm wide, elongate, contiguous to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale or darker brown, moderately rhizinate, the rhizines pale or darker brown, robust, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–7 µm. Apothecia common, substipitate, 1–3 mm in diameter; spores absent.

CHEMISTRY.—Fumarprotocetraric (major), physodalic, constipatic, protocetraric (trace), protoconstipatic (±), and usnic acids (the type description included stictic acid, representing a mixture in the collection, but did not mention constipatic or protocetraric acids) (det. J. Johnston).

DISTRIBUTION.—Eastern USA, Mexico.

COMMENTS.—This species has only been collected at higher elevations in the southern Appalachian Mountains. A specimen from Mexico (the type of *P. constrictans* f. *inactiva*) is more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narrow lobed than the average but falls within the range of variation of *X. monticola*.

Xanthoparmelia mougeotii

FIGURE 51*e*

Xanthoparmelia mougeotii (Schaerer) Hale, 1974b:488.
Parmelia mougeotii Schaerer 1850:46. [Type collection: Mt. Heledre, near Brujerium, *Mougeot* s.n., *Schaerer, Lichenes Helvetici Exsiccati* 548 (UPS, neotype; BM, FH-Tuck, WU, isoneotypes).]
Parmelia conspersa var. *quarzicola* Mougeot, 1845:262. [Type collection: Bruyerium, Vosges, France, *Mougeot* 1234 (FH-Tuck, lectotype).]
Parmelia mougeotii f. *discreta* Nylander, 1860:392. [Type collection: Helsinki, Finland, *Nylander* s.n. (H, Nyl. herb. no. 34810, lectotype).]
Imbricaria mougeotii (Schaerer) Koerber, 1865:32.
Parmelia discreta (Nylander) Nylander, 1869b:298.
Parmelia conspersa f. *mougeotii* (Schaerer) Leighton, 1871:136.
Parmelia mougeotii var. *spumata* Hulting, 1872:11. [Type collection: Morrum, Vestra Bleking, Sweden, *Hulting* s.n. (GB, lectotype).]
Parmelia sorediantha Müller Argoviensis, 1889b:509. [Type collection: Near Concepción, Argentina, *Lorentz* s.n. (G, lectotype; H, M, W isolectotypes).]
Parmelia mougeotii f. *microphylla* Anders, 1928:146. [Type collection: Aschendorf near B.-Leipa, Czechoslovakia, *Anders* s.n. [not seen]. A possible topotype dated 11 Aug 1933 in *Anders, Lichenes exsiccati* 333 was found in PRM.]
Parmelia mougeotii f. *deminuta* Servit, 1937:9. [Type collection: Vsenory near Prague, *Servit* s.n.(PRM, lectotype).]
Parmelia mougeotii f. *incurvoides* Servit, 1937:9. [Type collection: Mrakotinsky kopec at Mrakotin near Hlinsko, Bohemia, *Nadvornik* s.n. (PRM and herb. Nadvornik [not seen]).]
Parmelia mougeotii f. *sorediantha* (Müller Argoviensis) Gyelnik, 1935:48.

DESCRIPTION.—Thallus very tightly adnate to tightly adnate on rock, rarely on bark, usually appearing areolate at the center, 2–4 cm broad, dark yellowish green, sometimes turning a distinct brown; lobes sublinear, 0.2–0.5 mm wide, contiguous to subimbricate and crowded, brown rimmed at the tips; upper surface continuous, emaculate, shiny, rugulose, transversely cracked with age, moderately sorediate, the soralia orbicular, capitate, 0.5–1 mm in diameter; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate, the rhizines dark brown to black, simple, 0.1–0.2 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 µm. Apothecia very rare, adnate, 1–1.5 mm in diameter; spores 5–6 × 8–10 µm.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Jahns, 1980, fig. 413; Krog, Osthagen, and Tonsberg, 1980, p. 208; Ozenda and Clauzade, 1970, fig. 511.

DISTRIBUTION.—Finland, Sweden, Norway, England, Belgium, Germany, Switzerland, France, Czechoslovakia, Poland, USSR, western USA, Hawaii, Dominican Republic, Ecuador, Peru, Brazil, Argentina, South Africa (Cape Province).

COMMENTS.—This well-known European species has a pantemperate distribution in cool, humid localities. Dark brown pigmentation is caused by "Parmelia brown" pigments similar to those in *Neofuscelia* (H. Imshaug, personal communication).

FIGURE 51.—Species of *Xanthoparmelia*: *a*, *X. mollis* (*Hale* 74043, holotype in US); *b*, *X. molliuscula* (*Degelius* SA-402); *c*, *X. montanensis* (*McCune* 8863); *d*, *X. monticola* (*Dey* 1509, holotype in DUKE); *e*, *X. mougeotii* (*Hale* 42486); *f*, *X. mougeotina* (*Hale* 66360). Scale in mm.

Xanthoparmelia mougeotina

FIGURE 51*f*

Xanthoparmelia mougeotina (Nylander) D. Galloway, 1980:538.
Parmelia mougeotina Nylander, 1888:27. [Type collection: [*Knight*], New Zealand, (H, Nyl. herb. no. 34661, lectotype).]
Parmelia mougeotii var. *obscurata* Müller Argoviensis, 1892b:30. [Type collection: Based on *P. mougeotina* Nylander.]
Parmelia mougeotii f. *mougeotina* (Nylander) Gyelnik, 1938b:32.
Parmelia mougeotii f. *mougeotina* (Nylander) Zahlbruckner, 1941:105. [Superfluous combination.]

DESCRIPTION.—Thallus very tightly adnate on rock, 2–6 cm broad, dark yellowish green, darkening to brown with age; lobes sublinear, 0.3–0.6 mm wide, rather short, dichotomously branched, separate to contiguous, black rimmed; upper surface continuous to faintly white reticulate, moderately to densely isidiate, the isidia subglobose to cylindrical (Figure 17*e*), 0.04–0.08 mm in diameter, 0.1–0.2 mm high, the tips syncorticate, darkening, mostly unbranched; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple, 0.1–0.3 mm long. Pycnidia very rare; conidia bifusiform, 0.5 × 7–9 µm. Apothecia rare, adnate, ~1 mm in diameter; spores 5–6 × 10–12 µm.

CHEMISTRY.—Stictic (major), constictic, cryptostictic, norstictic, menegazziaic, and usnic acids.

ILLUSTRATION.—Galloway, 1980, fig. 8.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—Gyelnik (1938b:32) guessed that the type in H was sorediate but was unable to recognize either soredia or isidia. The type is indeed a mixture of isidiate and nonisidiate species, and Nylander's brief description gives little help in deciding on a lectotype. The species as delimited here seems to be confined to Australasia. *Xanthoparmelia congensis*, previously synonymized with it, is separated by the globose, erumpent isidia.

Xanthoparmelia multipartita

FIGURE 52*a*

Xanthoparmelia multipartita (R. Brown ex Crombie) Hale, 1984:79.
Parmelia multipartita (R. Brown ex Crombie) Elix, 1981:361.
Parmelia conspersa var. *multipartita* R. Brown ex Crombie, 1879:394. [Type collection: Port Jackson, NSW, Australia, *Brown* 542 (BM, lectotype).]

DESCRIPTION.—Thallus loosely adnate on rock, pulvinate, 6–9 cm broad, dark yellowish green; lobes sublinear-elongate, 0.5–1 mm wide, subdichotomously branched, imbricate with age, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, rugulose, black, very sparsely rhizinate, the rhizines black, coarse, simple, 0.3–0.8 mm long. Pycnidia common; conidia

bifusiform, 0.5 × 6 µm. Apothecia common, substipitate, 4–10 mm in diameter; spores 5–6 × 6–10 µm.

CHEMISTRY.—Hypostictic, hyposalazinic, hypoconstictic (±), and usnic acids.

ILLUSTRATION.—Elix, 1981, fig. 10.

DISTRIBUTION.—Australia (NSW, ACT, Vic, Tas), New Zealand.

COMMENTS.—These is no other loosely adnate species with this unusual chemistry. It is confined to Australasia.

Xanthoparmelia mutabilis, new combination

Parmelia mutabilis Taylor, 1847:171. [Type collection: Uitenhage, South Africa, *Zeyher, Hook. Herb.*, s.n. (FH-Tayl, lectotype).]

Omphalodium mutabile (Taylor) Minks, 1900:86.

Parmelia taylori Dodge, 1959:60. [Superfluous name based on *Parmelia mutabilis* Taylor.]

DESCRIPTION.—Thallus adnate to barely loosely adnate on rock, rather fragile, 3–5 cm broad, dark yellowish green; lobes sublinear, 1.5–2.5 mm wide, rather short and irregularly branched, imbricate; upper surface continuous to faintly white-maculate, isidia and soredia lacking; medulla white to uniformly pale orange (type specimen); lower surface plane, shiny, pale or darker brown, moderately rhizinate, the rhizines brown, simple, robust, 0.4–0.8 mm long. Pycnidia numerous; conidia not found. Apothecia substipitate, 2–3 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Fumarprotocetraric (major), succinprotocetraric, physodalic (±), caperatic, and usnic acids, secalonic acid pigments.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The identity of this rare South African lichen has long been in question. Nylander (1860:387) thought it was close to *Parmelia conspersa* except for the whitish color, but I doubt very much that he examined the type specimen. Müller Argoviensis (1888c:200), who did look at the type, based his description on a mixed specimen identifiable as *X. hypoleia*. The type sheet is a mixture of *X. mutabilis* (from Uitenhage), *X. hypoleia*, and *X. phaeophana*. Cleary the Uitenhage specimen is the type and is used as the basis of the description here.

Zahlbruckner (1929:138) did little to clarify the situation when he listed "*Parmelia mutabilis* Tayl. (non Fries)" as a synonym of *X. hypoleia*. This citation encouraged Dodge (1959:60) to propose a new name, *P. taylori*, for the presumed homonym. However, Fries (1831:186) merely cites "Parmelia verrucosa a. Urceolaria. Normalis: Urceolaria mutabilis Ach." with no reference to a "Parmelia mutabilis." A second "Parmelia mutabilis," ascribed by Zahlbruckner (1934:404) to Trevisan, is apparently based on an earlier reference (1928:334) to "Patellaria mutabilis Trev." with no mention of *Parmelia*. As far as I can determine, Taylor was the first one to use the name *Parmelia mutabilis*.

As so delimited, *X. mutabilis* is characterized by the medullary chemistry, which, except for the of presence pigments, indicates that it is closely related to *X. ceresina*. The pale orange medullary pigments are identical with those in *X. krogiae:* that is, undetermined secalonic acid derivatives.

Xanthoparmelia namakwa

FIGURE 52*b*

Xanthoparmelia namakwa Hale, 1986b:586. [Type collection: 19.5 km NNW of Vanrhynsdorp on east side of Hwy N7, elev. 200 m, Cape Province, South Africa, Grid 3118 BC, *Hale* 73072, 26 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate on rock, rather firm and leathery, 4–8 cm broad, darkish yellow-green; lobes sublinear, 1–2 mm wide, plane to weakly convex, contiguous, black rimmed; upper surface strongly effigurate-maculate over the whole surface or rarely only in patches, the maculae elongate, sometimes coalescing, shiny, becoming rugose with age toward the center, isidia and soredia lacking; medulla white; lower surface plane to slightly concave, uniformly pale brown or turning nearly black only at the tips, sparsely to moderately rhizinate, the rhizines coarse, 0.5–1 mm long. Pycnidia abundant; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 1–5 mm in diameter; spores 5–6 × 9–11 µm.

CHEMISTRY.—Salazinic (major), consalazinic (±), norstictic (+major), usnic acids, chalybaeizans unknown (±).

ILLUSTRATION.—Hale, 1986b, fig. 31.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This Namaqualand karoo lichen is close to *X. effigurata*, which has a uniformly black lower surface and salazinic acid (as the major metabolite) and the chalybaeizans unknown. The two species have been collected together only at Anenouspas. Another superficially similar species, *Namakwa exornata* (Steiner and Zahlbrucknmer) Hale (Hale, 1988a), has strongly convex lobes, coarse rhizines and recessed, pseudocyphella-like maculae.

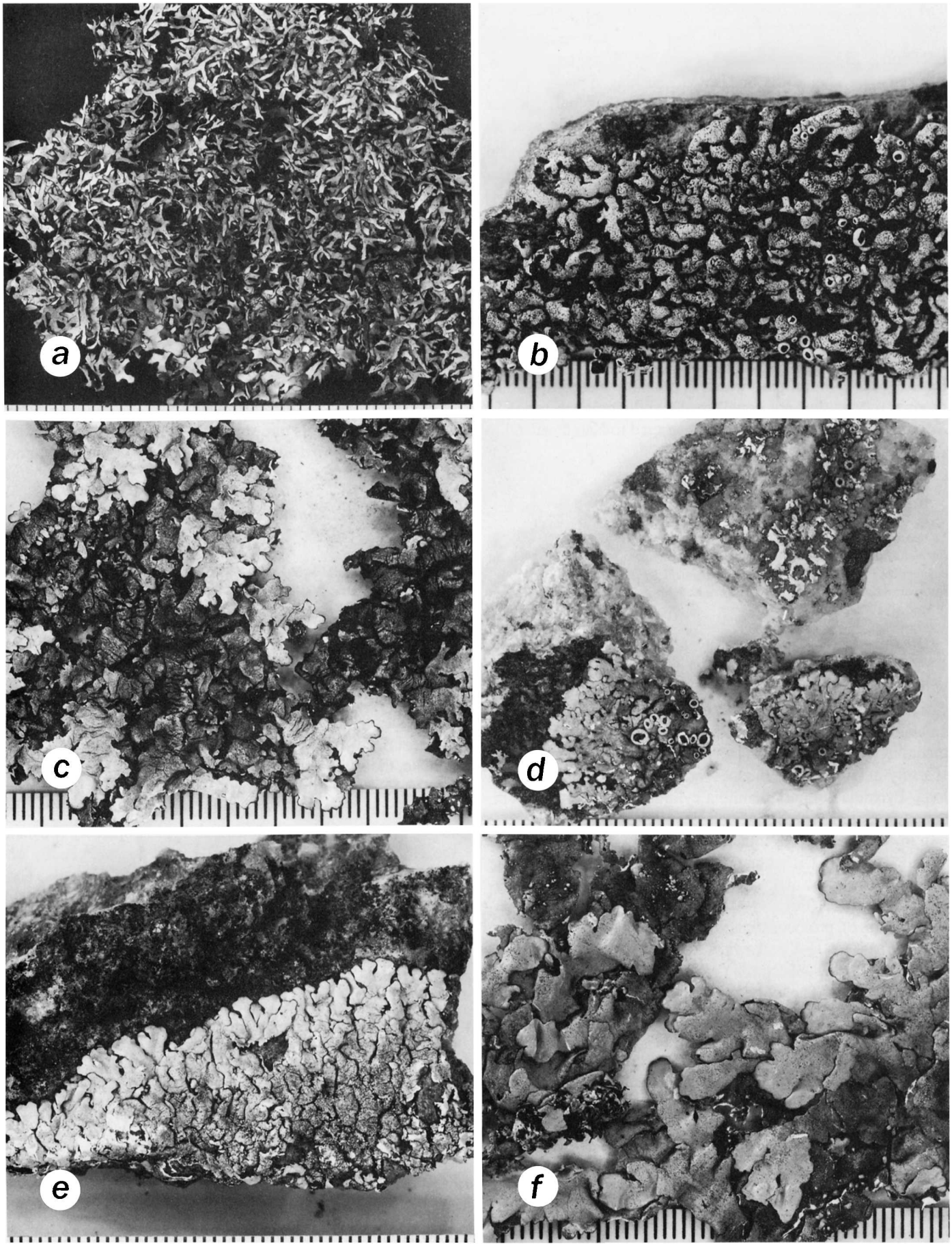
Xanthoparmelia namaquensis

FIGURE 52*c*

Xanthoparmelia namaquensis Hale, 1986b:586. [Type collection: 41 km NE of Vanrhynsdorp at Vanrhyns Pass along Hwy R27, elev. 800 m, Cape Province, South Africa, Grid 3119 AC, *Hale* 73018, 28 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate on rock, firm but easily breaking apart, 6–12 cm broad, yellowish green but darkening at the center; lobes sublinear, rather short and crowded, 2–5 mm wide, contiguous to imbricate; upper surface

FIGURE 52.—Species of *Xanthoparmelia: a, X. multipartita* (*Elix* 1654); b, *namakwa* (*Hale* 73072, holotype in US); *c, X. namaquensis* (*Hale* 73018, holotype in US); *d, X. nana* (*Nakanishi* 1, holotype in TNS); *e, X. nashii* (Nash 20392, holotype in ASU); *f, X. natalensis* (*Hale* 76846, holotype in US). Scale in mm.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continuous to very weakly white-maculate, shiny, transversely cracked with age, isidia and soredia lacking; upper medulla white, lower medulla dark purple in decaying parts; lower surface plane, black, dull, sparsely rhizinate, the rhizines black, coarse, 0.5–1 mm long. Pycnidia poorly developed; conidia bifusiform, 0.5 × 5–6 µm. Apothecia not common, substipitate, 2–10 mm in diameter; spores 5 × 9 µm.

CHEMISTRY.—Lecanoric and usnic acids, a bright pinkish orange anthraquinone pigment (±) on extraction with acetone (detected only in decomposing parts of the medulla).

ILLUSTRATION.—Hale, 1986b, fig. 32.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Of the eight species of *Xanthoparmelia* with lecanoric acid, this is the only one that is clearly loosely adnate. It sometimes produces a unique deep pinkish orange pigment (reacting K+ light purple), which is probably a decomposition product related (but not equal) to the anthraquinone series in *X. endomiltoides*. It is apparently restricted to Namaqualand.

Xanthoparmelia nana

FIGURE 52*d*

Xanthoparmelia nana (Kurokawa) Elix and Johnston, 1987:371.

Parmelia nana Kurokawa, 1985:86. [Type collection: 4 mi W of Midland Junction, Perth, W.A., Australia, *S. Nakanishi* 1 (TNS, holotype).]

Paraparmelia nana (Kurokawa) Elix and Johnston in Elix, Johnston, and Verdon, 1986:280.

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 1.5–2 cm broad, grayish green; lobes subirregular, 0.7–2 mm wide, short and irregularly branched, contiguous to subimbricate; upper surface continuous, emaculate, shiny, transversely cracked and darkening at the center, soredia and isidia lacking; medulla white; lower surface plane, pale brown to brown, sparsely rhizinate, the rhizines brown, simple, 0.2–0.4 mm long. Pycnidia common; conidia cylindrical to subbifusiform, 0.5 × 5–6 µm. Apothecia well developed, substipitate, 1–2 mm in diameter; spores immature.

CHEMISTRY.—Diffractaic (major), salazinic, consalazinic (trace), protocetraric (trace), barbatic (trace), 4-*O*-demethylbarbatic (trace), 4-*O*-demethyldiffractaic (trace), constipatic (trace), protoconstipatic (trace), and usnic acids.

ILLUSTRATION.—Kurokawa, 1985, fig. 9.

DISTRIBUTION.—Australia (WA).

COMMENTS.—The only other species in the genus with diffractaic and salazinic acids are *X. diffractaica* and *X. lesothoensis*, both larger, leathery lichens at high elevations in the Drakensberg escarpment in Lesotho. *Xanthoparmelia nana* is known only from the type collection near Perth.

Xanthoparmelia nashii

FIGURE 52*e*

Xanthoparmelia nashii Elix and Johnston in Elix, Johnston and Armstrong, 1986:293. [Type collection: King Rocks, 30 km NE of Hyden, W.A., Australia, *Nash* 20392 (ASU, holotype).]

DESCRIPTION.—Thallus adnate on rock, 4–7 cm broad, yellowish green, darkening somewhat with age; lobes sublinear, 1–2 mm wide, rather short, dichotomously branched, contiguous to subimbricate, 1–2 mm wide; upper surface continuous, emaculate, shiny, transversely cracked and rugulose with age, moderately to densely isidiate, the isidia cylindrical (Figure 17*f*), 0.1–0.15 mm in diameter, 0.1–0.5 mm high, the tips syncorticate, black, simple to sparingly branched; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, fine, 0.2–0.5 mm long, unbranched. Pycnidia and apothecia lacking.

CHEMISTRY.—Diffractaic (major), barbatic (trace), 4-*O*-demethylbarbatic (trace), 3-α-hydroxybarbatic (trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 29.

DISTRIBUTION.—Australia (WA).

COMMENTS.—This rare species in subarid western Australia is close to *X. everardensis*, a nonisidiate species most common in central Australia.

Xanthoparmelia natalensis

FIGURE 52*f*

Xanthoparmelia natalensis Hale, 1987a:259. [Type collection: E of Oribi Gorge Hotel, elev. 300 m, Natal, South Africa, *Hale* 76846, 6 Oct 1986 (US, holotype; PRE, isotype).]

Parmelia perfunctata Brusse, 1989a:402. [Nomen novum based on *Xanthoparmelia natalensis* Hale.]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 7–10 cm broad, dull yellowish green; lobes subirregular, 2.5–6 mm wide, broad and apically rotund, separate to imbricate; upper surface continuous, emaculate, shiny, becoming densely isidiate, the isidia cylindrical, in part lobulate and dorsiventral, 0.07–0.15 mm in diameter, 0.2–0.3 mm high, the tips syncorticate, brownish, sparingly branched; medulla white; lower surface plane, pale brown to brown, sparsely rhizinate, the rhizines simple, brown, 0.5–1 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, diffractaic, physodalic (±), and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 12.

DISTRIBUTION.—South Africa (Natal).

COMMENTS.—Morphologically similar *X. subramigera*, a common lichen in the Drakensberg region with erect isidia that do not become dorsiventral, has a generally paler lower surface, and lacks diffractaic acid. This species appears to be confined to southern Natal.

Xanthoparmelia naudesnekia

FIGURE 53*a*

Xanthoparmelia naudesnekia Hale, 1987b:324. [Type collection: On sheltered basaltic rocks in escarpment, Naudesnek, elev. 2180 m, Cape Province, S. Africa, Grid 3028 CB, *Hale* 76868, 9 Oct 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, firm, 5–7 cm broad, dull yellowish green; lobes subirregular, 0.8–1.5 mm wide, black rimmed, contiguous to imbricate but soon densely lobulate, the lobules sublaciniate and appressed, 0.5–1 mm wide and 1–2 mm long; upper surface continuous, emaculate, shiny, heavily pycnidiate, isidia and soredia lacking; upper medulla white, lower medulla ochre in part; lower surface plane, light brown to brown, moderately rhizinate, the rhizines simple, pale brown, 0.2–0.4 mm long. Pycnidia well developed; conidia bifusiform, 0.5 × 4–5 μm. Apothecia substipitate, 3–5 mm in diameter; spores not found.

CHEMISTRY.—Hypostictic (major), stenosporonic (major), colensoic (minor), hyposalazinic (minor), hypoconstictic (trace), and usnic acids, skyrin (det. J.A. Elix).

ILLUSTRATION.—Hale, 1987b, fig. 7.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The complex combination of acids in this rare lichen is unusual. Closely related *X. brevilobata* in Lesotho differs in lacking stenosporonic acid and in having shorter, more congested lobes. *Xanthoparmelia naudesnekia* is still known only from exposed basaltic ledges at Naudesnek Pass in the Drakensberg escarpment.

Xanthoparmelia nebulosa

Xanthoparmelia nebulosa (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:295.

Parmelia nebulosa Kurokawa and Filson in Filson, 1982:547. [Type collection: Mount Coree, A.C.T., Australia, *Kurokawa* 6350 (TNS, holotype; ANUC, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, firm, becoming pulvinate, 5–10 cm broad, light yellowish green; lobes sublinear, 1–3 mm wide, dichotomously branched, imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, brown, sparsely rhizinate, the rhizines pale brown, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 μm. Apothecia common, substipitate, 2–6 mm in diameter; spores 5–7 × 10–12 μm.

CHEMISTRY.—Unidentified fatty (major), constipatic (±trace), dehydroconstipatic (±trace), protoconstipatic (±trace), pertusaric (±trace), and usnic acids.

ILLUSTRATION.—Filson, 1982, fig. 12.

DISTRIBUTION.—Australia (NSW, ACT, Vic), New Zealand.

COMMENTS.—This rather rare but conspicuous lichen is distinguished by the fatty acid chemistry. The major component, an unidentified fatty acid, turns gray after development with sulfuric acid. This spot is close to lichesterinic acid.

Xanthoparmelia neochlorochroa

FIGURE 53*b*

Xanthoparmelia neochlorochroa Hale, 1987b:324. [Type collection: 27 mi S of Salmon, Lemhi County, Idaho, *Anderegg* 1480, 18 Jun 1973 (US, holotype; ANUC, ASU, isotypes).]

DESCRIPTION.—Thallus vagrant, free growing on soil, firm, breaking up into discrete colonies 2–4 cm broad, light yellowish green; lobes sublinear, 1–2 mm wide, moderately to strongly convoluted, irregularly branched, separate to imbricate; upper surface continuous to very faintly white-maculate, shiny, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane or subcanaliculate with an inconspicuous rim near the tips, brown, shiny, moderately to densely rhizinate, the rhizines brown with whitish splayed tips, 0.3–0.6 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic, connorstictic (±trace), and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 8.

DISTRIBUTION.—Western USA.

COMMENTS.—This is essentially the norstictic acid-containing chemotype of *X. chlorochroa*, a widespread vagrant soil lichen in western North America. It is most common in Idaho. The chemical pattern resembles that in Australian *X. convoluta-X. norconvoluta* and *X. camtschadalis-X. kasachstania* in USSR.

Xanthoparmelia neocongensis

Xanthoparmelia neocongensis (Hale) Hale, 1974b:488.

Parmelia neocongensis Hale, 1971a:351. [Type collection: Zimbabwe, Rhodesia, *Hoeg* s.n. (LD, holotype; TRH, US, isotypes).]

Parmelia patula Brusse, 1984:317. [Type collection: Cycad Trail, Olifants River Gorge, Transvaal, South Africa, Grid 2529 CB, *Brusse* 1337, 27 Mar 1981 (PRE, holotype; COLO, MEL, LD, isotypes).]

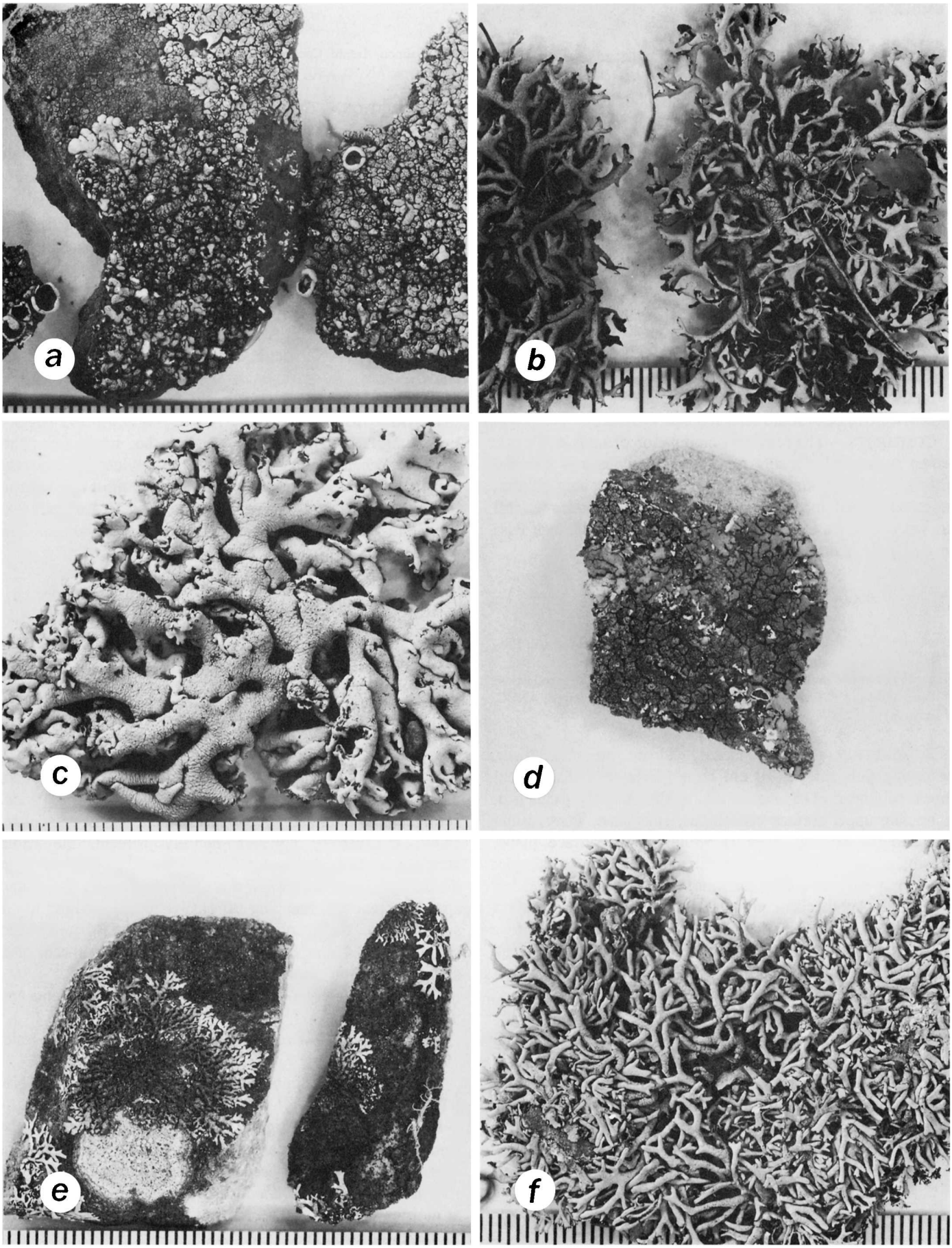
DESCRIPTION.—Thallus very tightly on rock, 1–6 cm broad, dark yellowish green; lobes sublinear, 0.5–1 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, transversely cracked, densely isidiate, the isidia subglobose to cylindrical (Figure 17*g*), 0.08–0.13 mm in diameter, 0.1–0.5 mm high, the tips syncorticate, darkening, sparsely branched, breaking off easily; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple, 0.2–0.4 mm long. Pycnidia lacking. Apothecia rare, adnate, ~1 mm in diameter; spores 4 × 7–8 μm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids.

ILLUSTRATIONS.—Brusse, 1984, fig. 6 (as *P. patula*); Hale, 1971a, fig. 2D.

DISTRIBUTION.—Zimbabwe, South Africa (Transvaal, Natal).

COMMENTS.—This tightly adnate lichen occurs in the semi-arid high veld bordering the eastern Drakensberg region. It is closely related to *X. weberi*, a larger, adnate lichen with a pale lower surface. *Xanthoparmelia oribensis*, which occurs at moister sites in Natal, is a much larger species with skyrin in the lower medulla.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Xanthoparmelia neocongruens

FIGURE 53*c*

Xanthoparmelia neocongruens Hale, 1984:76. [Type collection: Bowe's Dorp, near Kamieskroon, Namaqualand, Republic of South Africa, *Stokoe* 7719 BOL, holotype; US, isotype).]

DESCRIPTION.—Thallus loosely adnate on pebbles or less commonly free growing on soil, firm, 4–8 cm broad, light yellowish green; lobes sublinear, 2–5 mm wide, elongate, contiguous to imbricate; upper surface continuous, emaculate, shiny to dull, rugose with age, isidia and soredia lacking; upper medulla white, lower medulla in part ochre; lower surface plane to weakly convoluted, pale brown, moderately rhizinate, the rhizines pale brown or darkening, simple or sparingly furcate, 0.5–1.3 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–5 μm. Apothecia rare, substipitate, 2–5 mm in diameter; spores 4 × 8–9 μm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids, and skyrin.

ILLUSTRATION.—Hale, 1984, fig. 6.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species is commonly collected loosely attached on pebbles in open ridges of Bokkeveld shale in the Little Karoo. It is most closely related to *X. subdomokosii*, an adnate saxicolous lichen.

Xanthoparmelia neoconspersa

FIGURE 53*d*

Xanthoparmelia neoconspersa (Gyelnik) Hale, 1988b:404.

Parmelia neoconspersa Gyelnik, 1934c:161. [Type collection: Canon Sub, environs of Las Vegas, New Mexico, USA, *Brouard* 20681, 29 Apr 1929 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

DESCRIPTION.—Thallus tightly adnate on rock, 3–7 cm broad, dull yellowish green to brownish olive green; lobes sublinear, 0.6–1.2 mm wide, short and irregularly branched, contiguous to imbricate; upper surface continuous, emaculate, shiny to dull, becoming rugose-bullate with age, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–5 μm. Apothecia well developed, substipitate, 1.5–2 mm in diameter; spores 5–6 × 9–11 μm.

CHEMISTRY.—Stictic (major), constictic, norstictic (trace), and usnic acids.

DISTRIBUTION.—Western USA.

COMMENTS.—This rare New Mexican lichen appears to be related to adnate *X. angustiphylla*. The dark yellow-green thallus color and bullate-rugose center differentiate it from the South African-Australian *X. bicontinens*.

Xanthoparmelia neopropaguloides, new name

FIGURE 53*e*

Parmelia stenophylloides var. *propagulifera* Vainio, 1890:62. [Type collection: Caraa, Minas Gerais, Brazil, *Vainio, Lich. Bras. Exs.* 1241b (TUR, lectotype).]

Parmelia propagulifera (Vainio) Gylenik, 1938b:39. [Not *P. propagulifera* Vainio, 1899b:123.]

DESCRIPTION.—Thallus tightly adnate on rock, 4–6 cm broad, light yellowish green but darkening somewhat with age; lobes sublinear, 0.4–0.8 mm wide, elongate and dichotomously branched, separate to contiguous; upper surface continuous, emaculate, shiny, transversely cracked with age, moderately to densely isidiate, the isidia cylindrical (Figure 17*h*), 0.05–0.07 mm in diameter, 0.1–0.4 mm high, the tips syncorticate, darkening, simple to sparsely branched; medulla white; lower surface plane, pale or darker brown, shiny, moderately rhizinate, the rhizines stout, unbranched, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic (major), constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 9.

DISTRIBUTION.—Cuba, Dominican Republic, Guatemala, Panama, Venezuela, Brazil, Ivory Coast, South Africa (Transvaal, Natal, Transkei, Venda), Swaziland, SWA/Namibia.

COMMENTS.—This widely distributed, previously unrecognized lichen is related to, but much smaller than the adnate to loosely adnate *X. plittii*, which also has a more consistently pale lower surface. It was previously identified as *X. congensis*, an erumpent-isidiate species with a black lower surface. I recently (Hale, 1987b) called this taxon *Xanthoparmelia neopropagulifera* (Gyelnik) Hale, but this is a synonym of *Hypotrachyna microblasta* (Vainio) Hale (Hale, 1975).

Xanthoparmelia neoreptans

FIGURE 53*f*

Xanthoparmelia neoreptans Hale, 1987a:259. [Type collection: 3.4 km S of Van Wyksdorp on E side of hwy R327, elev. 350 m, Cape Province, South Africa, Grid 3321 CD, *Hale* 77717, 19 Oct 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate to nearly free growing on soil, rather fragile but not fragmenting, 3–6 cm broad, dull yellowish green; lobes sublinear to linear, 0.6–1 mm wide, dichotomously branched and overlapping, some laciniae towards the center becoming terete, suberect; upper surface faintly to partly strongly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface canaliculate with a more or less conspicuous yellowish rim, pale brown to brown or (especially at the tips) blackening, moderately to densely rhizinate, the rhizines brown but blackening toward the tips,

FIGURE 53.—Species of *Xanthoparmelia*: *a*, *X. naudesnekia* (*Hale* 76868, holotype in US); *b*, *X. neochlorochroa* (*Anderegg* 1480, holotype in US); *c*, *X. neocongruens* (*Stokoe* 7719, isotype in US); *d*, *X. neoconspersa* (*Brouard* 20681, lectotype in BP); *e*, *X. neopropaguloides* (*Vainio* 1241b, lectotype in TUR); *f*, *X. neoreptans* (*Hale* 77717, holotype in US). Scale in mm.

simple or furcate, 0.5–1.2 mm long. Pycnidia lacking. Apothecia rarely developed, substipitate, 3–5 mm in diameter; spores not found.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 13.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—In morphology and size, *X. neoreptans* is close to *X. molliuscula*, which contains stictic acid and has numerous, well-developed terete secondary lobes. It occurs rather rarely in semi-arid karoo in southern Cape Province. The Australian *X. reptans*, containing fumarprotocetraric acid, is a larger lichen with broader, dichotomously branched, canaliculate lobes 0.8–1.5 mm wide that lack terete laciniae.

Xanthoparmelia neorimalis

Xanthoparmelia neorimalis (Elix and Armstrong) Elix and Nash in Nash and Elix, 1986:455.

Parmelia neorimalis Elix and Armstrong, 1983:475. [Type collection: Black Mountain Reserve, Canberra, A.C.T., Australia, *Elix* 6124 (MEL, holotype).]

Parmelia interposita Kurokawa, 1985:81. [Type collection: 18 mi E of Kondinin, W.A., Australia, *S. Nakanishi* 11-b (TNS, holotype; not seen).]

Paraparmelia interposita (Kurokawa) Elix and Johnston in Elix, Johnston, and Verdon, 1986:280.

DESCRIPTION.—Thallus very tightly adnate on rock, the center appearing areolate, 3–6 cm broad, dark yellowish green; lobes subirregular to sublinear, 0.5–1 mm wide, contiguous to crowded and sublobulate at the center, black rimmed; upper surface continuous, emaculate, shiny, transversely cracked, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.1–0.2 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, adnate, ~1 mm in diameter; spores 3–5 × 7–9 µm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

ILLUSTRATIONS.—Elix and Armstrong, 1983, fig. 7; Kurokawa (1985), fig. 5 (as *Parmelia interposita*).

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, SA, NT, WA), Mexico.

COMMENTS.—This widespread lichen belongs to the *X. lineola* series and is distinguished by the centrally areolate, very tightly adnate thallus. Externally it resembles the Australian norlobaridone-containing *X. dubitata*.

Xanthoparmelia neosynestia

FIGURE 54*a*

Xanthoparmelia neosynestia Hale, 1986b:588. [Type collection: 41 km NE of Vanrhynsdorp at Vanrhyns Pass along Hwy R27, elev. 800 m, Cape Province, South Africa, Grid 3119 AC, *Hale* 73017, 28 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather brittle, 4–7 cm broad, dark greenish yellow; lobes subirregular to sublinear, 1–2.5 mm wide, elongate and dichotomously branched, imbricate; upper surface uniformly white-maculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown, sparsely to moderately rhizinate, the rhizines brown, 0.5–1 mm long, simple. Pycnidia numerous; conidia bifusiform, 0.5 × 5–6 µm. Apothecia well developed, adnate, 3–5 mm in diameter, the rim crenate; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic (major), norstictic (trace), protocetraric (trace), consalazinic, and usnic acids, chalybaeizans unknown (±) (present in holotype).

ILLUSTRATION.—Hale, 1986b, fig. 33.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species has the same distinctive dark greenish cast of *X. synestia* but the lower surface is uniformly pale or in part darker brown but not blackening. Another related species in Namaqualand, *X. springbokensis*, contains skyrin in the lower medulla. *Xanthoparmelia neosynestia* occurs over a broad area in Namaqualand and southwestern Cape Province on vertical, protected ledges in karoo.

Xanthoparmelia neotaractica

FIGURE 54*b*

Xanthoparmelia neotaractica Hale, 1984:76. [Type collection: Albert Pike Recreation Area, Montgomery Co., Alabama, *Hale* 3911 (US, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock, rather brittle, 5–8 cm broad, yellowish green; lobes sublinear, 1–1.5 mm wide, elongate and divaricately branched; upper surface continuous to very faintly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown to darker brown, sparsely to moderately rhizinate, the rhizines brown, simple, 0.3–0.6 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–3 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1984, fig. 7.

DISTRIBUTION.—Southeastern USA.

COMMENTS.—It is superficially similar to *X. somloensis* but lacks distinct white maculae, contains stictic acid, and occurs only in southeastern USA.

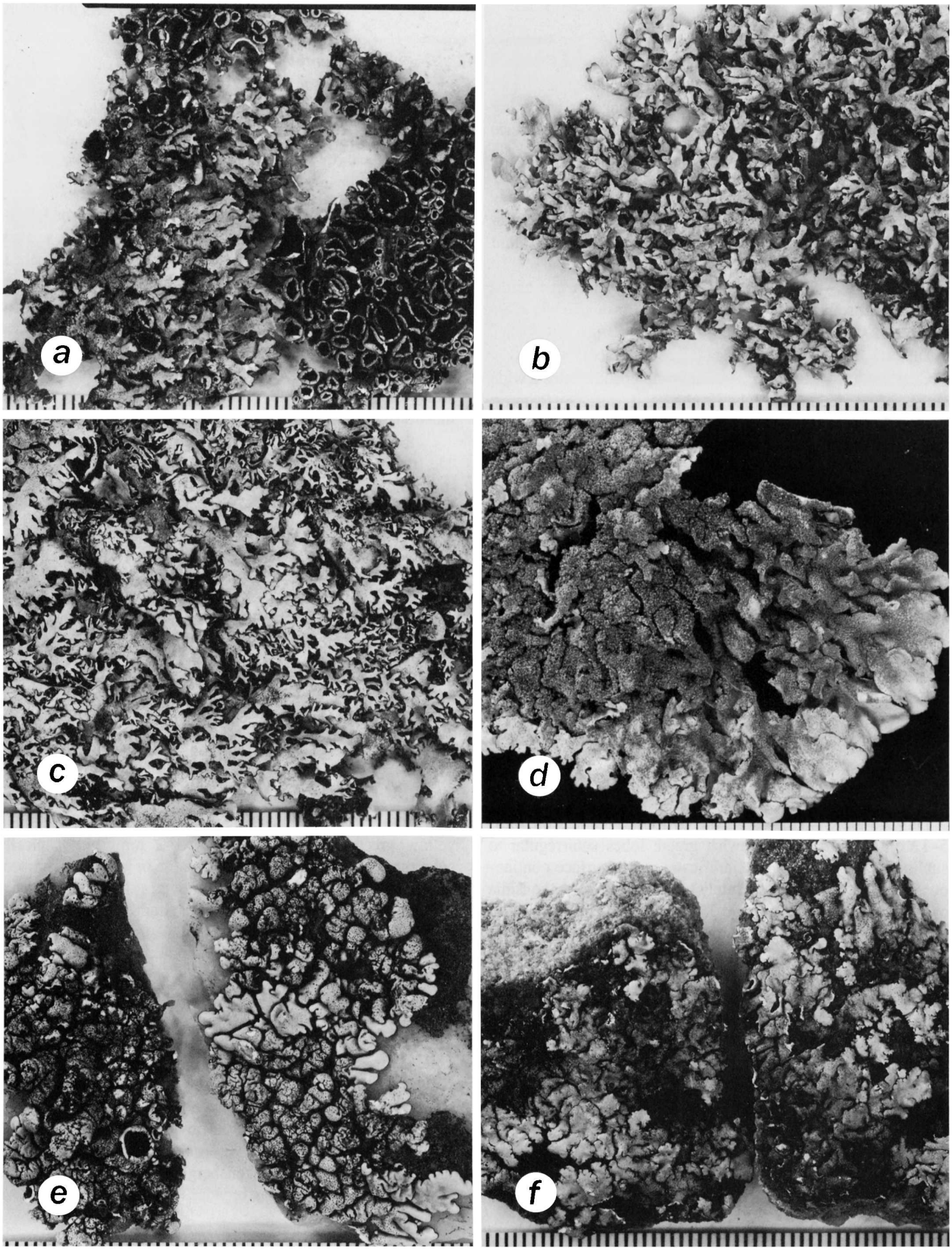
Xanthoparmelia neotasmanica

FIGURE 54*c*

Xanthoparmelia neotasmanica Hale, 1986b:588. [Type collection: 78.6 km S of Sutherland on Hwy R354, Cape Province, South Africa, Grid 3220 DC, *Hale* 73019, 29 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate on rock or in part

FIGURE 54.—Species of *Xanthoparmelia*: *a*, *X. neosynestia* (*Hale* 73017, holotype in US); *b*, *X. neotaractica* (*Hale* 3911); *c*, *X. neotasmanica* (*Hale* 73019, holotype in US); *d*, *X. neotinctina* (*Elix* 1973); *e*, *X. neotumidosa* (Hale 78506, holotype in US); *f*, *X. neoweberi* (*Hale* 76663, holotype in US). Scale in mm.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on soil, often growing in mats on tops and sides of sheltered rocks, 8–15 cm broad, light yellowish green; lobes sublinear, 2–6 mm wide, strap-shaped, sparsely branched or becoming laciniate, the laciniae about 0.6–1.0 mm wide; upper surface weakly to distinctly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, moderately to densely rhizinate, the rhizines black, simple to sparsely furcate, 0.5–1 mm long. Pycnidia abundant; conidia bifusiform, 0.5 × 6–7 µm. Apothecia rather rare, adnate, 3–9 mm in diameter; spores 5–6 × 9–12 µm.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids, chalybaeizans unknown (±).

ILLUSTRATION.—Hale, 1986b, fig. 34.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The *X. tasmanica* group encompasses a wide range of variation in lobe width and surface features. *Xanthoparmelia tasmanica* itself is a very common species in South Africa, as well as in North America and Australasia. *Xanthoparmelia neotasmanica* represents a well-defined population with uniform maculae. The East African lichen *X. africana* has a more rigid, pulvinate thallus and weaker white maculae.

Xanthoparmelia neotinctina

FIGURE 54*d*

Xanthoparmelia neotinctina (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:297.

Parmelia neotinctina Elix, 1981:363. [Type collection: 1 km N of Tallarook, Vict., Australia, *Elix* 4856 (MEL, holotype; CBG, isotype).]

Parmelia conspersa var. *constrictans* f. *isidiophora* Müller Argoviensis, 1883:48. [Type collection: Mt. Macedon, Australia, *Moffat* 38 (G, lectotype).]

Imbricaria constrictans **isidiophora* (Müller Argoviensis) Jatta, 1902:470.

Parmelia isidiigera f. *isidiophora* (Müller Argoviensis) Gyelnik, 1935:24.

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 5–12 cm broad, dark yellowish green; lobes subirregular to sublinear, 1.5–4 mm wide, imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia cylindrical (Figure 17*i*), 0.1–0.15 mm in diameter, 0.2–2 mm high, the tips syncorticate, black, becoming densely coralloid branched; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple, 0.3–0.5 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 µm. Apothecia rare, substipitate, 2–7 mm in diameter; spores 5–7 × 7–9 µm.

CHEMISTRY.—Norstictic (major), salazinic (±), connorstictic (±), and usnic acids.

ILLUSTRATION.—Elix, 1981, fig. 11.

DISTRIBUTION.—Australia (NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—The isidia are usually dense but a chemical test is needed to separate this common Australasian lichen from *X. australasica* and *X. isidiigera*. It is especially common in Tasmania and New Zealand.

Xanthoparmelia neotumidosa

FIGURE 54*e*

Xanthoparmelia neotumidosa Hale, 1987b:326. [Type collection: Douse-the-Glim Road, 3 km NE junction with Hwy N7, N of Vanrhynsdorp, Cape Province, South Africa, Grid 3118 BC, *Hale* 78506 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate on rock, 4–6 cm broad, firm, light yellowish green; lobes sublinear, 1–2 mm wide, convex and appearing inflated, rather short and irregularly branched, contiguous to subimbricate; upper surface continuous, emaculate, shiny, strongly rugose to almost bullate with age at the center, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.3–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia well developed, substipitate, 4–5 mm in diameter; spores 5 × 8–9 µm.

CHEMISTRY.—Protocetraric (major), 4-*O*-demethyldiffractaic (major), 4-*O*-demethylbarbatic (trace), squamatic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 10.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species is close to *X. tumidosa*, a more widespread karoo lichen in western Cape Province that lacks 4-*O*-demethyldiffractaic acid. *Xanthoparmelia duplicata*, a loosely adnate, white-maculate lichen, also from Namaqualand, has the same chemistry in addition to skyrin.

Xanthoparmelia neoweberi

FIGURE 54*f*

Xanthoparmelia neoweberi Hale, 1987a:259. [Type collection: 10.5 km E of Drakensberg Garden Hotel, elev. 1700 m, Natal, South Africa, Grid 2929 CD, *Hale* 76663, 4 Oct 1986 (US, holotype; LD, PRE, isotype).]

DESCRIPTION.—Thallus adnate on rock, 5–7 cm broad, light yellow green; lobes subirregular, 1–2 mm wide, apically subrotund, contiguous to imbricate, more or less black rimmed; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia subglobose to cylindrical (Figure 18*a*), 0.08–0.15 mm in diameter, 0.2–0.4 mm high, the tips syncorticate, darkening, mostly unbranched; upper medulla white, lower medulla in part ochre; lower surface plane, brown, moderately rhizinate, the rhizines simple, brown, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1987a, fig. 14.

DISTRIBUTION.—South Africa (Natal, Transvaal).

COMMENTS.—This species is obviously closely related to and can be confused with *X. weberi*, an equally common species in the eastern Drakensbergs in Natal and Transvaal which lacks skyrin and has broader lobes and a lighter brown lower surface.

Xanthoparmelia neowyomingica

FIGURE 55*a*

Xanthoparmelia neowyomingica Hale, 1989a:552. [Type collection: 3 mi S of Ward, vicinity of Glacier Lake, Boulder County, Colorado, USA, *Wirth* s.n., 1 Jun 1962 (US, holotype; COLO, isotype).]

DESCRIPTION.—Thallus loosely adnate to nearly free growing on soil, forming orbicular colonies 3–4 cm in diameter, firm, light yellowish green; lobes sublinear, 0.8–2 mm wide, weakly but distinctly convoluted, dichotomously branched at the tips, subascending, soon becoming laciniate with dense masses of weakly terete laciniae 0.3–0.6 mm wide; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane to canaliculate with a more or less prominent raised yellowish rim toward the tips, pale brown to brown, moderately to densely rhizinate, the rhizines pale brown or darkening, rather coarse with splayed tips, simple to branched and tufted, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–5 µm. Apothecia rare, substipitate, 2–4 mm in diameter; spores not developed.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 22.

DISTRIBUTION.—Western USA.

COMMENTS.—This species is closely related to the more common salazinic acid-containing *X. wyomingica*, but it produces terete laciniae. It is known only from the type collection in Colorado.

Xanthoparmelia nigraoleosa

Xanthoparmelia nigraoleosa Elix and Johnston, 1988a:506. [Type collection: Flinders Ranges, lower slopes of Mt. Remarkable, Melrose, elev. 500 m, South Australia, Australia, *Elix* 17748 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate, appearing somewhat areolate at the center, 3–6 cm broad, dull yellowish green or darkening with age; lobes sublinear, 0.8–1.5 mm wide, irregularly branched, black margined at the tips, contiguous to subimbricate; upper surface continuous, emaculate, shiny, transversely cracked toward the center, soredia and isidia lacking; medulla white; lower surface plane, brown at the apices but black at the center, moderately rhizinate, the rhizines black, slender, simple. Pycnidia not seen. Apothecia substipitate, 1–3 mm in diameter; spores 4–5 × 7–8 µm.

CHEMISTRY.—Constipatic, protoconstipatic, dehydroconstipatic (+minor), and usnic acids, atranorin (minor).

ILLUSTRATION.—Elix and Johnston, 1988a, fig. 15.

DISTRIBUTION.—Australia (SA).

COMMENTS.—This rare species occurs in dry, open eucalypt woodland in South Australia. Closely related *X. oleosa* has a pale lower surface. The South African *X. subnigra* also has a black lower surface but is a larger lichen, not so tightly adnate, and has a different fatty-acid profile.

Xanthoparmelia nigropsoromifera

Xanthoparmelia nigropsoromifera (Nash) Egan, 1976:225.

Parmelia nigropsoromifera Nash, 1974c:320. [Type collection: 8 km N of east end of Lake Roosevelt, Gila Co., Arizona, USA, *Nash* 7416 (ASU, holotype; DUKE, MIN, US, WIS, isotypes).]

DESCRIPTION.—Thallus adnate on rock, 4–7 cm broad, yellowish green; lobes subirregular, 1.5–3 mm wide, obtuse, contiguous to imbricate; upper surface continuous, emaculate, dull, becoming rugose with age, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines black, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6 µm. Apothecia common, substipitate, 2–6 mm in diameter; spores 4 × 7–8 µm.

CHEMISTRY.—Psoromic, 2′-*O*-demethylpsoromic, and usnic acids.

ILLUSTRATION.—Nash, 1974c, fig. 1.

DISTRIBUTION.—Southwestern USA.

COMMENTS.—This Sonoran desert lichen is similar to *X. psoromifera*, which has a pale brown lower surface. Another Sonoran endemic, *X. huachucensis*, has a black lower surface and lobes less than 1 mm wide.

Xanthoparmelia nonreagens

FIGURE 55*b*

Xanthoparmelia nonreagens Elix and Johnston, 1987:365. [Type collection: Mt. Farrenden, 26 km SSW of Charters Towers, Queensland, Australia, *Elix* 20562, 22 Jun 1986 (CBG, holotype).]

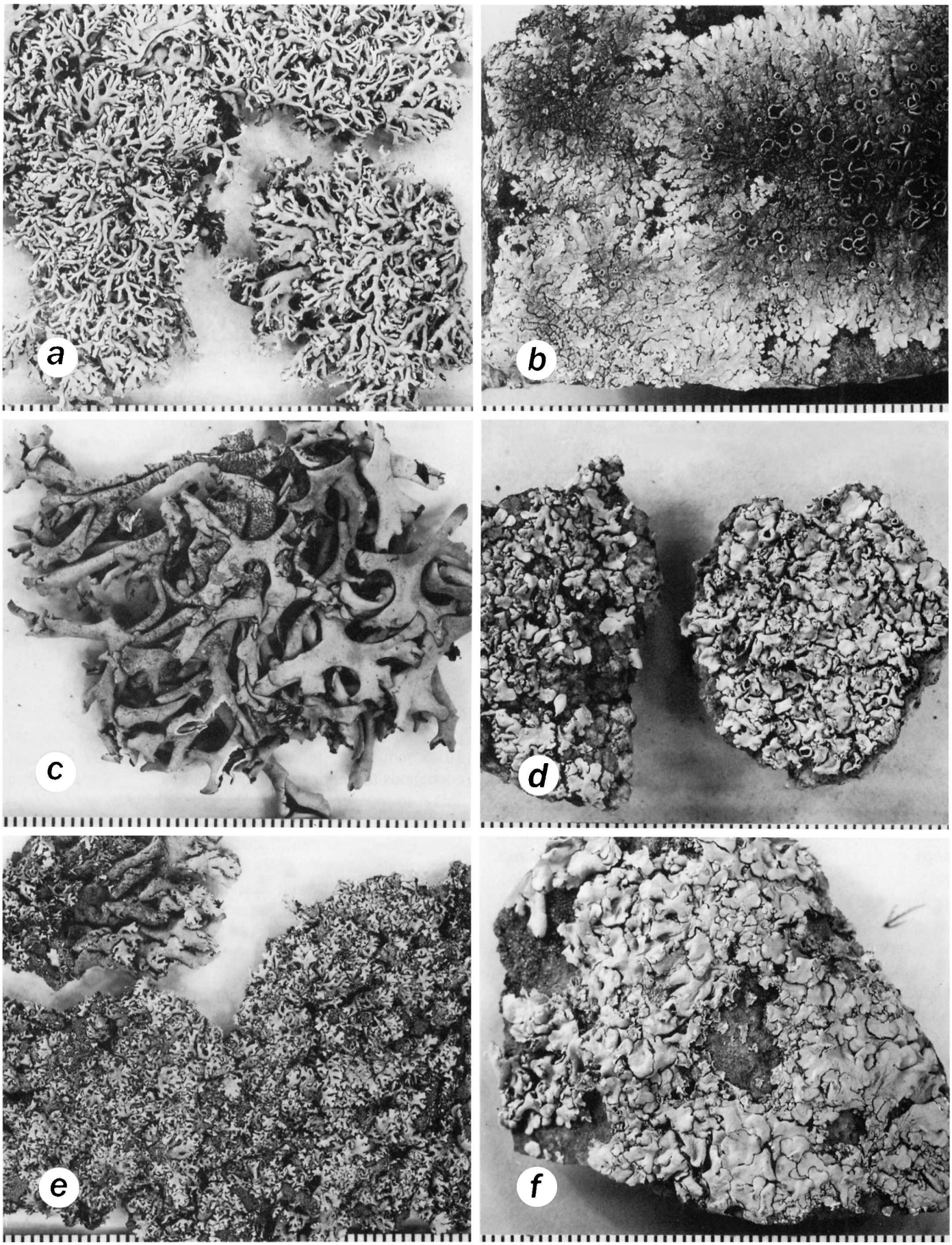
DESCRIPTION.—Thallus tightly adnate to adnate on rock, 2–4 cm broad, coalescing into larger colonies, dull yellowish green but darkening with age; lobes subirregular to sublinear, 1–1.5 mm wide, relatively long and irregularly branched, contiguous to imbricate; upper surface continuous, emaculate, shiny to opaque, transversely cracked with age, densely isidiate, the isidia subglobose to mostly cylindrical (Figure 18*b*), 0.06–0.1 mm in diameter, 0.1–0.3 mm high, the tips syncorticate to weakly epicorticate, brownish, simple or sparingly branched with age; medulla white; lower surface plane, pale tan to brown, sparsely to moderately rhizinate, the rhizines pale tan, simple, 0.1–0.3 mm long. Pycnidia lacking. Apothecia well developed, substipitate, 1–4 mm in diameter; spores 4–5 × 7–9 µm.

CHEMISTRY.—Scabrosin 4,4′-dibutyrate, scabrosin 4-acetate,4′-butyrate, scabrosin 4-acetate,4′hexanoate, scabrosin 4,4′-diacetate (±), and usnic acid.

ILLUSTRATION.—Elix and Johnston, 1987, fig. 7.

DISTRIBUTION.—Australia (Qld).

COMMENTS.—*Xanthoparmelia immutata*, a close relative, differs in having globose-inflated isidia and constipatic and protoconstipatic acids in addition to the scabrosin derivatives. *Xanthoparmelia remanens* has the same chemistry but the isidia are larger (0.08–0.12 mm in diameter) and clearly erumpent at maturity.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Xanthoparmelia norchlorochroa

FIGURE 55*c*

Xanthoparmelia norchlorochroa Hale, 1987b:326. [Type collection: 4 mi S of Malta, Raft River Valley, Cassia County, Idaho, elev. 1300 m, *Holmgren* 173, 6 Aug 1961 (US, holotype; ANUC, ASU, isotypes).]

DESCRIPTION.—Thallus vagrant, growing free on soil, firm and leathery, breaking up into irregular colonies 5–10 cm broad, dull yellowish green; lobes sublinear, 2–7 mm wide, elongated and contorted, strongly convoluted, sparsely branched, separate to imbricate; upper surface continuous to faintly white-maculate, dull, rugose and reticulately cracked with age, isidia and soredia lacking; medulla white; lower surface plane, dark brown to black, smooth to strongly rugose, rhizines lacking. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic, connorstictic (±), and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 11.

DISTRIBUTION.—Western USA.

COMMENTS.—The large leathery erhizinate thallus and with a black lower surface is unique among the vagrant species. It has been found only in the desert grazing lands of Idaho, occurring with *X. chlorochroa*, a smaller, salazinic acid-containing plant moderately to densely rhizinate below.

Xanthoparmelia norcolorata

FIGURE 55*d*

Xanthoparmelia norcolorata Hale, 1989a:554. [Type collection: On sheltered coarse granite in large koppie, 13.6 km N of Rehoboth on east side of Hwy B2, elev. 1700 m, South West Africa/Namibia, Grid 2317 AA, *Hale* 81260, 30 Apr 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate on rock, 6–8 cm broad, light yellowish green; lobes subirregular, 1–2 mm wide, rather short and crowded, pale rimmed, subimbricate, sublobulate, becoming suberect and revolute at the center; upper surface continuous, emaculate, dull, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines black, simple to sparsely branched, 0.3–0.6 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 µm. Apothecia substipitate, 1–2 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Norstictic, connorstictic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 23.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This rare species falls in the *X. schenckiana* group (see discussions under *X. schenckiana*). It is a smaller, narrower-lobed lichen without salazinic acid.

FIGURE 55.—Species of *Xanthoparmelia*: *a*, *X. neowyomingica* (*Wirth* s.n., holotype in COLO); *b*, *X. nonreagens* (*Elix* 20562, holotype in CBG); *c*, *X. norchlorochroa* (*Holmgren* 173, holotype in US); *d*, *X. norcolorata* (*Hale* 81260, holotype in US); *e*, *X. norhypopsila* (*Hale* 23106, holotype in US); *f*, *X. norlobaronica* (*Hale* 72523, holotype in US). Scale in mm.

Xanthoparmelia norconvoluta

Xanthoparmelia norconvoluta (Elix and Armstrong) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:299.

Parmelia norconvoluta Elix and Armstrong, 1983:477. [Type collection: Thurla, 9.6 km W of Red Cliffs, Vict., Australia, *Willis* ix.1940 (MEL, holotype).]

DESCRIPTION.—Thallus vagrant, free growing on soil, leathery, breaking apart, 3–6 cm broad; lobes sublinear, 3–8 mm wide (to 10 mm unrolled), strongly convoluted and inrolled, little branched, separate; upper surface continuous, emaculate, dull, fissured and rugose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown, sparsely rhizinate, the rhizines pale brown to brown or blackening, delicate, simple to sparsely branched, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic, connorstictic, and usnic acids.

ILLUSTRATION.—Elix and Armstrong, 1983, fig. 8.

DISTRIBUTION.—Australia (Vic, SA).

COMMENTS.—This chemotype of *X. convoluta* has been collected only rarely in mallee scrub and shrubland in arid southern Australia. It parallels *X. chlorochroa-X. neochlorochroa* in North America and *X. camtschadalis-X. kasachstania* in USSR with norstictic acid replacing salazinic acid.

Xanthoparmelia norhypopsila

FIGURE 55*e*

Xanthoparmelia norhypopsila Hale, 1987b:326. [Type collection: Mill Bluff Roadside Park, Juneau County, Wisconsin, USA, *Hale* 23106, Jul 1963 (US, holotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 5–8 cm broad, dull yellowish green; lobes subirregular to sublinear, 1–1.5 mm wide, contiguous to imbricate, becoming densely lobulate-laciniate at the center, the laciniae dichotomously branched, 0.3–0.5 mm wide, appressed; upper surface continuous, emaculate, shiny, densely isidiate, the isidia cylindrical and in part lobulate and decumbent (Figure 18*c*), 0.06–0.15 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, darkening, unbranched; medulla white; lower surface plane, shiny, dark brown at the tips and blackening at the center, sparsely rhizinate, rhizines black, simple, 0.2–0.4 mm long. Pycnidia well developed; conidia weakly bifusiform, 0.5 × 5–7 µm. Apothecia lacking.

CHEMISTRY.—Norstictic, connorstictic, and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 12.

DISTRIBUTION.—North-central USA.

COMMENTS.—The partly lobulate, decumbent isidia and chemistry are unusual characters. The species is known only from the type locality. Another norstictic acid-containing species in Wisconsin, *X. dierythra*, has cylindrical isidia and a pale brown lower surface.

Xanthoparmelia norlobaronica

FIGURE 55*f*

Xanthoparmelia norlobaronica Hale, 1989a:554. [Type collection: 3.8 km SW of Montagu in pass area on west side of road. elev. 200 m. Cape Province, South Africa, Grid 3320 CC, *Hale* 72523, 3 Feb 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate, fragmenting easily, 5–7 cm broad, light yellowish green; lobes subirregular, 1–2.5 mm wide, apically rotund, short and irregularly branched, imbricate; upper surface continuous, emaculate, shiny, rugulose with age, soredia and isidia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.5 mm long. Pycnidia well developed; conidia bifusiform, 0.5 × 4–6 µm. Apothecia lacking.

CHEMISTRY.—Norlobaridone, unknown $R_{fc}12$, usnic acid.

ILLUSTRATION.—Hale, 1989a, fig. 24.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species is comparable to the Australasian *X. filarszkyana*, which is more closely adnate and normally contains loxodin in addition to norlobaridone. It occurs at three localities in southern Cape Province.

Xanthoparmelia norpraegnans

FIGURE 56*a*

Xanthoparmelia norpraegnans Elix and Johnston, 1988b:358. [Type collection: 4 km E of Bulla Bulling, Western Australia, Australia, *Elix* 21742, 20 Aug 1987 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 1–3 cm broad, yellow green but darkening with age; lobes subirregular to sublinear, 0.4–0.6 mm wide, short contiguous to imbricate; upper surface continuous, emaculate, shiny, tangentially or irregularly cracked and areolate-rugulose with age, moderately isidiate, the isidia globose, the tips strongly epicorticate, becoming erumpent but not sorediate, rarely branched; 0.15–0.2 mm in diameter to 0.2 mm high; medulla white; lower surface plane, pale to light brown, shiny, the apices darker, sparsely to moderately rhizinate, the rhizines pale brown, simple, 0.1 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic (major), connorstictic, constipatic (±), protoconstipatic (±), and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1988b, fig. 7.

DISTRIBUTION.—Australia (WA).

COMMENTS.—More widespread *X. praegnans* is a somewhat larger lichen with salazinic acid. Chemically similar *X. flindersiana* has broader lobes and contains minor quantities of hypostictic and hyposalazinic acids.

Xanthoparmelia norpumila

Xanthoparmelia norpumila Elix and Johnston in Elix, Johnston, and Armstrong, 1986:300. [Type collection: Burnabbie Homestead, Hampton Range, Eyre Peninsula, Australia, *Serventy* s. n. (MEL 1033156, holotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on hard lateritic soils, firm, 3–10 cm broad light yellowish green; lobes sublinear, 1–2 mm wide, contiguous to imbricate, dichotomously branched, laciniate at the center, the laciniae becoming terete, 0.2–0.4 mm wide; upper surface continuous, emaculate, dull, isidia and soredia lacking; medulla white; lower surface plane to weakly canaliculate, a marginal rim barely developed, light brown at the tips but black at the center, sparsely to moderately rhizinate, the rhizines black, simple, thin, 0.5–1 mm long. Pycnidia lacking. Apothecia not commonly developed, substipitate, 3–5 mm in diameter; spores 5–6 × 10–11 µm.

CHEMISTRY.—Norstictic, connorstictic, and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 30.

DISTRIBUTION.—Australia (SA, WA).

COMMENTS.—This is a chemotype of *X. pumila* (salazinic acid present) with a more restricted range on the hard lateritic soils of arid mallee scrub.

Xanthoparmelia norwalteri

FIGURE 56*b*

Xanthoparmelia norwalteri Hale, 1989a:554. [Type collection: 9 km S of Lüderitz, SWA/Namibia, Grid 2615 CA, *Hale* 81205, 28 Apr 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate on pebbles, rather brittle, 1–3 cm broad, dull yellowish green; lobes sublinear, 1–2 mm wide, separate to subimbricate with ascending tips; upper surface white-maculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, smooth to rugulose, black, shiny, in part yellow rimmed, very sparsely rhizinate, the rhizines black, coarse, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic, connorstictic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 25.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This unusual member of the *X. walteri* group occurs at the same locality as diffractaic acid-containing *X. luderitziana* Hale (above). Both are more brittle and more obviously white-maculate than *X. walteri*, which occurs in the Lüderitz region as well.

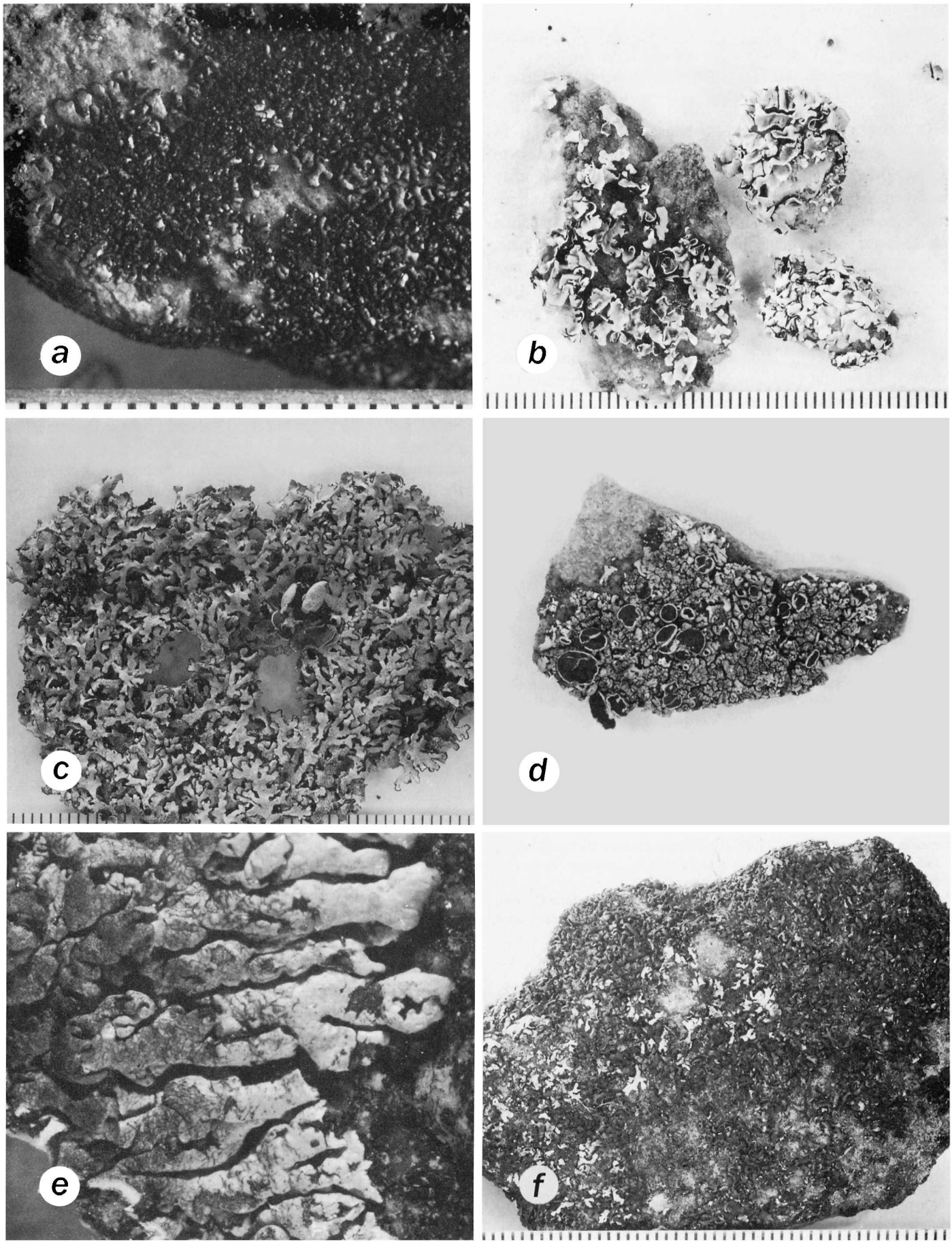
Xanthoparmelia notata

FIGURE 56*c*

Xanthoparmelia notata (Kurokawa) Hale, 1974b:488.

Parmelia notata Kurokawa in Kurokawa et al., 1971:33. [Type collection: 5 mi E Nerriga, NSW, Australia, *Kurokawa* 6401 (TNS, holotype; MEL,

FIGURE 56.—Species of *Xanthoparmelia*: *a*, *X. norpraegnans* (*Elix* 21742, holotype in CBG); *b*, *X. norwalteri* (*Hale* 81205, holotype in US); *c*, *X. notata* (*Kurokawa* 6402); *d*, *X. novomexicana* (*Arsène* 20647, lectotype in BP); *e*, *X. oblisata* (*Fletcher* 10140, holotype in US); *f*, *X. obscurata* (Hale 78399, holotype in US). Scale in mm.


a
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f

isotype).]

Parmelia subconspersa var. *eradicata* Zahlbruckner, 1896:195. [Type collection: New England, NSW, Australia, *Moore* s.n. (W, lectotype).]

DESCRIPTION.—Thallus loosely adnate on rock, firm, 6–14 cm broad, yellowish green or darkening; lobes sublinear to linear, 0.7–1.5 mm wide, more or less dichotomously branched, separate to imbricate, black rimmed; upper surface effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, rugulose, sparsely rhizinate, the rhizines black, simple to splayed or furcate, 0.5–2 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, substipitate, 3–10 mm in diameter; spores 4 × 8–9 µm.

CHEMISTRY.—Notatic (major), 4-*O*-methylhypoprotocetraric (major), subnotatic (±), isonotatic (±), hypoprotocetraric (±), 4-*O*-demethylnotatic (±), and usnic acids.

ILLUSTRATIONS.—Galloway, 1980, fig. 9; Kurokawa et al., 1971, pl. 1: fig. 1.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—This is the most common member of the *X. hypoleia* group in Australasia, and the only species in the genus with notatic acid as the major component.

Xanthoparmelia novomexicana

FIGURE 56*d*

Xanthoparmelia novomexicana (Gyelnik) Hale, 1974b:488.

Parmelia novomexicana Gyelnik, 1934c:161. [Type collection: Thunderbird, Las Vegas, New Mexico, USA, *Arsène* 20647 (BP, lectotype; designated isotype in Bouly de Lesdain herbarium destroyed).]

Parmelia conspersa var. *nigromarginata* Bouly de Lesdain, 1914:5. [Type collection: Loma Santa Maria, Morelia, Mexico, *Arsène* 3847 (US, lectotype).] [Not *P. conspersa* var. *nigromarginata* Stirton, 1900:78 (= *X. cheelii* (Gyelnik) Hale).]

Parmelia subconspersa f. *nigromarginata* (Bouly de Lesdain) Gyelnik, 1936:126.

Parmelia arseneana Gyelnik, 1938a:269. [Type collection: Gallinas Canyon, Las Vegas, New Mexico, USA, *Arsène* 21191 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia tuberculata Gyelnik, 1938a:293. [Type collection: Gallinas Canyon, Las Vegas, New Mexico, USA, *Arsène* 21197 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Xanthoparmelia arseneana (Gyelnik) Hale, 1974b:486.

DESCRIPTION.—Thallus tightly adnate to adnate on rock, sometimes appearing centrally areolate, 3–6 cm broad, dull yellowish green; lobes subirregular to sublinear, 0.6–1.2 mm wide, contiguous to imbricate, crowded and more or less areolate at the center; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.1–0.3 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 1–4 mm in diameter; spores 4–5 × 10–11 µm.

CHEMISTRY.—Fumarprotocetraric and usnic acids.

DISTRIBUTION.—Western USA, Mexico.

COMMENTS.—In the original description Gyelnik stressed the subcrustose, centrally areolate thallus structure yet later (1938a:269, 293) went on to describe *Parmelia arseneana* and *P. tuberculata*, comparing them to *P. novomexicana*. All three type specimens are essentially identical in chemistry and morphology. It is widepsread in the southwestern states and California.

Xanthoparmelia oblisata

FIGURE 56*e*

Xanthoparmelia oblisata Fletcher and Hale, 1988:279. [Type collection: Monte Agulhas Negras, Plateau de Retire, Mato Grosso, Brazil, 24°40′S, 44°60′W, *Fletcher* 10104 (LTR, holotype; US, isotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 3–7 cm broad, yellowish green but soon darkening at the center; lobes sublinear, 0.4–0.8 mm wide, relatively short and irregularly branched, contiguous to subimbricate, sparingly short laciniate, the laciniae 0.1–0.2 mm wide, subascending; upper surface continuous, emaculate, shiny, transversely cracked and rugulose with age, soredia and isidia lacking; medulla white; lower surface plane, shiny, brown to dark brown but not blackening, moderately rhizinate, the rhizines brown, robust, 0.1–0.3 mm long, unbranched. Pycnidia numerous; conidia bifusiform, 0.5 × 4–6 µm long. Apothecia lacking.

CHEMISTRY.—Stictic, constictic, norstictic (trace), and usnic acids.

ILLUSTRATION.—Fletcher and Hale, 1988, fig. 1.

DISTRIBUTION.—Brazil.

COMMENTS.—This rare species occurs at high elevation (near 3000 m). It is probably related to isidiate *X. neopropaguloides*, a common lichen in South America.

Xanthoparmelia obscurata

FIGURE 56*f*

Xanthoparmelia obscurata Hale, 1987b:327. [Type collection: On sloping sandstone outcrops, 3.5 km NW of Cederberg (Dwarsrivier), Cederberg Mountains, Cape Province, South Africa, Grid 3219 AC, *Hale* 78399, 29 Oct 1986 (US, holotype; ANUC, PRE, isotypes).]

DESCRIPTION.—Thallus closely adnate to adnate on rock, rather brittle and not easily removed, 5–8 cm broad, dull yellowish green at the tips but blackening at the center; lobes sublinear, 0.5–1 mm wide, irregularly branched, separate to imbricate but with ascending tips and becoming short laciniate; upper surface continuous, emaculate, shiny at the tips but dull with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines brown, simple, 0.3–0.6 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norlobaridone, an unknown fatty acid, and usnic acid (det. J.A. Elix).

ILLUSTRATION.—Hale, 1987b, fig. 13.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This rare species, easily mistaken for a *Neofuscelia*, is unlike any other African *Xanthoparmelia* and can only be compared with the Australian *X. dubitata*, which is very tightly adnate throughout and has an areolate center.

Xanthoparmelia ochropulchra

FIGURE 57*a*

Xanthoparmelia ochropulchra Hale, 1986b:590. [Type collection: 78.6 km S of Sutherland on Hwy R354, elev. ca. 900 m, Cape Province, South Africa, Grid 3220 DC, *Hale* 73101, 29 Jan 1986 (US, holotype; PRE, isotype).
Parmelia ochropulchra (Hale) Brusse, 1988:539.]

DESCRIPTION.—Thallus tightly adnate on rock, soft and friable, 3–8 cm broad, light yellowish green; lobes subirregular, 0.6–1.4 mm wide, contiguous to subimbricate; upper surface continuous to weakly reticulate white-maculate and minutely rugulose at the tips, shiny, isidia and soredia lacking; upper medulla white, lower medulla pale orange; lower surface plane, pale brown, sparsely rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia well developed, adnate, 1–1.5 mm in diameter; spores 5 × 8–9 µm.

CHEMISTRY.—4-*O*-Demethyldiffractaic (major), 4-*O*-demethylbarbatic (trace), and usnic acids, endocrocin and an unidentified anthraquinone pigment.

ILLUSTRATION.—Hale, 1986b, fig. 36.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The yellow pigments, presence of 4-*O*-demethyldiffractaic acid (also present in South African *X. conjuncta*, *X. duplicata* and *X. neotumidosa*) and small, friable, short-lobed thallus characterize this rare species. It is known only from the type collection in the Great Karoo.

Xanthoparmelia oleosa

Xanthoparmelia oleosa (Elix and Armstrong) Elix and Nash in Nash and Elix, 1986:455.
Parmelia oleosa Elix and Armstrong, 1983:478. [Type collection: Tuross River, 13 km S of Countegany, NSW, Australia, *Elix* 6397 (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, sometimes appearing areolate in the center, 3–8 cm broad, dull yellowish green or darkening; lobes subirregular to sublinear, 0.8–1.5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, rugulose, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, adnate, 1–4 mm in diameter; spores 4–5 × 7–8 µm.

CHEMISTRY.—Constipatic, protoconstipatic, dehydroconstipatic, pertusaric (±trace), and usnic acids.

ILLUSTRATION.—Elix and Armstrong, 1983, fig. 9.

DISTRIBUTION.—Australia (NSW, ACT, SA, NT, WA), New Zealand, western USA, Mexico, Argentina.

COMMENTS.—It is chemically similar to the strictly Australian *X. ustulata*, which has broader, adnate lobes. *Xanthoparmelia nigraoleosa* is the counterpart with a black lower surface.

Xanthoparmelia olifantensis

FIGURE 57*b*

Xanthoparmelia olifantensis Hale, 1986b:591. [Type collection: Olifantsbaai, Cape of Good Hope Nature Reserve, elev. 20 m, Cape Province, South Africa, Grid 3418 AD, *Hale* 72113, 21 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus very tightly adnate on rock, 2–3 cm broad, yellowish green; lobes sublinear, 0.4–0.6 mm wide, sparsely dichotomously branched, cracked and subareolate toward the center; upper surface continuous, emaculate, shiny, transversely cracked, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines black, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norstictic (major), salazinic (major), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 37.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species occurs on sandstone ledges exposed to ocean fog and wind. A similar species from Transvaal and Natal, *X. minuta*, also contains norstictic and salazinic acids in nearly equal concentration but is isidiate and contains traces of gyrophoric acid. The rare Australian species *X. dissitifolia* is more richly branched and has only traces of salazinic acid.

Xanthoparmelia olivetorica

FIGURE 57*c*

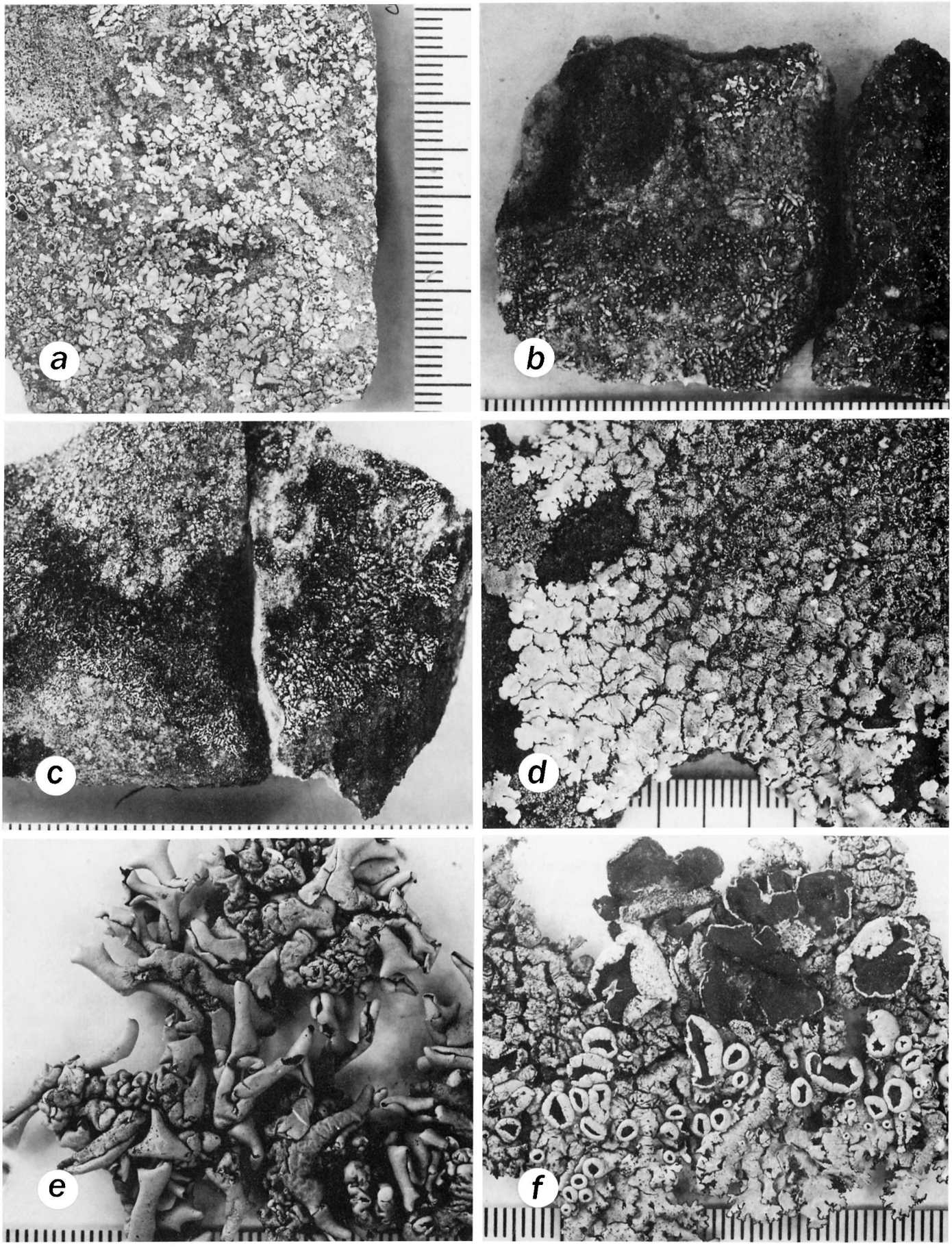
Xanthoparmelia olivetorica Hale, 1986b:591. [Type collection: Trail from Platteklip Gorge to Woodhead Reservoir, Table Mountain Nature Reserve, Cape Province, South Africa, Grid 3318 CD, *Hale* 72080, 23 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate on rock, 1–3 cm broad, dark greenish yellow but blackening with age toward the center; lobes sublinear, 0.2–0.6 mm wide, strongly black rimmed, contiguous; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, simple, about 0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Gyrophoric and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 38.

DISTRIBUTION.—South Africa (Cape Province).


a
b
c
d
e
f

COMMENTS.—The appressed thallus with very narrow, black-rimmed lobes resembles that of *X. stenosporonica*, a South African species with stenosporonic acid. The chemistry given in the original description (olivetoric acid) has proved to be incorrect, leaving *X. heterodoxa* as the only species with olivetoric acid in the genus. It is still only known from the type collection on Table Mountain. The collection number cited in the original publication (72079) was incorrect.

Xanthoparmelia oribensis

FIGURE 57*d*

Xanthoparmelia oribensis Hale, 1986b:592. [Type collection: Oribi Gorge Nature Reserve, elev. 300 m, Natal, South Africa, Grid 3030 CB, *Hale* 74041, 3 Feb 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate on flat rocks, 6–12 cm broad, yellowish green; lobes subirregular to sublinear, 2–4 mm wide, contiguous; upper surface continuous, emaculate, shiny, transversely cracked with age, moderately to densely isidiate, the isidia tall, cylindrical (Figure 18*d*), the tips syncorticate, shiny, darkening, becoming richly branched, 0.09–0.2 mm in diameter, 0.5–1 mm high; upper medulla white, lower medulla in part orange-red; lower surface plane, black but ochre when lower cortex breaks open, sparsely to moderately rhizinate, the rhizines black, simple, 0.5–1 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids, skyrin and several minor unidentified components.

ILLUSTRATION.—Hale, 1986b, fig. 39.

DISTRIBUTION.—South Africa (Natal).

COMMENTS.—The only other isidiate species with hypoprotocetraric acid and a black lower surface is tightly adnate, skyrin-free *X. neocongensis*. *Xanthoparmelia oribensis* is most common on sandstone cliff tops in the humid, subtropical Oribi Gorge area in Natal.

Xanthoparmelia pachyclada

FIGURE 57*e*

Xanthoparmelia pachyclada Hale, 1987a:261. [Type collection: 38.2 km NNW of Van Rhynsdorp on E side of hwy N7, elev. 200 m, Cape Province, South Africa, Grid 3118 BC, *Hale* 78858, 31 Oct 1986 (US, holotype; ANUC, LD, PRE, isotypes).]

DESCRIPTION.—Thallus vagrant, free-growing on soil, leathery and gnarled, dispersed as separate colonies 3–5 cm broad, yellowish green; lobes sublinear, 2–5 mm wide, strongly convoluted and twisted, tube-like, little branched; upper surface continuous, emaculate, shiny, heavily rugose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, erhizinate or very sparsely rhizinate, the rhizines brown, simple, ~0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 15.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This Namaqualand knersvlakte soil lichen has a typical vagrant growth form. It is chemically related to another soil lichen, *X. neocongruens*, which has weakly convoluted lobes and skyrin and which could conceivably be the progenitor of this vagrant species.

FIGURE 57.—Species of *Xanthoparmelia*: *a*, *X. ochropulchra* (*Hale* 73101, holotype in US); *b*, *X. olifantensis* (*Hale* 72113, holotype in US); *c*, *X. olivetorica* (*Hale* 72080, holotype in US); *d*, *X. oribensis* (*Hale* 74041, holotype in US); *e*, *X. pachyclada* (*Hale* 78858, holotype in US); *f*, *X. paradoxa* (*Hale* 78697, holotype in US). Scale in mm.

Xanthoparmelia pantherina

Xanthoparmelia pantherina (Kurokawa) Elix and Johnston, 1987:371.

Parmelia pantherina Kurokawa, 1985:88. [Type collection: You Yangs near Geelong, Vict., Australia, elev. 340 m, *Bratt* 68/98 (TNS, holotype; not seen).]

DESCRIPTION.—Thallus loosely adnate on rock, 2–4 cm broad, yellowish green; lobes sublinear to linear, 0.5–1.2 mm wide, elongate and dichotomously branched; upper surface strongly effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface black, rugulose, very sparsely rhizinate, the rhizines black, coarse, simple, ~0.3 mm long. Pycnidia common; conidia not found. Apothecia substipitate, 1–6 mm in diameter; spores not developed.

CHEMISTRY.—Norstictic (major), connorstictic, salazinic (±), and usnic acids.

ILLUSTRATION.—Kurokawa, 1985, fig. 11.

DISTRIBUTION.—Australia (SA, Vic).

COMMENTS.—This rare species belongs in the *X. hypoleia* complex and occurs only in Australia.

Xanthoparmelia paradoxa

FIGURE 57*f*

Xanthoparmelia paradoxa Hale, 1987a:261. [Type collection: E side of hwy R46, 2 km NW of hwy N2 (W of Touwsrivier), elev. 900 m, Cape Province, South Africa, Grid 3319 BD, *Hale* 78697, 28 Oct 1986 (US, holotype; PRE, isotype).]

Parmelia mixta Brusse, 1989a:402. [Nomen novum based on *Xanthoparmelia paradoxa* Hale.]

DESCRIPTION.—Thallus adnate to loosely adnate, firm and leathery, 7–9 cm broad, deep yellow green; lobes sublinear or subirregular, the lobe tips obtuse, 1–3 mm wide, contiguous; upper surface continuous, emaculate to very faintly reticulate white-maculate, shiny, becoming strongly rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, dull, pale brown but darkening toward the tips, densely rhizinate, the rhizines pale brown, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia abundant, adnate to substipitate, 3–15 mm in diameter, the amphithecium strongly rugose; spores 6 × 9–10 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, physodalic, hypostictic, hyposalazinic, and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 16.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The unique combination of acids sets this rare species apart. In the field it could be confused with *X. austroafricana,* which has fumarprotocetraric and succinprotocetraric acids, lacks strong transverse fissuring, and has a darker greenish color.

Xanthoparmelia parvoclystoides

FIGURE 58*a*

Xanthoparmelia parvoclystoides Elix and Johnston, 1988b:360. [Type collection: 6.5 km W of Springton on High Eden Road, Mt. Lofty Ranges, South Australia, Australia, *Elix* 2252 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 5–7 cm broad, appearing areolate at the center, yellowish green but darkening with age; lobes sublinear, 0.5–1.1 mm wide, irregularly branched, contiguous to imbricate; upper surface continuous, emaculate, opaque, irregularly cracked with age, soredia and isidia lacking; medulla white; lower surface plane, pale tan but darkening at the tips, moderately to densely rhizinate, the rhizines brown, simple, 0.1–0.2 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 6–7 μm. Apothecia sessile to substipitate, 1–4 mm in diameter; 4–6 × 9–11 μm.

CHEMISTRY.—Norstictic (major), connorstictic (minor), salazinic (±minor), and usnic acids, atranorin (±minor).

ILLUSTRATION.—Elix and Johnston, 1988b, fig. 8.

DISTRIBUTION.—Australia (WA, SA).

COMMENTS.—Closely related *X. neorimalis* with a wide distribution in semi-arid Australia contains salazinic acid as the major component. *Xanthoparmelia parvoclystoides* is most common in cooler, wetter areas of South Australia and West Australia.

Xanthoparmelia parvoincerta

FIGURE 58*b*

Xanthoparmelia parvoincerta Elix and Johnston in Elix, Johnston, and Armstrong, 1986:304. [Type collection: Porongurup Range, Angwin Peak, W.A., Australia, *Elix* 10648 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, forming rosettes 1–2 cm broad, the center becoming areolate, yellowish green; lobes sublinear, 0.5–1.5 mm wide, contiguous to subimbricate, sometimes black rimmed; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, rather coarse, simple, 0.2–0.4 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 μm. Apothecia common, substipitate, 1 mm in diameter; spores 5–6 × 8 μm.

CHEMISTRY.—Salazinic, consalazinic, constipatic (±), protoconstipatic (±), and usnic acids, atranorin (±).

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 31.

DISTRIBUTION.—Australia (NT, WA), South Africa (Transvaal, Cape Province).

COMMENTS.—This rare species is intermediate between *X. dissitifolia* (norstictic acid present), an Australian species with very narrow lobes (0.2–0.5 mm wide), and *X. incerta,* a larger lichen with broad lobes (1–3 mm).

Xanthoparmelia perplexa, new combination

FIGURE 58*c*

Parmelia perplexa Stizenberger, 1890:154. [Type collection: Near Ceres, Warme Bokkeveld Mountains, South Africa, *MacOwan* s.n. (ZT, lectotype).]

Xanthoparmelia subcrustosa Hale, 1986b:600. [Type collection: On granite boulders in karoo, 8.3 km E of Garies on Studerpas road, Cape Province, South Africa, Grid 3018 AC, *Hale* 73016, 26 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 3–10 cm broad, darkish yellow green; lobes sublinear, 0.4–0.8 mm wide, short and irregularly branched, crowded and bullate-areolate at the center, becoming short laciniate, black-rimmed; upper surface continuous, emaculate, shiny, transversely cracked and rugulose with age, soredia and isidia lacking; medulla white; lower surface plane, light to dark brown, moderately rhizinate, the rhizines brown, simple, 0.2–0.3 mm long. Pycnidia numerous; conidia cylindrical, 0.5 × 5–8 μm. Apothecia adnate, 0.5–1 mm in diameter; spores 4–6 × 8–10 μm.

CHEMISTRY.—Salazinic (major), norstictic (±trace), connorstictic (±trace), and usnic acids, chalybaeizans unknown.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This rare species is known only in the southwestern Cape region. It is superficially close to other "centrally areolate" species such as Australasian *X. neorimalis* (salazinic acid present).

Xanthoparmelia perrugosa

FIGURE 58*d*

Xanthoparmelia perrugosa Hale, 1987a:262. [Type collection: Mountain Zebra National Park, SW of Cradock, elev. 1500 m, Cape Province, South Africa, Grid 3225 AB, *Hale* 77940, 14 Oct 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, easily removed intact when moist, leathery, 6–9 cm broad, light yellow green; lobes subirregular with rotund tips, 2–4 mm wide, contiguous, soon becoming uniformly bullate-wrinkled at the center; upper surface continuous, emaculate, shiny, transversely cracked and bullate-rugose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple,

0.3–0.5 mm long. Pycnidia well developed; conidia bifusiform, 4–5 µm. Apothecia well developed, adnate, 3–7 mm in diameter with an incurved rim; spores 6 × 9–10 µm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, unidentified fatty, and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 17.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—There are several comparable hypoprotocetraric acid-containing species: widespread *X. subdomokosii* has smooth lobes and skyrin in the lower medulla, and *X. toninioides* from Namaqualand has more adnate, convex lobes 1–2 mm wide. *Xanthoparmelia prodomokosii* from arid Australia and South Africa is tightly adnate with narrow lobes. The strong, uniform rugosity develops within a few millimeters of the lobe tips.

Xanthoparmelia pertinax

Xanthoparmelia pertinax (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:306.

Parmelia pertinax Kurokawa and Filson, 1975:41. [Type collection: Western side of Corunna Range, Eyre Peninsula, S.A., Australia, *Filson* 11728 (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 4–8 cm broad, yellowish olive-green; lobes subirregular, 1–2.5 mm wide, contiguous to imbricate, black rimmed; upper surface continuous, emaculate, shiny, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines dark brown, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6 µm. Apothecia common, substipitate, 2–4 mm in diameter; spores 6–7 × 9–10 µm.

CHEMISTRY.—Fumarprotocetraric (major), succinprotocetraric, protocetraric (±trace), and usnic acids.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 2: fig. 4.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, SA, WA).

COMMENTS.—This widespread Australian species is externally close to *X. lineola*, a salazinic acid-containing species. The American species *X. novomexicana* lacks succinprotocetraric.

Xanthoparmelia peruviensis

FIGURE 58*e*

Xanthoparmelia peruviensis Hale, 1985a:284. [Type collection: Santa Rosa, Cuzco, Peru, *D. Stafford* 532 (BM, holotype; US, isotype).]

DESCRIPTION.—Thallus loosely adnate to free growing on soil, 3–5 cm broad; lobes linear to sublinear, 0.7–1.2 mm wide, dichotomously branched and divaricate, the ultimate tips terete; upper surface faintly reticulate white-maculate, isidia and soredia lacking; medulla white; lower surface plane to canaliculate, the marginal rim pale yellowish, the center brown, densely rhizinate, the rhizines furcate, brown, to 2 mm long. Pycnidia present; conidia not seen. Apothecia adnate, ~1 mm in diameter; spores lacking.

CHEMISTRY.—Stenosporonic (major), lobaric (minor), and usnic acids (det. J.A. Elix).

ILLUSTRATION.—Hale, 1985a, fig. 6.

DISTRIBUTION.—Peru, Bolivia.

COMMENTS.—This unusual terricolous lichen is known from several localities at higher elevations (up to 4200 m) in Bolivia and Peru. Reticulate maculation is rarely encountered in the genus (cf. *X. competita*), and the chemistry (first reported as colensoic acid) is more typical of tightly adnate, saxicolous Old World species such as *X. keralensis* and *X. stenosporonica*. The lichenin test is negative (R. Common, personal communication), indicating an isolated position in the genus for this species.

Xanthoparmelia phaeophana

FIGURE 58*f*

Xanthoparmelia phaeophana (Stirton) Hale in Swinscow and Krog, 1988:353.

Parmelia phaeophana Stirton, 1877:214. [Type collection: [Somerset East], South Africa, *McOwan* s.n. (BM, lectotype; GLAM, isolectotype).]

Parmelia phaeophana var. *stenotera* Stirton, 1877:215. [Type collection: [Near Klyn Visch River, Somerset East, South Africa], *McOwan* [50] (BM, lectotype; BP, GLAM, isolectotypes).]

Parmelia subfuscescens Nylander, 1885:613. [Type collection: Mauritius, s.c. (H-Nyl, lectotype).]

Parmelia terricola Steiner and Zahlbruckner in Zahlbruckner, 1926:510. [Type collection: Port Elizabeth, Republic of South Africa, *Brunnthaler* s.n. (WU, lectotype).]

Parmelia citrinireagens Gyelnik, 1931b:282. [Type collection: Enon, South Africa, *Breutel* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia citrinireagens var. *angustior* Gyelnik, 1931b:282. [Type collection: Table Mountain, Cape Province, South Africa, *Wilms* [2754] (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia digitulata f. *angustior* (Gyelnik) Gyelnik, 1934b:370. [Listed in key without citation of basionym.]

Parmelia digitulata var. *citrinireagens* (Gyelnik) Gyelnik, 1934b:370. [Listed in key without citation of basionym.]

Parmelia digitulata var. *citrinireagens* (Gyelnik) Gyelnik, 1934c:154. [Invalid combination without citation of basionym.]

Parmelia imitans f. *protoimbricatoides* Gyelnik, 1934c:156. [Type collection: Montague Pass, South Africa, *Breutel* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia subconspersa var. *africana* Gyelnik, 1934c:164. [Type collection: Near Adelaide, South Africa, *Ringon* (?) 859 (BP, lectotype; W, isolectotype).]

Parmelia digitulata var. *citrinireagens* (Gyelnik) Gyelnik, 1935:32.

Parmelia conspersa f. *terricola* (Steiner and Zahlbruckner) Gyelnik, 1936:123.

Parmelia austroafricana f. *angustior* (Gyelnik) Gyelnik, 1938b:21.

Parmelia austroafricana f. *citrinireagens* (Gyelnik) Gyelnik, 1938b:21.

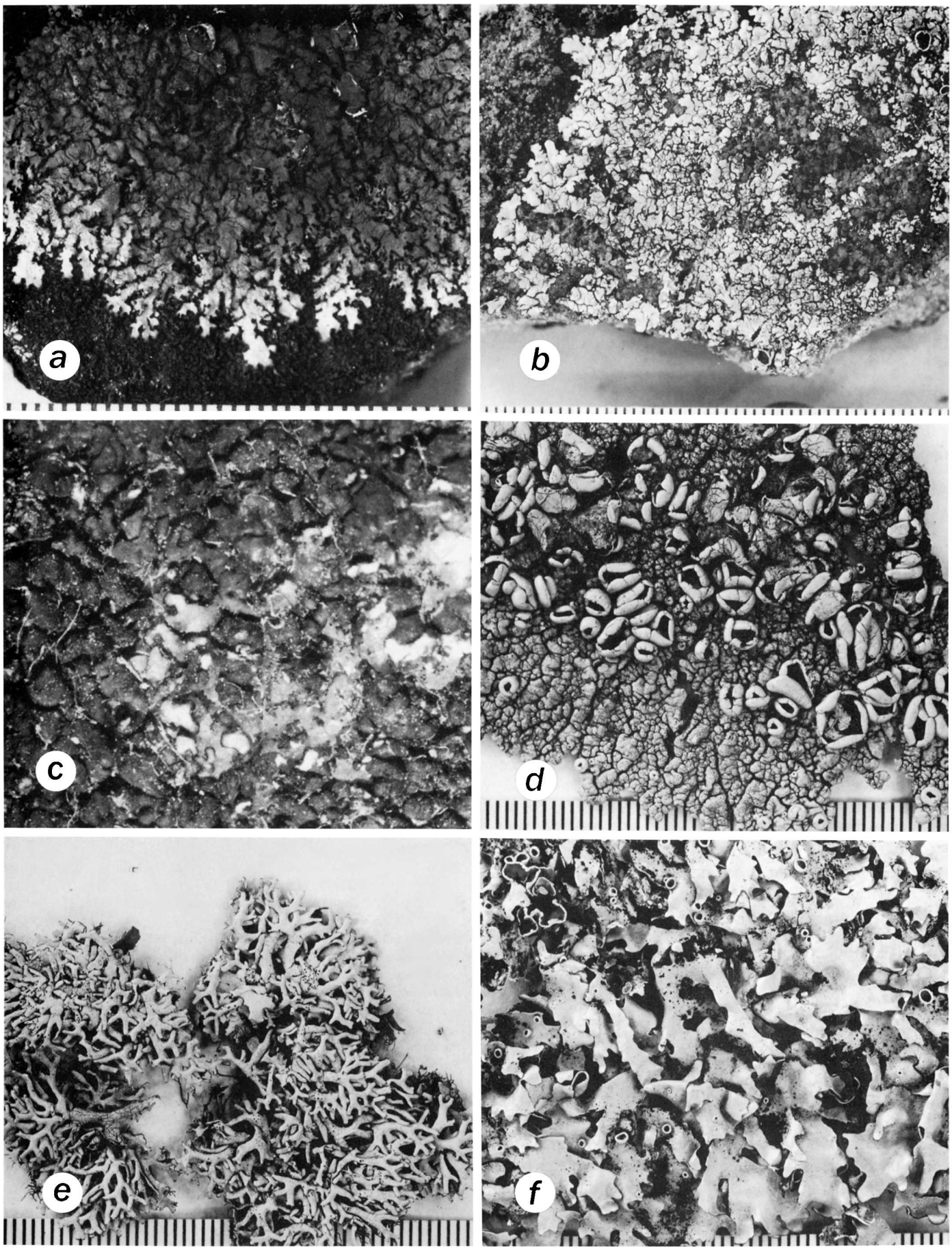
Parmelia austroafricana f. *esaxicola* (Gyelnik) Gyelnik, 1938b:22.

Parmelia conspersa f. *stenotera* (Stirton) Gyelnik, 1938b:36.

Parmelia digitulata var. *esaxicola* Gyelnik, 1938a:276. [Type collection: Wolseley, South Africa, *v.d. Byl* 1144 (W, lectotype; BP, isolectotype).]

Parmelia phaeophana f. *protoimbricatoides* (Gyelnik) Gyelnik, 1938b:35.

Parmelia eylesii Dodge, 1959:74. [Type collection: Forest Hill Kop, Makoni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Distr., S. Rhodesia, *Eyles* 832 (BM, holotype, FH-Dodge, isotype).]

Parmelia stenotera (Stirton) Dodge, 1959:73.

Parmelia wightii Dodge, 1959:69. [Type collection: Mauritius, *Wight* s.n. (FH-Tayl, holotype).]

Parmelia wrightii Dodge, 1959:128. [Type collection: Simons Bay, Cape of Good Hope, South Africa, *Wright* s.n. (FH-Tuck, lectotype; US, isolectotype).]

Xanthoparmelia subfuscescens (Nylander) Hale, 1974b:489.

Xanthoparmelia nuwarensis Hale, 1986b:590. [Type collection: 1 km S of Nuwerus on Hwy 363, elev. ca. 500 m, Cape Province, South Africa, Grid 3118 AB, *Hale* 72111, 26 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rarely on soil, fairly rigid, 6–15 cm broad, dull yellowish green to light yellowish green; lobes sublinear, extremely variable, 2–10 mm wide, rather elongate and separate to contiguous, in part subascending and laciniate; upper surface more or less uniformly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, becoming rugose with age, pale brown to brown, blackening near the tips, sparsely to moderately rhizinate but often with extensive eroding bare areas, the rhizines pale brown, simple to splayed or furcate, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 μm. Apothecia common, substipitate, 3–15 mm in diameter; spores 5–6 × 10–12 μm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, protocetraric (±), physodalic (±), virensic (±trace), caperatic (±), and usnic acids.

ILLUSTRATION.—Swinscow and Krog, 1988, fig. 184.

DISTRIBUTION.—Bourbon, Madagascar, Malawi, Kenya, Uganda, South Africa (Transvaal, Venda, Natal, OFS, Natal, Transkei, Ciskei, Cape Province), Swaziland, Lesotho, Zimbabwe, Mauritius, Kerguelen Island.

COMMENTS.—The typification of this most common of all *Xanthoparmeliae* in southern Africa has had a complicated history. I originally adopted the name *P. subconspersa* Nylander, but Gyelnik (1935:49) had already typified this name with a *Flavoparmelia rutidota* specimen from Australia mentioned in Nylander's protologue (H-Nyl herb, no. 34698). Nylander and other nineteenth-century lichenologists consistently identified *X. phaeophana* as P. *subconspersa* in their herbaria and his syntype from Bourbon is indeed *X. phaeophana*. Strangely Nylander (1885:613) did not recognize *Parmelia subfuscescens* as a *Xanthoparmelia*.

The synonymy of *X. phaeophana* is extremely large considering that the distinctive morphological characters, broad sublinear lobes, loose adnation, lower surface with large bare areas, white-maculate upper surface, and the distinctive chemistry are easily recognized. There is, as one would expect in such a large population, a wide range of variation in lobe configuration, density and distribution of rhizines on the lower surface, and thallus size. I have removed one small population with an adnate thallus and an emaculate surface: *X. ceresina*. *Xanthoparmelia phaeophana* is far and away the commonest species of *Xanthoparmelia* in southern Africa, occurring in a wide range of habitats but more common in the higher rainfall areas, least common in more arid karoo sites.

FIGURE 58.—Species of *Xanthoparmelia*: *a*, *X. parvoclystoides* (*Elix* 2252, holotype in CBG); *b*, *X. parvoincerta* (*Hale* 72206); *c*, *X. perplexa* (*MacOwan* s.n., lectotype in ZT (×10)); *d*, *X. perrugosa* (*Hale* 77940, holotype in US); *e*, *X. peruviensis* (*Stafford* 532); *f*, *X. phaeophana* (*Hale* 72419). Scale in mm.

Xanthoparmelia phillipsiana

FIGURE 59*a*

Xanthoparmelia phillipsiana (Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:307.

Parmelia phillipsiana Filson, 1981:324. [Type collection: 1 km S of Double Point, west side of Macquarie Island, *Filson* 5904 (MEL, holotype).]

DESCRIPTION.—Thallus adnate on rock, 3–6 cm broad,light to darkish yellow green; lobes sublinear, 0.5–1 mm wide, appearing convex, contiguous to subimbricate; upper surface continuous, emaculate, shiny, transversely cracked, becoming densely isidiate, the isidia cylindrical (Figure 18*e*), large in relation to lobe width, 0.1–0.15 mm in diameter, to 1 mm high, the tips syncorticate to epicorticate, simple to coralloid branched with age toward the thallus center; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, simple, 0.2–0.4 mm long. Pycnidia lacking. Apothecia rare, substipitate, 2–8 mm in diameter; spores 6 × 9 μm.

CHEMISTRY.—Stictic, constictic, norstictic (trace), cryptostictic (trace), and usnic acids.

ILLUSTRATION.—Filson, 1981, fig. 6.

DISTRIBUTION.—Australia (Tas), New Zealand, Macquarie Island.

COMMENTS.—This curious lichen has a unique aspect among the species in the *X. conspersa* group with its narrow, convex lobes and coralloid isidia that are disproportionately large for a tiny thallus. It is related to *X. conspersa*, a larger lichen not yet collected in Australasia. *Xanthoparmelia mougeotina* is much smaller, darker, and very tightly adnate, as well as sparsely isidiate.

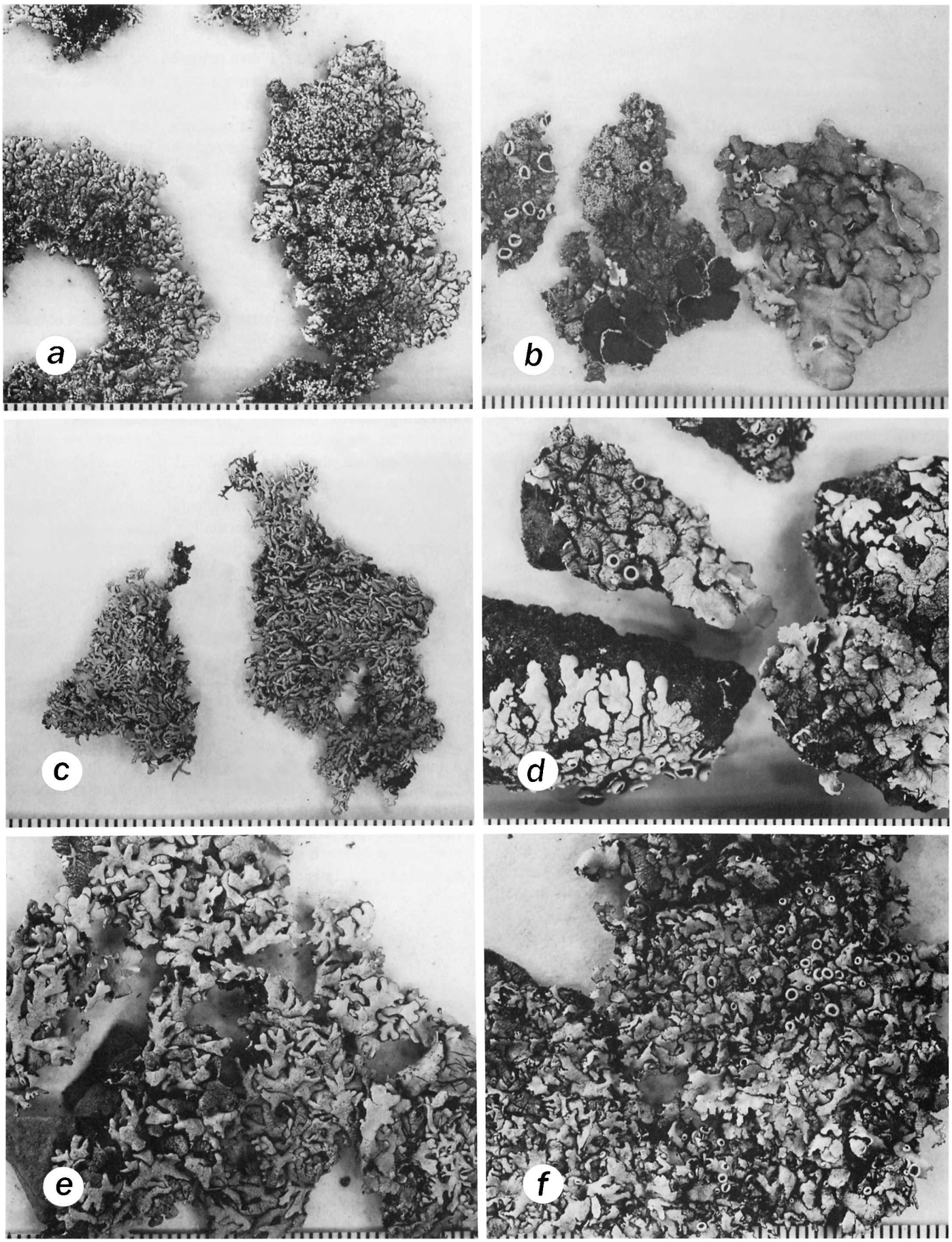
Xanthoparmelia piedmontensis

FIGURE 59*b*

Xanthoparmelia piedmontensis (Hale) Hale, 1974b:488.

Parmelia piedmontensis Hale, 1964:468. [Type collection: Mt. Arabia, near Conyers, Rockdale Co., Georgia, USA, *Hale* 24016 (US, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 2–8 cm broad, darkish yellow green; lobes subirregular, 1.5–3 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia subglobose to cylindrical (Figure 18*f*), 0.07–0.1 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, darkening, simple to coralloid branched at maturity; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple. 0.2–0.6 mm long. Pycnidia lacking. Apothecia common, substipitate,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2–8 mm in diameter; spores 4–5 × 5–6 µm.

CHEMISTRY.—Fumarprotocetraric and usnic acids.

DISTRIBUTION.—Southeastern USA.

COMMENTS.—This rare Piedmont lichen could be the isidiate morph of *X. hypomelaena* but the thallus is not as tightly adnate.

Xanthoparmelia planilobata

FIGURE 59*c*

Xanthoparmelia planilobata (Gyelnik) Hale, 1988b:405.

Parmelia conspersa f. *planilobata* Gyelnik, 1938a:275. [Type collection: Little Besuque, Santa Fe, New Mexico, USA, *Arsène* 22298, [1 Aug 1935] (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

DESCRIPTION.—Thallus loosely adnate on soil or soil over rocks, rather fragile, pulvinate, 2–4 cm broad, darkish yellow green; lobes sublinear, 0.3–0.8 mm wide, elongate and sparsely dichotomously branched, imbricate and somewhat ascending, black rimmed, developing marginal laciniae; upper surface continuous, emaculate, shiny to dull, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, black, finely rugose, very sparsely rhizinate, the rhizines black, simple, 0.2–0.3 mm long. Pycnidia poorly developed; conidia not found. Apothecia rather rare, substipitate, 2–4 mm in diameter; spores poorly developed, 5 × 9 µm.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

DISTRIBUTION.—Western USA, Mexico.

COMMENTS.—A closely related species from Australasia and South Africa, *X. tegeta*, has a smooth, uniformly rhizinate lower surface, broader lobes, and is usually more adnate on rocks. *Xanthoparmelia planilobata* is known from several localities in New Mexico.

Xanthoparmelia plittii

Xanthoparmelia plittii (Gyelnik) Hale, 1974b:488.

Parmelia plittii Gyelnik, 1931b:287. [Type collection: Liberty Road at Gwynna Falls, Baltimore County, Maryland, USA, *Plitt* P-5 (BP, lectotype; US, isolectotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rarely tree bark, 4–10 cm broad, yellowish green; lobes subirregular, 1–2 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia cylindrical (Figure 18*g*), 0.08–0.15 mm in diameter, 0.1–0.5 mm high, the tips syncorticate, darkening, simple or becoming densely branched with age; medulla white; lower surface plane, pale brown or darkening, but not blackening, moderately rhizinate, the rhizines pale brown, simple to furcate, 0.3–0.6 mm long. Pycnidia uncommon; conidia bifusiform, 0.5 × 5–7 µm. Apothecia common, substipitate, 2–7 mm in diameter; spores 4–5 × 9–10 µm.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

DISTRIBUTION.—North America, Mexico, Guatemala, Cuba, Dominican Republic, Venezuela, Colombia, Brazil, Paraguay, Uruguay, Angola, South Africa (Transvaal, Venda, Natal).

COMMENTS.—This widespread temperate-subtropical species is closely related to nonisidiate *X. cumberlandia*. In eastern North America it grows in more shaded habitats than *X. conspersa*, which has a black lower surface. *Xanthoparmelia subplittii* from South America has globose, erumpent isidia, and *X. neopropaguloides* is tightly adnate and narrow lobed (0.4–0.8 mm wide).

Xanthoparmelia praegnans

Xanthoparmelia praegnans (Elix and Armstrong) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:308.

Parmelia praegnans Elix and Armstrong, 1983:479. [Type collection: 11.2 km N of North Creek, Marree-Oodnadatta Road, S.A., Australia, *Filson* 15626a (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, sometimes appearing areolate at the center, 2–5 cm broad, dull yellowish green; lobes sublinear, 0.8–1.5 mm wide, short, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia globose to subcylindrical and inflated at apices (Figure 18*h*), 0.07–0.15 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, darkening, in part erumpent or abrading but not sorediate, unbranched; medulla white; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines pale brown to brown, simple, 0.2–0.5 mm long. Pycnidia lacking. Apothecia common, substipitate, 1–3 mm in diameter; spores 5–6 × 7–8 µm.

CHEMISTRY.—Salazinic, consalazinic, norstictic (±trace), protocetraric (±trace), constipatic (±trace), protoconstipatic (±trace), and usnic acids.

ILLUSTRATION.—Elix and Armstrong, 1983, fig. 10.

DISTRIBUTION.—Australia (Qld, SA, NT, WA).

COMMENTS.—This widepsread species occurs in arid inland localities. The related Namibian species *X. tenacea* is a smaller lichen with a consistently brown lower surface.

Xanthoparmelia probarbellata

FIGURE 59*d*

Xanthoparmelia probarbellata Hale, 1986b:592. [Type collection: 52.5 km SE of Lady Grey on Hwy R58, elev. ca. 1900 m, Cape Province, South Africa, Grid 3027 CD, *Hale* 72109, 9 Feb 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate on rock, 4–6 cm broad, yellowish green; lobes sublinear, 2–3 mm wide, somewhat separate to contiguous; upper surface continuous, emaculate, shiny, isidia and soredia lacking; upper white, lower medulla ochre in part; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines brown, 0.5–1 mm long.

FIGURE 59.—Species of *Xanthoparmelia*: *a*, *X. phillipsiana* (*Filson* 5904, holotype in MEL); *b*, *X. piedmontensis* (*Hale* 24016, holotype in US); *c*, *X. planilobata* (*Arsène* 22298, lectotype in BP); *d*, *X. probarbellata* (*Hale* 72109, holotype in US); *e*, *X. protodysprosa* (*Hale* 77712, holotype in US); *f*, *X. protolusitana* (*Hale* 81342, holotype in US). Scale in mm.

Pycnidia numerous; conidia bifusiform, 0.5 × 5–6 µm. Apothecia numerous, adnate, 3–5 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Salazinic and norstictic acids in nearly equal concentration, chalybaeizans unknown (trace), usnic acid, and skyrin.

ILLUSTRATION.—Hale, 1986b, fig. 40.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—An Australian species, *X. barbellata*, has similar chemistry (except for the lack of the chalybaeizans unknown) but is more loosely adnate and may occur on soil as well as rocks.

Xanthoparmelia prodomokosii

Xanthoparmelia prodomokosii Hale, Elix, and Johnston in Elix and Johnston, 1988a:506. [Type collection: MacDonnell Range, 1 km E of Pine Gap, Northern Territory, Australia, *Elix* 11309, 17 Sep 1983 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 5–8 cm broad, light yellowish green; lobes subirregular, 1.5–2.5 mm wide, short and irregularly branched, contiguous to imbricate; upper surface continuous, emaculate, shiny, transversely cracked and bullate-rugose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia substipitate; spores 4–5 × 6–8 µm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic (±trace), and usnic acids, scabrosin-4-acetate-4′-butyrate, scabrosin-4,4′-diacetate, scabrosin-4,4′dibutyrate, and scabrosin-4-acetate-4′-hexanoate.

ILLUSTRATION.—Elix and Johnston, 1988a, fig. 16.

DISTRIBUTION.—Australia (NT), South Africa (Cape Province).

COMMENTS.—This species is close to *X. subdomokosii*, which has a pale lower surface, is more loosely adnate, and contains skyrin. *Xanthoparmelia domokosii*, a tightly adnate South African lichen, has a black lower surface.

Xanthoparmelia protodysprosa

FIGURE 59*e*

Xanthoparmelia protodysprosa Hale, 1987a:262. [Type collection: 3.4 km S of Van Wyksdorp on hwy R327, elev. 250 m, Cape Province, South Africa, Grid 3321 DD, *Hale* 77712, 19 Oct 1986 (US, holotype; LD, PRE, isotypes).]

Parmelia protodysprosa (Hale) Brusse, 1989a:403.

DESCRIPTION.—Thallus loosely adnate on slate, 3–5 cm broad, light yellowish green; lobes sublinear to linear, 1–2 mm wide, dichotomously branched, elongate, subascending, separate to imbricate; upper surface weakly to strongly effigurate-maculate, shiny, rugulose and transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, shiny, black, very sparsely rhizinate, the rhizines coarse, simple with splayed tips, 0.5–1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Lecanoric and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 18.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This chemistry is within the *X. hypoleia* complex. The upper surface is not as strongly effigurate-maculate as other members of this complex, however, and the thallus is rather soft, not at all stiff. It is known only from the type collection in Namaqualand.

Xanthoparmelia protolusitana

FIGURE 59*f*

Xanthoparmelia protolusitana Hale, 1989a:554. [Type collection: On low sandstone ledges along small stream, 9 km W of Ramatsiliso Nek, elev. 2400 m, Lesotho, Grid 3028 BB, *Hale* 81342, 28 Apr 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather stiff, 4–8 cm broad, darkish yellow green; lobes subirregular to sublinear, 0.7–2 mm wide, imbricate, becoming laciniate, the laciniae sublinear, 0.2–0.4 mm wide, black rimmed; upper surface continuous, emaculate, shiny, rugulose and sparsely transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, black and shiny, sparsely to moderately rhizinate, the rhizines black, simple, 0.3–0.5 mm long. Pycnidia lacking. Apothecia numerous, substipitate, 1–4 mm in diameter; spores not found.

CHEMISTRY.—Stictic, constictic, and usnic acids, lusitana unknown.

ILLUSTRATION.—Hale, 1989a, fig. 26.

DISTRIBUTION.—Lesotho.

COMMENTS.—Although related to *X. angustiphylla*, the thallus is rather stiff. It has been collected two times in the high sandstone Drakensberg escarpment in Lesotho. The lack of norstictic acid and presence of the "lusitana" unknown (a faintly reacting yellowish spot below norstictic acid) suggest a closer relationship with the isidiate species *X. verrucigera*. The collection number cited in the original publication (81205) was incorrect.

Xanthoparmelia protomatrae

FIGURE 60*a*

Xanthoparmelia protomatrae (Gyelnik) Hale, 1974b:488.

Parmelia protomatrae Gyelnik, 1931a:155. [Type collection: Mt. Vadállókövek, near Budapest, Hungary, *Gyelnik* s.n. (BP, lectotype; H. isolectotype).]

Parmelia protomatrae f. *angustifolia* Gyelnik, 1931a:155. [Type collection: Mt. Hegyes, Mátra Mountains, Hungary, *Gyelnik* s.n. (BP, lectotype).]

Parmelia protomatrae f. *crustaeformis* Gyelnik, 1931a:155. [Type collection: Mt. Ajnácskö, Mátra Mountains, Hungary, *Gyelnik* s.n. (BP, lectotype).]

Parmelia protomatrae var. *tenuior* Gyelnik, 1931a:155. [Type collection: Pulvertum, Albae Carolinae, Hungary, *Haynald* s.n. (BP, lectotype).]

Parmelia mitrovicensis Gyelnik, 1932a:216. [Type collection: Mitrovica,

Serbia, Yugoslavia, *Andrasovszky* s.n. (BP, lectotype).]

Parmelia serbica Gyelnik, 1932a:216. [Type collection: Mt. Zvecan, near Mitrovica, Serbia, Yugoslavia, *Andrasovszky* s.n. (BP, lectotype).]

Parmelia conspersa f. *matrae* Gyelnik, 1932b:450. [Type collection: Mt. Saskö, Heves, Mátra Mountains, Hungary, *Gyelnik* s.n. (BP, lectotype).]

Parmelia digitulata f. *mitrovicensis* Gyelnik, 1934c:154. [Nomen nudum without a description.]

Parmelia subconspersa var. *varazzana* Gyelnik, 1934c:164. [Type collection: Varazze, Italy, *Sbarbaro* 146 (BP, lectotype; designated isotype in Bouly de Lesdain herbarium destroyed).]

Parmelia digitulata var. *mitrovicensis* (Gyelnik) Gyelnik, 1935:32.

Parmelia nigrescens Gyelnik, 1938a:284. [Type collection: Borsodense, Szarvaskö, Pyrkersziklak, Bükk Mountains, Hungary, *Gyelnik* s.n. (BP, lectotype). Not *Parmelia nigrescens* Stirton, 1878:253 (= *Menegazzia*) nor *P. nigrescens* (Hudson) Acharius, 1803:227 (= *Collema*).]

Parmelia austroafricana f. *mitrovicensis* (Gyelnik) Gyelnik, 1938b:21.

Parmelia stenophylla f. *dentata* Zhao, 1964:148. [Type collection: Huang Shan, Anhui, China, *Zhao* et al. 5860 (HMAS).]

Parmelia subconspersa f. *angustifolia* (Gyelnik) Verseghy, 1980:119.

Xanthoparmelia dentata (Zhao) Wei, 1983:224.

DESCRIPTION.—Thallus loosely adnate on rock, firm, 5–8 cm broad, dull yellowish green; lobes sublinear, 1–2 mm wide, elongate, dichotomously branched, separate to contiguous, laciniate at the center with age; upper surface faintly or strongly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale or darker brown, moderately rhizinate, the rhizines pale to dark brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–7 µm. Apothecia common, substipitate, 2–5 mm in diameter; spores 5 × 8 µm.

CHEMISTRY.—Fumarprotocetraric and usnic acids.

ILLUSTRATION.—Chao, 1964, fig. 8 (as *P. stenophylla* f. *dentata*).

DISTRIBUTION.—Norway, France, Belgium, Czechoslovakia, Italy, Hungary, Yugoslavia, USSR, Saudi Arabia, China.

COMMENTS.—Krog (1978) reported in detail on the distribution of this previously poorly known species in Norway. While it is most common in Hungary, it ranges widely from France to the USSR and China, falling within the geographic range of salazinic acid-containing *X. somloensis* in Eurasia, its closest relative.

Xanthoparmelia protoquintaria

FIGURE 60*b*

Xanthoparmelia protoquintaria Hale, 1989a:556. [Type collection: On sandstone ledges in Fynbos, Fernkloof Nature Reserve at Hermanus, Cape Province, South Africa, Grid 3419 AD, *Hale* 78171, 25 Oct 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 2–4 cm broad, darkish yellow green; lobes subirregular to sublinear, 0.4–0.9 mm wide, short, dichotomously branched, contiguous to subimbricate; upper cortex continuous, emaculate, shiny, transversely cracked at the center, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, moderately rhizinate, the rhizines black, simple to furcate, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypostictic, hyposalazinic, hypoconstictic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 27.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The only other hypostictic acid-containing *Xanthoparmelia* with a black lower surface is the Australian *X. multipartita*, which is a loosely adnate, linear-lobed species. The present species is known only from the type collection on ocean-facing ledges in southwestern Cape Province.

Xanthoparmelia proximata

FIGURE 60*c*

Xanthoparmelia proximata Hale, 1987a:262. [Type collection: On east side of hwy R40 at the Saddle, SE of Barberton, elev. 1500 m, Transvaal, South Africa, Grid 2531 BC, *Hale* 76052, 20 Sep 1986 (US, holotype; ANUC, LD, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate on rock, 5–7 cm broad, dull yellowish green; lobes sublinear, 0.4–1 mm wide, short and imbricate, dichotomously branched, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, shiny, black, moderately rhizinate, the rhizines black, simple, 0.2–0.5 mm long. Pycnidia commonly developed; conidia bifusiform, 5–6 µm. Apothecia well developed, adnate, 1–1.5 mm in diameter; spores 6–7 × 10–12 µm.

CHEMISTRY.—Salazinic (major), norstictic (minor), consalazinic (trace), protocetraric (trace), unknown fatty $R_{fc}32$, 36, and usnic acids (det. J.A. Elix).

ILLUSTRATION.—Hale, 1987a, fig. 19.

DISTRIBUTION.—South Africa (Transvaal).

COMMENTS.—This chemistry, the co-occurrence of significant amounts of salazinic and norstictic acids, is relatively rare in South African *Xanthoparmeliae*. One species, *X. olifantensis*, is also tightly adnate but has smaller, separate lobes 0.4–0.6 mm wide. Another, *X. minuta*, is isidiate and contains traces of gyrophoric acid.

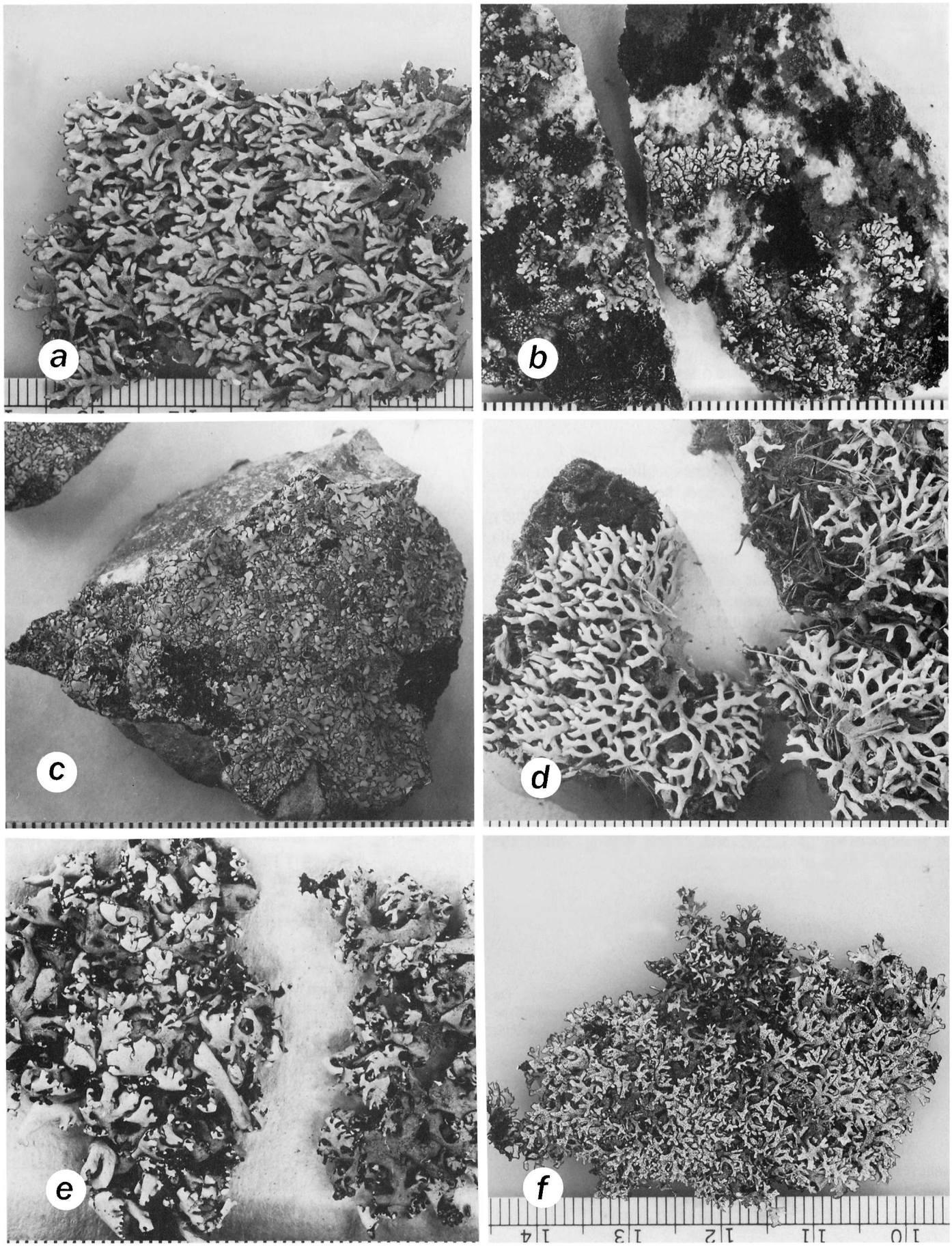
Xanthoparmelia pseudoamphixantha

FIGURE 60*d*

Xanthoparmelia pseudoamphixantha (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:309.

Parmelia pseudoamphixantha Elix, 1981:365. [Type collection: 30 km W of Ouyen along Highway 12, Victoria, Australia, *Elix* 3682 (MEL, holotype).]

DESCRIPTION.—Thallus loosely adnate to free growing on soil, forming rosettes 2–6 cm broad, light yellowish green; lobes sublinear, 0.6–1.5 mm wide, elongate, dichotomously branched, separate to loosely imbricate; upper surface strongly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface canaliculate with a raised marginal rim, ivory colored to brown, sparsely to moderately rhizinate, the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rhizines rarely sparsely branched, dark brown to black, 1–2 mm long, simple to furcate and projecting out from below. Pycnidia lacking. Apothecia rare, substipitate, 1–1.5 mm in diameter; spores 4–5 × 6–7 µm.

CHEMISTRY.—Norstictic, connorstictic, salazinic (±trace), hyposalazinic (±trace), and usnic acids.

ILLUSTRATION.—Elix, 1981, fig. 12.

DISTRIBUTION.—Australia (NSW, Vic, SA).

COMMENTS.—Morphologically indistinguishable *X. amphixantha* is more common and ranges into Tasmania. A third member of this characteristically Australian group of soil lichens, *X. reptans*, has the broadest range, from western Australia to New Zealand. A chemical test is necessary for identification.

Xanthoparmelia pseudocongensis

Xanthoparmelia pseudocongensis Hale, 1987b:327. [Type collection: Road to Mangwazana Mission, Ubombo Mountains, N of Ubombo, Natal, South Africa, Grid 2732 CA, *Hale* 78993, 8 Nov 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate, 2–6 cm broad, light yellowish green or darkening; lobes sublinear, 0.3–0.8 mm wide, short dichotomously branched, contiguous to imbricate, black rimmed; upper surface continuous, emaculate, shiny or becoming dull at the center, moderately isidiate, the isidia cylindrical (Figure 18*i*), 0.04–0.09 mm in diameter, to 1 mm high, the tips syncorticate, black, unbranched; medulla white; lower surface plane, black, shiny, moderately rhizinate, the rhizines black, simple, 0.2–0.3 mm long. Pycnidia rarely developed; conidia 0.5 × 4–5 µm. Apothecia rare, adnate, 1–2 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Stictic, constictic, and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 14.

DISTRIBUTION.—South Africa (Transvaal, Venda, Natal, OFS).

COMMENTS.—This South African species, previously confused with *X. congensis*, has short, blunt, black-rimmed lobes and cylindrical, black-tipped isidia. *Xanthoparmelia substenophylloides*, a more widespread species, has elongate, pale-rimmed lobes. Australasian *X. mougeotina* has a dark, centrally areolate thallus.

Xanthoparmelia pseudohungarica

FIGURE 60*e*

Xanthoparmelia pseudohungarica (Gyelnik) Hale, 1988b:405.

Parmelia convoluta var. *pseudohungarica* Gyelnik, 1931b:285. [Type collection: Vácz, Comit. Pest, Hungary, *Boros* s.n. (BP, lectotype).]

Parmelia pseudohungarica (Gyelnik) Gyelnik, 1932a:217.

Parmelia conspersa var. *pulvinaris* Zahlbruckner, 1925, no. 618. [Type collection: Szikrapuszta near Alpar, Pest, Hungary, *Timkó* s.n. (W, lectotype; BM, BP, FH, H, L, LD, M, UPS, US, isolectotypes). Nomen nudum without a description.]

Parmelia stenophylla f. *pulvinaris* (Zahlbruckner) Szatala, 1929a:78.

Parmelia pulvinaris (Zahlbruckner) Gyelnik, 1931a:155. [Invalid combination based on a nomen nudum.]

Parmelia pulvinaris var. *hungarica* Gyelnik, 1931a:156. [Type collection: Vasad, Pótharaszti, Comit. Pest, Hungary, *Gyelnik* s.n. (BP, lectotype).]

Parmelia pulvinaris var. *terricola* Gyelnik, 1931a:155. [Type collection: Near Jutas, Veszprém, Hungary, *Gyelnik* s.n. (BP, lectotype; H, isolectotype).]

Parmelia pseudohungarica var. *vacensis* Gyelnik, 1932a:217. [Illegitimate name for *P. convoluta* var. *pseudohungarica* Gyelnik.]

Parmelia pulvinaris f. *lacinulata* Gyelnik in Servit and Klement, 1933:31. [Type collection: Kaadner Burberg, Czechoslovakia, *Klement* s.n. Nomen nudum without a description.]

Parmelia laxa var. *terricola* Gyelnik, 1934b:372. [Nomen illeg. without citation of basionym.]

Parmelia laxa var. *pulvinaris* (Zahlbruckner) Gyelnik, 1935:26. [Nomen illeg. based on a nomen nudum.]

Parmelia taractica var. *pseudohungarica* (Gyelnik) Gyelnik, 1936:128.

Parmelia conspersa f. *subterricola* Gyelnik, 1936:123. [Based on *Parmelia pulvinaris* f. *terricola* Gyelnik.]

Parmelia conspersa var. *pulvinaris* Zahlbruckner ex Gyelnik, *Lichenotheca Parva* 31, 1937a. [Type collection: Praemetricum, Szikrapuszta, near Alpar, Comit. Pest, Hungary, *Timkö* s.n. (BP, lectotype).]

Parmelia pseudohungarica (Gyelnik) Gyelnik in Servit and Klement, 1933:31. [Superfluous combination.]

Parmelia taractica var. *pulvinaris* (Zahlbruckner) Poelt and Vězda, 1981:222. [Illegitimate combination. Basionym not cited.]

DESCRIPTION.—Thallus loosely adnate to free growing on soil, firm, forming discrete subpulvinate colonies 3–8 cm broad, dull yellowish green; lobes sublinear, 1–3 mm wide, rather short but irregularly branched and dissected, coarsely short laciniate with broadly revolute tips, separate to imbricate; upper surface faintly but distinctly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane to weakly convoluted, sometimes with a raised yellowish rim toward the tips, shiny, smooth to rugulose, brown to dark brown, moderately to densely rhizinate, the rhizines brown, simple to furcate, 0.3–0.8 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

DISTRIBUTION.—Hungary, Czechoslovakia, Yugoslavia.

COMMENTS.—This species is widespread in eastern and central Europe on sterile soils. It can be differentiated from *X. somloensis* and *X. subdiffluens* by the short dissected-laciniate, revolute lobes, dense rhizines, and the terricolous habit. Gyelnik (1937a) realized belatedly that the epithet *pulvinaris* had not previously been validly published, although he had already validly published *Parmelia pseudohungarica*.

Xanthoparmelia pseudohypoleia

FIGURE 60*f*

Xanthoparmelia pseudohypoleia (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:311.

Parmelia pseudohypoleia Elix, 1976:667. [Type collection: Paddys River, near Murray's Corner, A.C.T., Australia, *Elix* 1749 (MEL, holotype; CANB, isotype).]

FIGURE 60.—Species of *Xanthoparmelia*: *a*, *X. protomatrae* (*Bucek* s.n.); *b*, *X. protoquintaria* (*Hale* 78171, holotype in US); *c*, *X. proximata* (*Hale* 76052, holotype in US); *d*, *X. pseudoamphixantha* (*Elix* 844); *e*, *X. pseudohungarica* (*Timkó* 618); *f*, *X. pseudohypoleia* (*Elix* 1756). Scale in mm.

DESCRIPTION.—Thallus loosely adnate on rock, somewhat pulvinate, firm, 5–8 cm broad, dull yellowish green; lobes sublinear to linear, 0.5–1 mm wide, more or less dichotomously branched, separate to loosely imbricate; upper surface effigurate-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, coarse, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 3–7 mm in diameter; spores 4–5 × 6–8 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric (±trace), protocetraric (±trace), lobaric (±), and usnic acids.

ILLUSTRATION.—Elix, 1976, fig. 3.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, Tas), South Africa (Cape Province).

COMMENTS.—This is a member of the *X. hypoleia* group characterized by the presence of fumarprotocetraric acid. See further discussions under *X. hypoleia*.

Xanthoparmelia psornorstictica

FIGURE 61*a*

Xanthoparmelia psornorstictica Hale, 1989a:556. [Type collection: On coarse granite outcrops in pasture, 18 km NE of Keimoes on S side of Hwy R27, elev. 900 m, Cape Province, South Africa, Grid 2821 CA, *Hale* 79495, 17 Mar 1988 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm and leathery, 5–7 cm broad, light yellowish green; lobes subirregular with rotund tips, 1.5–3 mm wide, relatively short and crowded; upper surface continuous, emaculate, dull, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, brown at the tips but black toward the center, sparsely to moderately rhizinate, the rhizines black, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 µm. Apothecia substipitate, 1–3 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Psoromic (major), norstictic (major), and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 28.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—A narrow-lobed member of the *X. schenckiana* group, this species has a unique combination of acids. It was abundant at the type locality, an arid desert site, but has not been found elsewhere. See further discussions under *X. schenckiana*.

Xanthoparmelia psoromica

FIGURE 61*b*

Xanthoparmelia psoromica Hale, 1987b:327. [Type collection: 28.5 km N of Barkly Pass on Hwy R393, elev. 2200 m, Cape Province, South Africa, Grid 3127 BB, *Hale* 77030, 10 Oct 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm, 7–12 cm broad, light yellowish green; lobes subirregular, 3–7 mm wide, apically rotund, contiguous to imbricate; upper surface continuous, emaculate, dull, rarely weakly pruinose, rugose with age, isidia and soredia lacking; upper medulla white, lower medulla in part dull orange-red; lower surface plane, dark brown at the tips, blackening at the center, rugulose with age, moderately rhizinate, the rhizines black, rather coarse, simple, 0.5–1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–5 mm in diameter, the rim incurved, the disc often white pruinose; spores 6 × 9–11 µm.

CHEMISTRY.—Psoromic, 2′-*O*-demethylpsoromic, stenosporonic (±), caperatic (±), and usnic acids, schenckiana pigment (±).

ILLUSTRATION.—Hale, 1987b, fig. 15.

DISTRIBUTION.—South Africa (OFS, Cape Province), Lesotho, SWA/Namibia.

COMMENTS.—This is a member of the *X. schenckiana* group with psoromic acid as the main constituent. It occurs chiefly in eastern Cape Province with *X. diacida* (protocetraric and psoromic acids) and is less tightly adnate than *X. schenckiana* or *X. colorata*. A sample of 48 specimens tested with TLC gave these results: 27 contained psoromic and 2′-*O*-demethylpsoromic only; another 7 also had caperatic acid; and 2 had caperatic and stenosporonic acids. Nine specimens had the two main components and the schenckiana pigments and 3 with this composition also contained caperatic and stenosporonic acids. See *X. schenckiana* for further discussions.

Xanthoparmelia psoromifera

Xanthoparmelia psoromifera (Kurokawa) Hale, 1974b:488.
Parmelia psoromifera Kurokawa, 1967:374. [Type collection: Jalisco, 25 km S of Guadalajara, Mexico, *Wirth* 22 (US, holotype).]
Parmelia psoromifera Kurokawa ex Hale, 1967:418.

DESCRIPTION.—Thallus adnate on rock, 3–8 cm broad, light yellowish green; lobes subirregular, 1–2 mm wide, contiguous to imbricate, crowded at the center; upper surface continuous, emaculate, shiny, rugose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 µm. Apothecia common, substipitate, 3–6 mm diameter; spores 4–5 × 10–12 µm.

CHEMISTRY.—Psoromic, 2′-*O*-demethylpsoromic, and usnic acids.

ILLUSTRATIONS.—Egan, 1975, fig. 4; Hale, 1967, fig. 6; Kurokawa, 1967, fig. 2.

DISTRIBUTION.—Western North America, South Africa (Cape Province).

COMMENTS.—This is the presumptive parent morph of isidiate *X. lavicola*. it is relatively common in arid southwestern USA and known from one locality in Namaqualand.

Xanthoparmelia pumila

FIGURE 61*c*

Xanthoparmelia pumila (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:312.

Parmelia pumila Kurokawa and Filson, 1975:42. [Type collection: Eyre Highway, 40 km E of Kimba, S.A., Australia, *Filson* 11740 (MEL, holotype; TNS, isotype).]

DESCRIPTION.—Thallus adnate on hard lateritic soils, firm, 3–10 cm broad, light yellowish green; lobes sublinear, 1–2 mm wide, separate to contiguous and imbricate, becoming densely laciniate toward the center, the laciniae terete, appressed, 0.2–0.4 mm wide; upper surface continuous, emaculate, often dull whitish pruinose at the tips, isidia and soredia lacking; medulla white; lower surface plane to weakly canaliculate with a weakly developed rim, light brown at the tips but blackening at the center, moderately rhizinate, the rhizines dark brown to black, thin, simple, 0.3–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia rare, substipitate, 2–6 mm in diameter; spores 5 × 10–11 µm.

CHEMISTRY.—Salazinic (major), consalazinic, norstictic (trace), and usnic acids.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 3: fig. 2.

DISTRIBUTION.—Australia (NSW, SA, WA).

COMMENTS.—This unique Australian lichen grows firmly attached to hard-surfaced lateritic soils in mallee scrub. Norstictic acid-containing *X. norpumila* is morphologically identical. There are no other species in the genus with this growth habit.

Xanthoparmelia punctulata

Xanthoparmelia punctulata (Gyelnik) Hale, 1988b:405.

Parmelia punctulata Gyelnik, 1938c:85. [Type collection: Estancita, Prov. Córdoba, Argentina, *Hosseus* 102 (BP, lectotype).]

Xanthoparmelia argentinensis Nash, Elix, and Johnston, 1987:288. [Type collection: 3 km E of Cacheuta along route 7, Provincia de Mendoza, Argentina, *Nash* 23915 (ASU, holotype; ANUC, BAFC, BM , CTES, US, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 3–6 cm broad, dull yellowish green, darkening at the center; lobes subirregular, 1.5–4 mm broad, apically subrotund, subimbricate; upper surface continuous, emaculate, shiny, irregularly cracked with age, moderately isidiate, the isidia globose (Figure 19*a*), 0.08–0.15 mm in diameter, to 0.2 mm high, the tips epicorticate, brownish, erumpent, easily abrading and forming a scurfy mass, unbranched; medulla white; lower surface plane, black except for a brown zone at the tips, moderately rhizinate, the rhizines black, coarse, simple, 0.5–1 mm long. Pycnidia lacking. Apothecia rare, substipitate, to 6 mm in diameter; spores 4–5 × 9–11 µm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

ILLUSTRATION.—Nash, Elix, and Johnston, 1987, fig. 2.

DISTRIBUTION.—Peru, Argentina.

COMMENTS.—This species is closely related to *X. cordillerana*, a more widespread Andean species with a brown lower surface. The lectotype is a mixture of isidiate *X. punctulata* and sorediate *X. ulcerosa*, but Gyelnik clearly mentioned isidia.

Xanthoparmelia pustulifera

FIGURE 61*d*

Xanthoparmelia pustulifera Hale, Nash and Elix in Hale, 1986b:594. [Type collection: 1 km S of summit, Swartberg Pass, ca. 20 km NW of Kango Caves, Cape Province, South Africa, Grid 3322 AC, *Hale* 75115, 31 Jan 1986 (US, holotype; PRE, isotype) (type locality given in the original description was in error).]

DESCRIPTION.—Thallus tightly adnate on rock, fragile, 3–5 cm broad, dull yellowish green; lobes short and sublinear, dichotomously branched, 0.5–1.2 mm wide, contiguous to subimbricate, becoming sublobulate with age, the lobules appressed; upper surface continuous, emaculate, shiny, irregularly cracked with age, moderately isidiate, the isidia initially globose, 0.1–0.3 mm in diameter and up to 0.3 mm high, the tips epicorticate, soon erupting into pustulate or coarsely subsorediate masses; medulla white; lower surface plane, brownish at the tips but black toward the center, moderately rhizinate, the rhizines black, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, norstictic (trace), and usnic acids and an unidentified fatty acid.

ILLUSTRATION.—Hale, 1986b, fig. 41.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The only closely related species, *X. mougeotii*, has distinctly capitate soralia and is more tightly adnate. The East African *X. glomerulata* has tall cylindrical isidia that become erumpent and subsorediate.

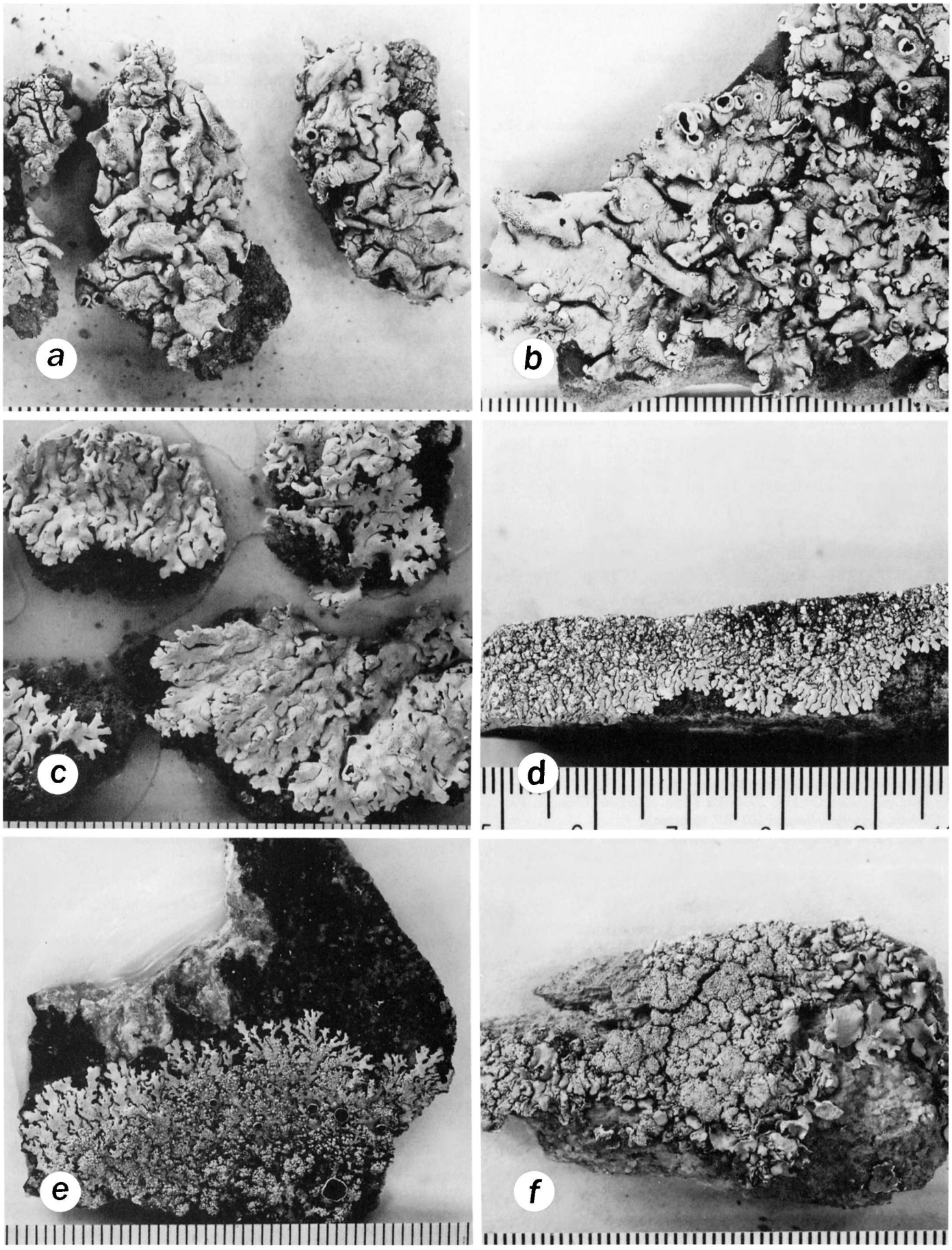
Xanthoparmelia pustuliza

FIGURE 61*e*

Xanthoparmelia pustuliza (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:313.

Parmelia pustuliza Elix, 1981:367. [Type collection: Gudgenby River Gorge, 4.5 km S of Tharwa, A.C.T., Australia, *Elix* 6117 (MEL, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 2–5 cm broad, dull yellowish green; lobes sublinear, 0.8–1.5 mm wide, contiguous to subimbricate, black rimmed; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia subglobose and inflated to subcylindrical (Figure 19*b*), 0.1–0.2 mm in diameter, 0.1–0.2 mm high, the tips epicorticate, pale to brownish, bursting open apically and becoming coralloid-granulose, unbranched; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black simple, 0.2–0.4 mm long. Pycnidia lacking. Apothecia rare, substipitate, 1–3 mm in diameter; spores 4–6 × 6–9 µm.


a
b
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f

CHEMISTRY.—Norstictic (major), connorstictic, hypostictic (±trace), hyposalazinic (±trace), constipatic (±trace), and usnic acids.

ILLUSTRATION.—Elix, 1981, fig. 13.

DISTRIBUTION.—Australia (NSW, ACT, Tas, WA), New Zealand.

COMMENTS.—This rare, distinctive erumpent-isidiate lichen grows along moist rock surfaces.

Xanthoparmelia pustulosorediata

FIGURE 61*f*

Xanthoparmelia pustulosorediata Hale, 1989a:556. [Type collection: On crumbling sheltered granite in large koppie, 5 km NE of Aus on hwy 35 (road to Helmeringshausen), 4.7 km N of Hwy B4, elevation 1300 m, South West Africa/Namibia, Grid 2616 CB, *Hale* 81134, 27 Apr 1988 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate on rock, brittle and breaking apart when collected, 5–8 cm broad, dull yellowish green; lobes subirregular, 1–3 mm wide, short and crowded; upper surface continuous to faintly white-maculate in part, shiny to dull white-pruinose, soon strongly rugose and developing coarsely sorediate, erupting pustules covering much of the thallus; medulla white; lower surface plane, pale brown or darkening, moderately rhizinate, the rhizines brown, simple, 0.2–0.8 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, and usnic acids, lusitana unknown.

ILLUSTRATION.—Hale, 1989a, fig. 29.

DISTRIBUTION.—SWA/Namibia, South Africa (Cape Province).

COMMENTS.—Dense pustulate-sorediate outgrowths characterize this unusual species, collected in extremely arid sites at the base of granite ledges where water accumulates during infrequent rains.

Xanthoparmelia putsoa

FIGURE 62*a*

Xanthoparmelia putsoa Hale, 1987b:328. [Type collection: On small ledges on grassy bald, Blue Mountain Pass, elev. 2634 m, Lesotho, Grid 2928 BA, *Hale* 78977, 4 Nov 1986 (US, holotype; ANUC, PRE, isotypes).]

DESCRIPTION.—Thallus adnate on rock, rather leathery, 6–9 cm broad, light yellowish green but darkening somewhat with age; lobes subirregular, 1.3–2 mm wide, contiguous to overlapping and becoming coarsely laciniate at the center, the laciniae sublinear, 0.5–1 mm wide, appressed, black-rimmed; upper surface continuous, emaculate, shiny, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple 0.5–1 mm long. Pycnidia abundant; conidia bifusiform, 0.5 × 5–7 µm long. Apothecia poorly developed, substipitate, ~1.5 mm in diameter; spores 5 × 7 µm, poorly developed.

CHEMISTRY.—Echinocarpic (major), gyrophoric (major), 5-*O*-methylhiascic (minor), conechinocarpic (minor), and usnic acids (det. J.A. Elix).

ILLUSTRATION.—Hale, 1987b, fig. 16.

DISTRIBUTION.—Lesotho.

COMMENTS.—This is the first occurrence of echinocarpic acid in *Xanthoparmelia*. Morphologically the species is close to *X. gyrophorica* Hale, another high elevation species in Lesotho with a less congested thallus and gyrophoric acid only.

Xanthoparmelia quintaria

FIGURE 62*b*

Xanthoparmelia quintaria (Hale) Hale, 1974b:488.

Parmelia quintaria Hale, 1971a:353. [Type collection: Hottentots Huise, Distr. Cape, South Africa, *Almborn* 950 (LD, holotype; DUKE, TNS, US, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, more or less pulvinate, breaking apart when collected, 2–8 cm broad, light yellowish green; lobes sublinear, 0.6–1 mm wide, contiguous to imbricate and congested; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, brown to dark brown, sparsely to moderately rhizinate, the rhizines brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia substipitate, 1–2 mm in diameter; spores 4–5 × 7–9 µm.

CHEMISTRY.—Hypostictic, hyposalazinic, hypoconstictic (trace), hypoprotocetraric (trace), and usnic acids.

ILLUSTRATION.—Hale, 1971a, fig. 3C.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Closer examination of the type and additional collections shows that the lower surface is brown to dark brown but not black. This lichen has no close relatives except perhaps for *X. protoquintaria*, which is black below and tightly adnate. *Xanthoparmelia metastrigosa* from Australia is also loosely adnate but has broader lobes (1.5–4 mm wide). It is confined to granitic shoreline rocks within 100 m of the shoreline in the southwestern Cape area, from Camps Bay to Hottentotts Huise on Cape Peninsula.

Xanthoparmelia remanens

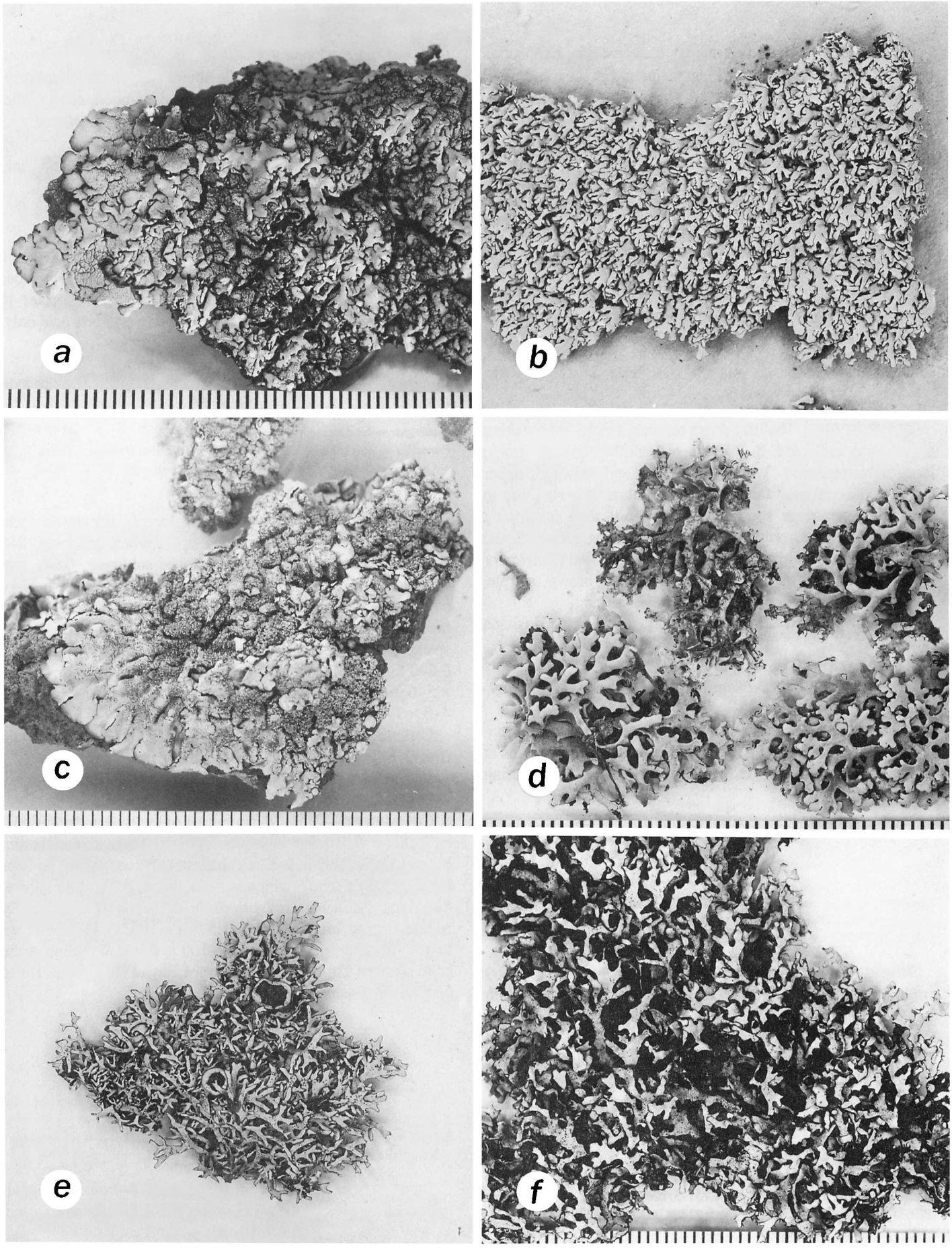
FIGURE 62*c*

Xanthoparmelia remanens (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:314.

Parmelia remanens Elix, 1981:368. [Type collection: 10 km E of Cooma, along Numeralla Road, NSW, Australia, *Elix* 1522 (MEL, holotype).]

DESCRIPTION.—Thallus adnate on rock, 5–7 cm broad, dull yellowish green; lobes subirregular, 1.5–2.5 mm wide,

FIGURE 61.—Species of *Xanthoparmelia*: *a*, *X. psornorstictica* (*Hale* 79495, holotype in US); *b*, *X. psoromica* (*Hale* 77030, holotype in US); *c*, *X. pumila* (*Filson* 11740); *d*, *X. pustulifera* (*Hale* 75115, holotype in US); *e*, *X. pustuliza* (*Elix* 314b); *f*, *X. pustulosorediata* (*Hale* 81134, holotype in US). Scale in mm.


a
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e
f

contiguous to imbricate and crowded; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia cylindrical (Figure 19*c*), 0.08–0.12 mm in diameter, 0.2–0.5 mm high, the tips epicorticate, rarely somewhat erumpent, simple or becoming coralloid branched; medulla white; lower surface plane, brown to dark brown, moderately rhizinate, the rhizines brown, simple, rather coarse, 0.2–0.5 mm long. Pycnidia lacking. Apothecia not common, substipitate, 1–3 mm in diameter; spores 5–6 × 10–11 µm.

CHEMISTRY.—Scabrosin 4,4′-diacetate, scabrosin 4-acetate-4′-butyrate, scabrosin 4,4′-dibutyrate, scabrosin 4-acetate-4′-hexanoate, and usnic acid.

ILLUSTRATION.—Elix, 1981, fig. 14.

DISTRIBUTION.—Australia (Qld, NSW, Tas, SA, NT, WA).

COMMENTS.—A rare but widespread species, *X. remanens* resembles *X. scabrosa*, which has more distinctly erumpent isidia and produces norlobaridone and loxodin, with or without the scabrosin derivatives, as the main component. Another very closely related species in Australia, *X. nonreagens*, has smaller, nonerumpent isidia.

Xanthoparmelia reptans

FIGURE 62*d*

Xanthoparmelia reptans (Kurokawa) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:316.

Parmelia reptans Kurokawa in Baker et al., 1973:137. [Type collection: 6 mi W of Red Cliffs, Vict., Australia, *Kurokawa* 6621 (TNS, holotype).]

DESCRIPTION.—Thallus loosely adnate to free growing on soil, firm, 1–4 cm broad, light yellowish green; lobes sublinear, 0.8–1.5 mm wide, elongate, dichotomously branched, separate to imbricate, the ultimate lobes sometimes becoming subterete at the center; upper surface white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface canaliculate with a yellow rim, pale brown or darker, moderately to densely rhizinate, the rhizines simple to furcate, dark brown to black, 1–2 mm long. Pycnidia lacking. Apothecia rare, substipitate, 1–1.5 mm in diameter; spores 4–5 × 6–7 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric (±), protocetraric (±trace), physodalic (±trace), and usnic acids.

ILLUSTRATIONS.—Baker et al., 1973, fig. 1; Filson and Rogers, 1979, fig. 23A.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, SA, WA), New Zealand.

COMMENTS.—This terricolous lichen is related to *X. amphixantha*, which contains stictic acid. It is very common in semi-arid shrublands in Australasia.

Xanthoparmelia rogersii

Xanthoparmelia rogersii Elix and Johnston in Elix, Johnston, and Armstrong, 1986:317. [Type collection: Girraween National Park, Qsld., Australia, *Rogers* 2871 (MEL, holotype).]

Parmelia rogersii (Elix and Johnston) Brusse, 1988:539.

DESCRIPTION.—Thallus loosely adnate, 4–8 cm broad, light yellow green; lobes sublinear, 2–4 mm wide, separate to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines black, simple, 0.5–1.2 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5 µm. Apothecia common, substipitate, 3–10 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, protocetraric (±trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 32.

DISTRIBUTION.—Australia (Qld), Kenya.

COMMENTS.—This appears to be a rare chemotype of *X. tasmanica*, differing morphologically in the lack of secondary laciniae.

Xanthoparmelia rubrireagens

FIGURE 62*e*

Xanthoparmelia rubrireagens (Gyelnik) Hale, 1974b:488.

Parmelia rubrireagens Gyelnik, 1938a:288. [Type collection: Goulburn, Rocky Hill, NSW, Australia, *Watts* 90 (BP, lectotype).]

DESCRIPTION.—Thallus loosely adnate on rock, 5–8 cm broad, light yellowish green; lobes sublinear to linear, 0.4–1 mm wide, elongate, dichotomously branched and irregularly and weakly constricted, separate to imbricate; upper surface mostly continuous with a few patches of weak white maculae, isidia and soredia lacking; medulla white; lower surface plane, black, becoming transversely rugose, sparsely rhizinate with extensive bare areas and small clumps of rhizines at the tips or center, the rhizines black, rather long, simple to furcate, 0.5–1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 4–5 µm. Apothecia often developed, substipitate, 2–6 mm in diameter; spores 5–6 × 7–9 µm.

CHEMISTRY.—Salazinic, consalazinic, norstictic (±trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 16 (as *X. eradicata*).

DISTRIBUTION.—Australia (NSW, ACT).

COMMENTS.—This conspicuous species is rather common in cooler upland NSW. It is related to *X. constrictans*, a South African vicariad with greater development of rhizines, a smooth lower surface, and strongly constricted, white-maculate lobes.

Xanthoparmelia rubromedulla

FIGURE 62*f*

Xanthoparmelia rubromedulla Hale, 1986b:594. [Type collection: Waaihoek Peak, elev. 1680 m, Worcester Division, Cape Province, South Africa, Grid

FIGURE 62.—Species of *Xanthoparmelia*: *a*, *X. putsoa* (*Hale* 78977, holotype in US); *b*, *X. quintaria* (*Almborn* 950, holotype in LD); *c*, *X. remanens* (Elix 1074); *d*, *X. reptans* (*Hale* 58416); *e*, *X. rubrireagens* (*Watts* 90, lectotype in BP); *f*, *X. rubromedulla* (*Esterhuysen* 22560, holotype in BOL). Scale in mm.

3319 AD, *Esterhuysen* 22560, 12 Jan 1954 (BOL, holotype; US, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock or soil, rather rigid, 5–10 cm broad, darkish yellowish green; lobes sublinear, 1–1.5 mm wide, dichotomously branched, somewhat constricted, subimbricate; upper surface uniformly white-maculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla orange-red; lower surface plane, brown at the tips but becoming black, sparsely to moderately rhizinate, the rhizines black, rather coarse, simple, 0.5–1 mm long. Pycnidia sparse; conidia not found. Apothecia lacking.

CHEMISTRY.—Salazinic (major), consalazinic (±), and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1986b, fig. 42.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species bears a considerable resemblance to *X. constrictans* but the thallus is more rigid, quite loosely adnate, pulvinate on rock or soil, and contains skyrin. *Xanthoparmelia eradicata* has much narrower lobes (0.2–0.5 mm wide). All of these species are confined to the southwestern Cape region.

Xanthoparmelia rubropustulata

FIGURE 63*a*

Xanthoparmelia rubropustulata Hale, 1987a:264. [Type collection: W side of hwy R43, 17.4 km N of N2, elev. 500 m, Cape Province, South Africa, Grid 3419 CA, *Hale* 78194, 26 Oct 1986 (US, holotype; LD, PRE, isotype).]
Parmelia rubropustulata (Hale) Brusse, 1989b:29.

DESCRIPTION.—Thallus adnate on rock, fragile, 4–7 cm broad, dull yellowish green; lobes subirregular, 1–1.5 mm wide, contiguous and becoming crowded at the center, upper surface continuous, emaculate, shiny, rugose with age, moderately isidiate, the isidia globose-pustulate, bullate, 0.1–0.5 mm in diameter, fragile, the tips epicorticate, breaking open at maturity, erumpent, unbranched, medulla uniformly deep wine red; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic and usnic acids, two "endomiltoides" anthraquinone pigments.

ILLUSTRATION.—Hale, 1987a, fig. 20.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The coarse, globose isidial growths separate this rare species from *X. endomiltoides*, its closest relative.

Xanthoparmelia rugulosa

FIGURE 63*b*

Xanthoparmelia rugulosa Hale, 1987b:328. [Type collection: On sandstone talus boulders on a hillside pasture, 17.6 km NE of the town of Barkly Pass on the W side of hwy R393, Cape Province, S. Africa, Grid 3127 BB, *Hale* 76998, 10 Oct 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, fragile, 3–5 cm broad, yellowish green; lobes subirregular, 1–1.5 mm wide, short, contiguous to imbricate and crowded at the center; upper surface continuous, emaculate, shiny, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, delicate, simple, 0.2–0.6 mm long. Pycnidia common; conidia cylindrical to weakly bifusiform, 0.5 × 6–8 µm. Apothecia rather rare, adnate, 0.5–1 mm in diameter; spores 5–6 × 7–9 µm.

CHEMISTRY.—Diffractaic (major), 4-*O*-demethyldiffractaic (±trace), 3-α-hydroxybarbatic (±tr), 4-*O*-demethylbarbatic (±trace), squamatic (±trace), baeomycesic (±trace), and usnic acids, atranorin (trace) (det. J.A. Elix).

ILLUSTRATION.—Hale, 1987b, fig. 17.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The only other comparable species with diffractaic acid is *X. tucsonensis* from the western USA and Australia, a much larger lichen with lobes 1–3 mm wide. *Xanthoparmelia rugulosa* has been collected only once on Cave sandstone in a moist area of eastern Cape Province.

Xanthoparmelia rupestris

Xanthoparmelia rupestris Elix and Johnston in Elix, Johnston, and Armstrong, 1986:319. [Type collection: 12 km E of Michelago, Tinderry Mountains, NSW, Australia, *Nash* 20455 (ASU, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock, more or less pulvinate, 4–10 cm broad, yellowish green; lobes sublinear, 1–3 mm wide, elongate and dichotomously branched, separate to loosely imbricate, black rimmed; upper surface continuous to very weakly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane to weakly convoluted, dark brown to black or mottled brown and black, very sparsely rhizinate, the rhizines black, coarse, simple, 0.5–1 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Scabrosin 4,4′dibutyrate, scabrosin 4-acetate-4′-hexanoate, scabrosin 4-acetate-4′-butyrate, scabrosin 4,4′-diacetate (trace), and usnic acid.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 33.

DISTRIBUTION.—Australia (NSW).

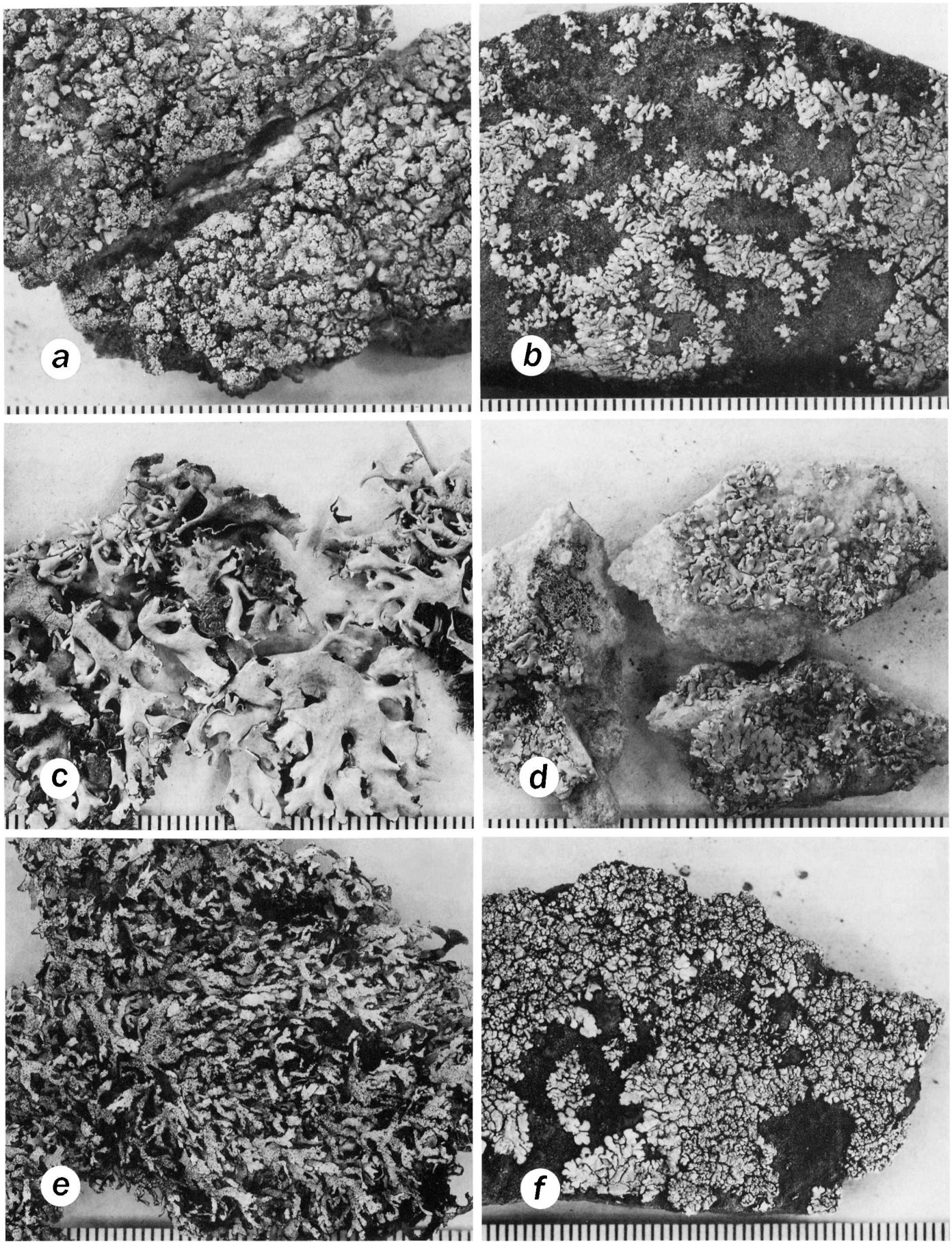
COMMENTS.—This very rare species is related to *X. dichotoma* (norlobaridone present), a widespread Australian species.

Xanthoparmelia salamphixantha

FIGURE 63*c*

Xanthoparmelia salamphixantha Hale, 1989a:558. [Type collection: On sterile soil in karoo pasture, on Hwy R364, 29 km S of junction with Hwy R27,

FIGURE 63.—Species of *Xanthoparmelia: a, X. rubropustulata* (*Hale* 78194, holotype in US); *b, X. rugulosa* (*Hale* 76998, holotype in US); *c, X. salamphixantha* (*Hale* 79962, holotype in US); *d, X. saleruptens* (*Hale* 79905, holotype in US); *e, X. salkiboensis* (*Santesson* 21163, holotype in UPS); *f, X. saniensis* (*Hale* 74031, holotype in US). Scale in mm.


a
b
c
d
e
f

elev. 600 m, Cape Province, South Africa, Grid 3119 CD, *Hale* 79962, 24 Mar 1988 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate to nearly free growing on soil and mosses, easily breaking apart, 4–8 cm broad, light yellowish green; lobes sublinear, 2–5 mm wide, dichotomously branched, more or less separate; upper surface uniformly white-maculate, shiny, rugose and irregularly cracked with age, isidia and soredia lacking; medulla white; lower surface weakly canaliculate with a raised yellow rim, pale brown or darkening and in part jet black, shiny, sparsely rhizinate, the rhizines dark brown, simple, 0.5–2 mm long. Pycnidia common; conidia 0.5 × 4–6 µm long. Apothecia substipitate, 3–5 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic (major), consalazinic, norstictic (trace), and usnic acids, chalybaeizans unknown.

ILLUSTRATION.—Hale, 1989a, fig. 30.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—While similar to *X. subflabellata*, *X. salamphixantha* has broader lobes with a heavily white-maculate surface. It has been found in two localities on sterile soil in karoo-dominated pastures in southwestern Cape Province.

Xanthoparmelia saleruptens

FIGURE 63*d*

Xanthoparmelia saleruptens Hale, 1989a:558. [Type collection: On large overhanging Table Mountain sandstone ledges, 7 km W of Oliewenboskraal on road to Paleisheuwel (west of Hwy N7), elev. 900 m, Cape Province, South Africa, Grid 3218 BD, *Hale* 79905, 25 Mar 1988 (US, holotype; PRE, isotype).]

Parmelia geckonalis Brusse, 1989a:400. [Type collection: 8 km W of Olyvenboskraal, Witelshloof, Cape Province, South Africa, Grid 3218 BD, *Brusse* 5536.]

DESCRIPTION.—Thallus tightly adnate on rock, fragile, 1–3 cm broad, light yellowish green; lobes subirregular, 0.8–1.5 mm wide, contiguous to subimbricate; upper surface continuous, emaculate, dull white pruinose, sparsely pustulate-isidia, the isidia irregularly developed from ridges, ~0.3 mm in diameter, the tips weakly epicorticate, pale, erupting and forming subsorediate masses, unbranched; medulla white; lower surface plane, pale brown, sparsely rhizinate, the rhizines pale brown, simple, 0.1–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic (major), consalazinic, and usnic acids, chalybaeizans unknown.

ILLUSTRATION.—Hale, 1989a, fig. 31.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This rare species belongs in the *X. eruptens* group. In common with other species in this group it grows on the underside of large overhanging sandstone ledges in areas of winter fog.

Xanthoparmelia salkiboensis

FIGURE 63*e*

Xanthoparmelia salkiboensis Hale, 1989a:558. [Type collection: Near Johnsell Point, Shira Plateau, Mt. Kilimanjaro, Tanzania, elev. 3950 m, *Santesson* 21163, 13 Jan 1970 (UPS, holotype; US, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock or mosses over rocks, pulvinate, rather brittle, 4–8 cm broad, dark yellowish green; lobes sublinear, 0.8–2 mm wide, dichotomously branched, black rimmed, imbricate, irregularly laciniate with age; upper surface continuous, emaculate, shiny, rugulose and transversely cracked with age, soredia and isidia lacking; medulla white; lower surface plane, black, shiny, smooth to slightly rugulose, sparsely to moderately rhizinate, the rhizines black, rather coarse and unbranched, 0.3–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–5 µm. Apothecia rare, substipitate, 3–5 mm wide, the rim inrolled; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic (major), consalazinic, norstictic (trace), protocetraric (trace), and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 32.

DISTRIBUTION.—Kenya, Tanzania.

COMMENTS.—This high-elevation lichen with black-rimmed lobes is common at an elevation of 3600–4000 m in Kenya and Tanzania. It differs from *X. kiboensis* in the pulvinate growth habit, shiny lower surface, and chemistry (norstictic acid in *X. kiboensis*).

Xanthoparmelia saniensis

FIGURE 63*f*

Xanthoparmelia saniensis Hale, 1986b:596. [Type collection: Sani Pass east of Customs Gate, elev. 2875 m, Lesotho, Grid 2929 CB, *Hale* 74031, 19 Feb 1986 (US, holotype; LD, PRE, isotypes).]

Parmelia saniensis (Hale) Brusse, 1989a:403.

DESCRIPTION.—Thallus tightly adnate on doleritic rock, 4–6 cm broad, yellowish green; lobes subirregular, 1–1.5 mm wide, brown to black rimmed, contiguous to imbricate and bullate at the center; upper surface continuous, emaculate, shiny, densely isidiate, the isidia globose and basally constricted (Figure 19*d*), 0.13–0.25 mm in diameter, 0.1–0.3 mm high, the tips epicorticate, bursting open apically but not sorediate, unbranched; upper medulla white, lower medulla in part ochre; lower surface plane, pale brown tinged with ochre, moderately rhizinate, the rhizines pale brown, 0.3–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypostictic, hyposalazinic, hypoconstictic, and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1986b, fig. 43.

DISTRIBUTION.—Lesotho, South Africa (eastern Cape Province).

COMMENTS.—This remarkable high elevation species is characterized by the large globose isidia and tightly adnate habit. It has only one probable relative, the rare Brazilian *X. kalbii*, which is not as tightly adnate and lacks skyrin. It is typically found on moist sheltered basalt outcrops in the Drakensberg escarpment.

Xanthoparmelia scabrosa

FIGURE 64*a*

Xanthoparmelia scabrosa (Taylor) Hale, 1974b:488.
Parmelia scabrosa Taylor, 1847:162. [Type collection: Swan River, Australia, *Drummond* s.n. (FH-Tayl, lectotype; BM, G, H-Nyl, isolectotypes).]
Parmelia conspersa var. *hypoclystoides* Müller Argoviensis, 1888c:201. [Type collection: Mt. Macedon, Australia, *Moffat* 41 (G, lectotype).]
Parmelia conspersa var. *hypocleistoides* [sic] f. *isidiosa* Müller Argoviensis, 1888c:201. Based on *P. scabrosa* Tayl.
Parmelia linkolae Gyelnik, 1930a:60. [Type collection: Dunedin, New Zealand, *Lindsay* s.n. (H, Nyl. herb. no. 34708, lectotype; BP, isolectotype).]
Parmelia hypoclystoides (Müller Argoviensis) Gyelnik, 1935:25.
Parmelia beltjensii Gyelnik, 1938a:270. [Type collection: Toda Beloe, Insula Flores Oceaniae, *Beltjens* s.n. (BP, lectotype).]
Parmelia subreagens Gyelnik, 1938a:291. [Type collection: Waratak, NSW, Australia, *Gregson* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]
Parmelia amplexula var. *beltjensii* (Gyelnik) Gyelnik, 1938b:20.
Xanthoparmelia hypoclystoides (Müller Argoviensis) Hale, 1974b:487.
Parmelia scabropustulata Elix, 1981:369. [Type collection: Ellas Track, Port Hills, Christchurch, New Zealand, *Elix* 7612 (CHR, holotype; MEL, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 4–15 cm broad, yellowish green; lobes subirregular to sublinear, 1.5–4 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia variable, warty and subglobose to cylindrical or irregularly inflated (Figure 19*e*), 0.08–0.12 mm in diameter, 0.1–0.4 mm high, the tips epicorticate, erumpent and becoming pustulate-sorediate with age, mostly unbranched; medulla white; lower surface plane, brown to dark brown, sparsely to moderately rhizinate, the rhizines brown, simple, 0.2–0.5 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 6–7 µm. Apothecia rare, substipitate, 2–8 mm in diameter; spores 5–6 × 10–12 µm.

CHEMISTRY.—Norlobaridone (major), loxodin, scabrosin 4,4′diacetate (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4,4′dibutyrate (±), scabrosin 4-acetate-4′-hexanoate, isonorlobaridone (±trace), norlobariol (±trace), norlobariol methyl ester (±trace), conloxodin (±trace), conorlobaridone (±trace), and usnic acid.

ILLUSTRATIONS.—Elix, 1981, fig. 15 (as *Parmelia scabropustulata*); Filson and Rogers, 1979, pl. 12D; Galloway, 1980, fig. 10.

DISTRIBUTION.—Argentina, Japan, Australia (Qld, NSW, ACT, Vic, Tas, SA, NT, WA), New Zealand, New Guinea.

COMMENTS.—This is one of the more widespread species in eastern Asia and Australasia. It is especially common in New Zealand where it even grows on pavement and sidewalks in cities. The lower surface is usually darkish brown. Related species are *X. amplexula* with cylindrical isidia, *X. verdonii* with a black lower surface, and *X. constipata*, a primarily terricolous species.

Müller Argoviensis (1888c), following his extremely conservative treatment of foliose lichens, actually created a new form level name for *P. scabrosa*: *P. conspersa* var. *hypoclystoides* f. *isidiosa*.

Xanthoparmelia schenckiana

FIGURE 64*b*

Xanthoparmelia schenckiana (Müller Argoviensis) Hale, 1974b:489.
Parmelia schenckiana Müller Argoviensis, 1888d:529. [Type collection: Obib, Orange River, Great Namaland, South Africa, *Schenck* 542 (G, lectotype; ZT, isolectotype).]
Parmelia schenckiana f. *imperfecta* Gyelnik, 1938a:289. [Type collection: Between Brandvlei and Tontelboskolk, Calvinia distr., South Africa, *Byl* 1127 (W, lectotype; BP, isolectotype).]
Parmelia schenckiana f. *perfecta* Gyelnik, 1938a:289. [Nomen nudum.]
Parmelia zeyheri Dodge, 1959:132. [Type collection: Forests toward Grahamtown, Cape of Good Hope, South Africa, *Zeyher* s.n. (FH-Tayl, holotype).]

DESCRIPTION.—Thallus adnate on rock, leathery, 4–12 cm broad but coalescing to cover large areas, bright yellowish green; lobes subirregular, 2–5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, dull and becoming white-pruinose at the tips, rugose with age, isidia and soredia lacking; upper medulla white, lower medulla usually dull pale rusty orange in part; lower surface plane, shiny, black, sparsely rhizinate, the rhizines black coarse, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 µm. Apothecia common, substipitate, 2–5 mm in diameter; spores 6 × 10–11 µm.

CHEMISTRY.—Protocetraric, caperatic (±), and usnic acids, schenckiana pigments (±) and secalonic acid derivatives (±).

DISTRIBUTION.—Lesotho, South Africa (Cape Province).

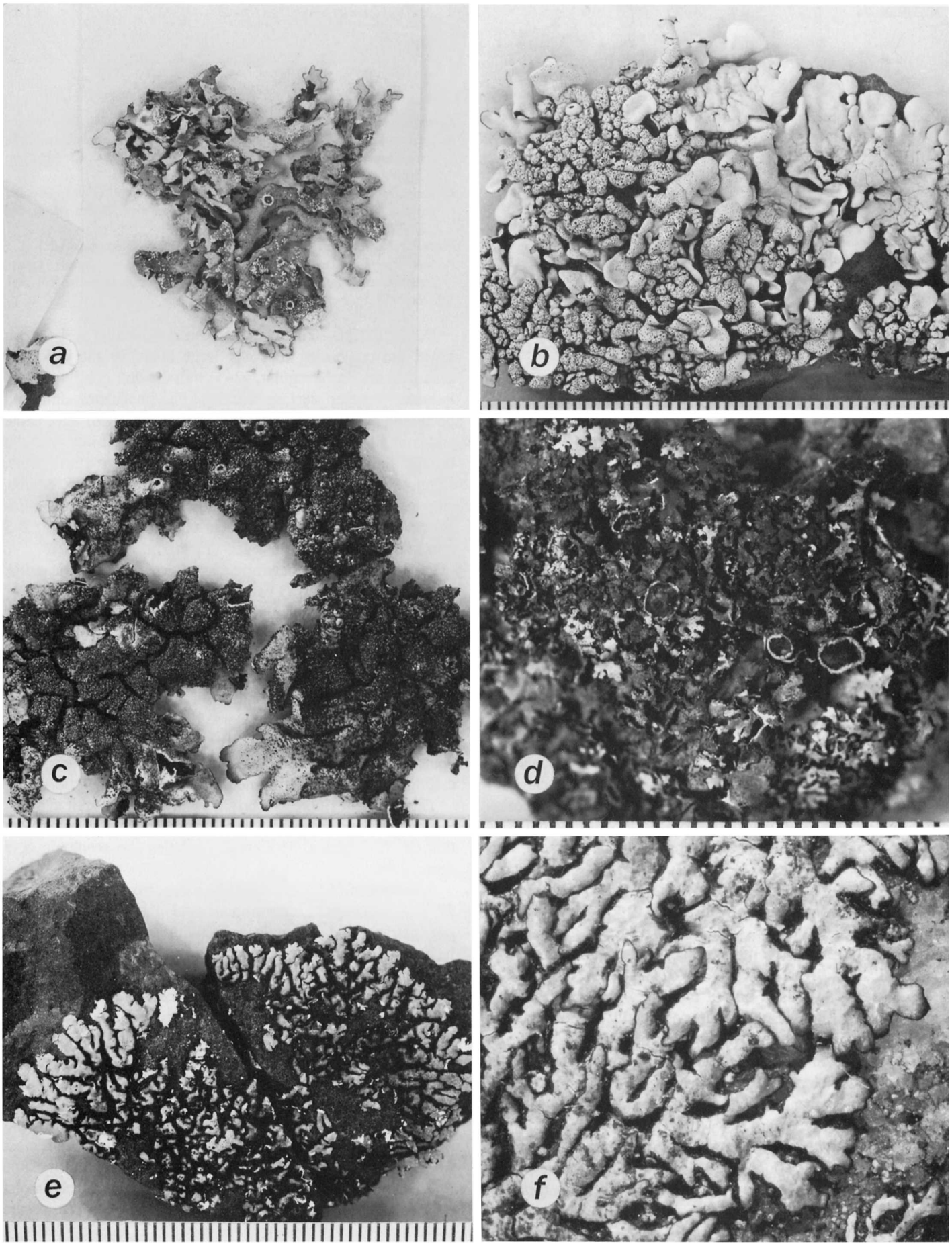
COMMENTS.—*X. schenckiana* was the first described species in a group of conspicuous, bright yellow South African lichens. All of them are rather leathery, broad lobed with rotund tips yet surprisingly tightly adnate for a lichen this size, jet black and dull below with sparse coarse rhizines, and without isidia or soredia. They also frequently produce a dull rusty reddish anthraquinone pigment in the lower medulla, which I am calling the schenckiana pigment.

This pigment fluoresces bright yellow (higher spot at about R_f5) under long-wave UV and forms a diffuse streak below this on TLC plates. The streak includes the secolonic acid derivatives.

A sample of 45 specimens of *X. schenckiana* was examined: 27 contained protocetraric acid and the pigment; 5 had protocetraric and caperatic acids with the pigment; and 13 lacked the pigment, containing only protocetraric acid with (7) or without (6) caperatic acid.

Xanthoparmelia schenckiana and *X. colorata* with norstictic-salazinic acids are widespread from eastern Cape Province through the Little and Great Karoo, reaching a peak of abundance in Namaqualand. Both are densely white-pruinose. Although these two chemotypes are sympatric, they usually occur at different localities.

Other species in the group, *X. diacida* (protocetraric and psoromic acids) and *X. psoromica* (psoromic acid), occur most frequently in the Cave sandstone region of eastern Cape Province and are much rarer outside this relatively moist region. They are only weakly, if at all, white pruinose. A rare


a
b
c
d
e
f

fifth species, *X. psornorstictica* (psoromic and norstictic acids), occurs in extremely arid upper Namaqualand. A final species that seems to belong in this group, *X. norcolorata*, contains norstictic acid as the major metabolite but lacks pigments. It occurs far to the north of the other species in Namibia.

Xanthoparmelia schmidtii

FIGURE 64*c*

Xanthoparmelia schmidtii Hale, 1984:78. [Type collection: Road to Visalia on M-296, Tulare Co., California, USA, *Hale* 57087 (US, holotype; DUKE, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 4–8 cm broad, dark yellowish green; lobes subirregular, 1.8–5 mm wide, more or less rotund, contiguous to imbricate; upper surface continuous, emaculate, shiny, densely isidiate, the isidia cylindrical to irregularly inflated (Figure 19*f*), 0.1–0.2 mm in diameter, 0.1–0.6 mm high, the tips syncorticate, darkening, densely branched with age; medulla white; lower surface plane, pale or darker brown, moderately rhizinate, the rhizines pale or darker brown, simple, 0.3–0.6 mm long. Pycnidia lacking. Apothecia rare, substipitate, 1–3 mm in diameter; spores 6 × 9–10 µm.

CHEMISTRY.—Barbatic (major), 4-*O*-demethylbarbatic (minor), norstictic (major), salazinic (major), and usnic acids.

ILLUSTRATION.—Hale, 1984, fig. 8.

DISTRIBUTION.—Western USA.

COMMENTS.—This has all the appearances of a hybrid species, but only one putative parent, salazinic acid-containing *X. mexicana*, can be identified. This chemically unique species is confined to the foothills of the Sierra Nevada in Tulare County, California, where *X. mexicana* is extremely common.

Xanthoparmelia segregata

FIGURE 64*d*

Xanthoparmelia segregata Elix and Johnston, 1988b:361. [Type collection: Elphinstone overpass on Calder Highway, Victoria, Australia, *Johnston* 1502, 10 Dec 1984 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 4–6 cm broad, yellowish green; lobes subirregular to sublinear, 0.5–1 mm wide, short and irregularly branched, black-rimmed, imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia subglobose to cylindrical, rather tall, the tips syncorticate, rarely branching, 0.05–0.08 mm in diameter, 0.1–0.2mm high; medulla white; lower surface plane, pale brown to brown, darker at the tips, shiny, sparsely rhizinate, the rhizines pale brown to brown, simple, 0.1–0.2 mm long. Pycnidia lacking. Apothecia common, substipitate, 2–3 mm in diameter; spores 4–6 × 7–9 µm.

CHEMISTRY.—Norstictic (major), salazinic (major), consalazinic, connorstictic, and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1988b, fig. 9.

DISTRIBUTION.—Australia (NSW, Vic).

COMMENTS.—Although close to norstictic acid-containing *X. streimannii*, this rare species has co-occurence of salazinic acid.

Xanthoparmelia serusiauxii

FIGURE 64*e*

Xanthoparmelia serusiauxii Hale, 1986b:596. [Type collection: Laguneberg Mountains, NE of Mile 72, Distr. Omaruru, South West Africa/Namibia, Grid 2114 CC, *Hale* 75102 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate on rock, rather soft, 4–10 cm broad, dark yellowish green and blackening at the center; lobes sublinear, 1–2 mm wide, little branched, convex and appearing inflated, black-rimmed, contiguous, short laciniate at the center with age; upper surface continuous, emaculate or the tips faintly reticulate white-maculate, shiny or becoming dull white pruinose, heavily rugose with age, isidia and soredia lacking; medulla white; lower surface plane, black, dull, sparsely rhizinate, the rhizines black, coarse, simple, 0.3–0.5 mm long. Pycnidia common; conidia not found. Apothecia lacking.

CHEMISTRY.—Lecanoric and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 44.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This very common *Xanthoparmelia* grows on dolerite boulders and small flat pebbles in desert pavement in the central coastal Namib area. It is the last surviving *Xanthoparmelia* species 40–45 km inland at the edge of the ocean fog zone. It is easily recognized by the soft, seemingly inflated thallus and dense pruina. Closely related species in the Namib desert are *X. equalis* (evernic acid) and *X. laguneber-gensis* (protocetraric acid), both of which have a pale lower surface.

Xanthoparmelia shebaiensis

FIGURE 64*f*

Xanthoparmelia shebaiensis Nash and Elix, 1987:471. [Type collection: Mount Sheba, Transvaal, South Africa, *Nash* 23419 (ASU, holotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, 2–4 cm broad, yellowish green; lobes sublinear, 0.3–0.7 mm wide, short and apically blunt, dichotomously branched, contiguous to imbricate, black-rimmed; upper surface continuous to reticulate white-maculate at the tips, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

FIGURE 64.—Species of *Xanthoparmelia*: *a*, *X. scabrosa* (*Drummond* s.n., lectotype in FH-Tayl); *b*, *X. schenckiana* (*Hale* 78654); *c*, *X. schmidtii* (Hale 57087); *d*, *X. segregata* (*Johnston* 1502, holotype in CBG); *e*, *X. serusiauxii* (*Hale* 75102, holotype in US); *f*, *X. shebaiensis* (*Nash* 23459 (×10)). Scale in mm.

CHEMISTRY.—Stenosporonic (major), colensoic, norcolensoic, and usnic acids with several unknown substances.

ILLUSTRATION.—Nash and Elix, 1987, fig. 6.

DISTRIBUTION.—South Africa (Transvaal).

COMMENTS.—The faint reticulate maculation resembles that of *X. peruviensis*, another species with stenosporonic acid. Chemically similar *X. stenosporonica* from the Swartberg Mountains of Cape Province, South Africa, has a continuous surface. South African *X. colensoica* is part of the same chemosyndrome but contains colensoic as the major component.

Xanthoparmelia sigillata, new combination

Parmelia sigillata Brusse, 1988:537. [Type collection: 9 km N of De Rust, Meiringspoort, Cape Province, South Africa, Grid 3322 BC, *Brusse* 4827 (PRE, holotype (not seen); BM, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, centrally areolate, 2–4 cm broad, light yellowish green; lobes sublinear, 1–2 mm wide, dichotomously branched, contiguous to subimbricate; upper surface continuous, shiny, transversely cracked with age, soredia and isidia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines light brown, simple. Pycnidia numerous; conidia 0.05 × 5–6 µm. Apothecia well developed, adnate, 1–2.5 mm in diameter; spores 5–6 × 8–11 µm.

CHEMISTRY.—Evernic (major), lecanoric, and usnic acids.

DISTRIBUTION.—South Africa (Cape Province).

ILLUSTRATION.—Brusse, 1988, fig. 7.

COMMENTS.—Externally this rare karoo species is close to *X. worcesteri*, which contains lecanoric acid as the chief component and is emaculate.

Xanthoparmelia simulans

FIGURE 65*a*

Xanthoparmelia simulans Hale, 1986b:597. [Type collection: S side of Swartberg Pass, Swartberg Mountains, NW of Kango Caves on Hwy R328, elev. 1800 m, Cape Province, South Africa, Grid 3322 AC, *Hale* 74045, 31 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate on soil or over mosses on soil, subpulvinate, 5–8 cm broad, bright yellowish green, darkening with age; lobes sublinear, 0.5–1 mm wide, divaricately branched and irregularly constricted, black rimmed, subascending; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, rather coarse, simple, 0.5–1 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic (major), constictic, cryptostictic, norstictic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 45.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species differs from closely related *X. constrictans* in the presence of the stictic acid complex (in place of salazinic acid) and by the emaculate upper surface. It is confined to higher exposed elevations in southeastern Cape Province. *Xanthoparmelia suberadicata* from Madagascar shares the production of stictic acid but lacks rhizines and has uniformly linear lobes with a strongly rugose lower surface.

Xanthoparmelia skyrinifera

FIGURE 65*b*

Xanthoparmelia skyrinifera Hale, 1986b:597. [Type collection: 15.9 km NE of Barrydale along Hwy R62, elev. ca. 500 m, Cape Province, South Africa, Grid 3321 DD, *Hale* 74040, 2 Feb 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate on rocks to nearly free growing on soil, firm, 6–12 cm broad, bright yellowish green; lobes sublinear, 1.5–2.5 mm wide, more or less imbricate; upper surface faintly to distinctly white-maculate, rugose and transversely cracked with age, isidia and soredia lacking; upper medulla white, lower medulla ochre in part; lower surface plane, pale brown with an ochre tinge but turning darker brown toward the center, sparsely to moderately rhizinate, the rhizines pale brown, 0.5–1.5 mm long, simple to furcate and apically splayed. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Protocetraric and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1986b, fig 46.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This lichen is characterized by the loosely adnate habit the pale brown, moderately rhizinate, pigmented lower surface It is especially common on Bokkeveld shale outcrops in the Little Karoo. Another species with protocetraric acid and skyrin, *X. subcolorata*, has a rugose, eroding lower surface and sparse rhizines.

Xanthoparmelia somloensis

FIGURE 65*c*

Xanthoparmelia somloensis (Gyelnik) Hale in Ahti, Brodo, and Noble, 1987:96.

Parmelia somloensis Gyelnik, 1931a:156. [Type collection: Comit. Veszprém, Mt. Somló, near Doba, Hungary, *Gyelnik* s.n. (BP, lectotype).]

Parmelia conspersa B stenophylla Acharius, 1803:206. [Type collection: Sweden, s.c. (H-Ach, lectotype; BM-Ach, isolectotype).]

Parmelia conspersa g georgina Acharius, 1810:487. [Type collection: [Tiflis], Georgia, USSR, *Stevens* s.n. (H-Ach, lectotype; UPS, isolectotype).]

Parmelia conspersa a *latior* Schaerer, 1840:473. [Type collection: [Valle Entremont, supra Lyddes], s.c. (G, lectotype).]

Parmelia conspersa c *abortiva* Schaerer, 1850:46. [Type collection: Europe, s.c. (G, lectotype).]

Parmelia conspersa var. *imbricata* Massalongo, 1856:167. [Type collection: Italy, *Massalongo, Lichenes Exsiccati Italici* 313 (UPS, lectotype; BM, *FH-Tuck*, G, H-Nyl. herb. no. 34759, L, LD, M, S, VER, WU, ZT, isolectotypes).]

Parmelia conspersa f. *stenophylla* (Acharius) Leighton, 1871:135.

Parmelia conspersa f. *convoluta* Rabenhorst, 1871:891. [Type collection: Between Grimma and Hohenstadt, Saxonia, Germany, *Ettich* s.n., no. 891

in *Rabenhorst, Lichenes Europaei* (H, lectotype; B, UPS, ZT, isolectotypes). Nomen nudum without a description.]

Parmelia molliuscula f. *stenophylla* (Acharius) B. Stein, 1889:135.

Parmelia conspersa var. *imitans* Müller Argoviensis, 1891:378. [Type collection: Nila Valley, [Tihri-Garhwal], North-Western India, *Duthie* s.n. (BM, lectotype; G, isolectotype).]

Parmelia conspersa ssp. *molliuscula* var. *stenophylla* (Acharius) Elenkin, 1901a:20.

Parmelia conspersa f. *taeniata* Anders, 1906:62. [Type collection: Mickenhan, North Bohemia, *Anders* s.n., [12 Mar 1922] (PRM, lectotype).]

Parmelia conspersa var. *stenophylla* f. *georgina* (Acharius) Harmand, 1909:515.

Parmelia conspersa f. *imbricata* (Massalongo) Mereschkowsky, 1920a:488.

Parmelia stenophylla (Acharius) Du Rietz, 1921:176. [Not *P. stenophylla* Müller Argoviensis, 1893:128 (= *Bulbothrix*).]

Parmelia saxatilis var. *subomphalodes* Zahlbruckner, 1930:190. [Type collection: Hwangtou-schan, Schenhsi, China, *Giraldi* [241] (W, lectotype).]

Parmelia conspersa f. *viridulo-umbrina* Gyelnik, 1930b:31. [Type collection: Baltimore, Maryland, USA, *Plitt* s.n. (BP, lectotype).]

Parmelia convoluta (Rabenhorst) Gyelnik, 1931a:156. [Not *P. convoluta* Krempelhuber, 1881:337 (= *Xanthoparmelia convoluta* (Krempelhuber) Hale).]

Parmelia viridulo-umbrina (Gyelnik) Gyelnik, 1931b:286.

Parmelia intermedia Gyelnik, 1931a:156. [Nomen nudum but a specimen in H (Nylandia, Helsinki, Finland, s.c.) identified by Gyelnik is typical *X. somloensis*.]

Parmelia somloensis var. *lacinulifera* Gyelnik, 1931b:283. [Type collection: Ostrovi, Macedonia, *Lillee* 1279 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia convoluta var. *subdensa* Gyelnik, 1931b:285. [Type collection: Caucasus, *Lojka* 404 (BP, lectotype).]

Parmelia pseudohungarica var. *komotauensis* Gyelnik, 1932a:217. [Type collection: Komotau, Czechoslovakia, *Klement* s.n. (BP, lectotype).]

Parmelia pulvinaris var. *balatonica* Gyelnik, 1932a:211. [Type collection: Near Badacsontomaj, Mt. Kisorsi, Hungary, *Boros* s.n. (BP, lectotype).]

Parmelia pulvinaris f. *dentaticola* Gyelnik, 1932a:211. [Type collection: Salgir Valley, near Simpheropolin, Taurica Peninsula, *Mereschkovsky, Lichenes Rossiae Exsiccati* 55 (BP, lectotype).]

Parmelia viridulo-umbrina var. *umbrina* Gyelnik, 1932a:211. [Superfluous name for *P. conspersa* f. *viridulo-umbrina* Gyelnik.]

Parmelia hypopallida Gyelnik, 1932a:217. [Type collection: Komotau, Bohemia, Czechoslovakia, *Klement* s.n. (BP, lectotype).]

Parmelia viridulo-umbrina var. *somloensis* (Gyelnik) Gyelnik, 1932a:211.

Parmelia pseudohungarica var. *komotauensis* Gyelnik in Servit and Klement, 1933:31. [Type collection: Bodensteinhubels at Tschermich, Czechoslovakia, *Klement* s.n. and SO-Plateau of Kaadner Burberg, Czechoslovakia, *Klement* s.n. (not seen). Synonym of *Parmelia pseudohungarica* var. *komotauensis* Gyelnik, 1932a:217.]

Parmelia hypopallida Gyelnik in Servit and Klement, 1933:29. [Type collection: Weschitz, Czechoslovakia, *Klement* s.n.]

Parmelia molliuscula var. *taeniata* (Anders) Servit in Servit and Klement, 1933:29.

Parmelia ioannis-simae var. *hypopallida* (Gyelnik) Gyelnik, 1934a:306.

Parmelia laxa f. *balatonica* (Gyelnik) Gyelnik, 1934b:372. [Mentioned in a key without citing basionym.]

Parmelia imitans var. *imbricatoides* Gyelnik, 1934c:156. [Type collection: Río Frio, Mexico, *Amable* 720 (BP, lectotype).]

Parmelia polyphylloides f. *lacinulifera* (Gyelnik) Gyelnik, 1934c:162. [Nomen nudum with no description.]

Parmelia imitans var. *hypopallida* (Gyelnik) Gyelnik, 1934c:155. [Basionym given as "Parmelia hypopallida Gyelnik in sched.," a species validly published in 1932.]

Parmelia laxa f. *borealis* Gyelnik, 1934c:159. [Type collection: Klippingsberg, Torsö, Sweden, *Vrang* 203 (BP, lectotype).]

Parmelia laxa var. *rosettaeformis* Gyelnik, 1934c:158. [Type collection: Örkény, Comit. Pest, Hungary, *Timkó* 2165/2 (BP, lectotype).]

Parmelia polyphylloides var. *somloensis* (Gyelnik) Gyelnik, 1934c:162. [Basionym given as "Parmelia viridulo-umbrina var. somloensis Gyelnik in sched." but *P. somloensis* Gyelnik had already been published in 1931.]

Parmelia subpolyphylloides Gyelnik, 1934c:165. [Type collection: Insula Riiskeri [Riishiri, Hokkaido], Japan, *Faurie* 1373 (BP, lectotype).]

Parmelia imitans (Müller Argoviensis) Gyelnik, 1935:25.

Parmelia imitans f. *hypopallida* (Gyelnik) Gyelnik, 1935:25.

Parmelia polyphylloides f. *viridulo-umbrina* (Gyelnik) Gyelnik, 1935:28.

Parmelia conspersa f. *balatonica* (Gyelnik) Gyelnik, 1936:123.

Parmelia conspersa f. *borealis* (Gyelnik) Gyelnik, 1936:123.

Parmelia conspersa f. *dentaticola* (Gyelnik) Gyelnik, 1936:123.

Parmelia conspersa var. *rosettaeformis* (Gyelnik) Gyelnik, 1936:123.

Parmelia taractica var. *komotauensis* (Gyelnik) Gyelnik, 1936:128.

Parmelia conspersa var. *stenophylla* f. *taeniata* (Anders) Hillmann, 1936:174.

Parmelia conspersa var. *stenophylla* f. *imbricata* (Massalongo) Hillmann, 1936:175.

Parmelia imitans f. *arenicola* Gyelnik, 1938a:278. [Type collection: Canet Plage, Perpignan, France, *Moesz* s.n. (BP, lectotype).]

Parmelia imitans f. *verrucosa* Gyelnik, 1938a:280. [Type collection: Roquehaute, Hérault, France, *Augustin* 29 (BP, lectotype).]

Parmelia phaeophana f. *verrucosa* (Gyelnik) Gyelnik, 1938b:35.

Parmelia phaeophana f. *arenicola* (Gyelnik) Gyelnik, 1938b:35.

Parmelia phaeophana f. *imbricatoides* (Gyelnik) Gyelnik, 1938b:35.

Parmelia phaeophana f. *imitans* (Müller Argoviensis) Gyelnik, 1938b:35.

Parmelia stenophylla f. *corticola* Koskinen, 1955:80. [Type collection: Nomen nudum with no type designated; specimens identified by Koskinen in H include *X. somloensis* and *X. conspersa*.]

Parmelia stenophylla f. *imbricata* (Massalongo) Lettau, 1957:203.

Parmelia stenophylla f. *taeniata* (Anders) Lettau, 1957:203.

DESCRIPTION.—Thallus loosely adnate on rock, rather firm, 6–20 cm broad, light yellowish green; lobes sublinear, 1.2–4 mm wide, usually elongate and dichotomously branched, separate to divaricately imbricated; upper surface weakly to distinctly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines pale brown, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 3–15 mm in diameter; spores 4–5 × 8–9 µm.

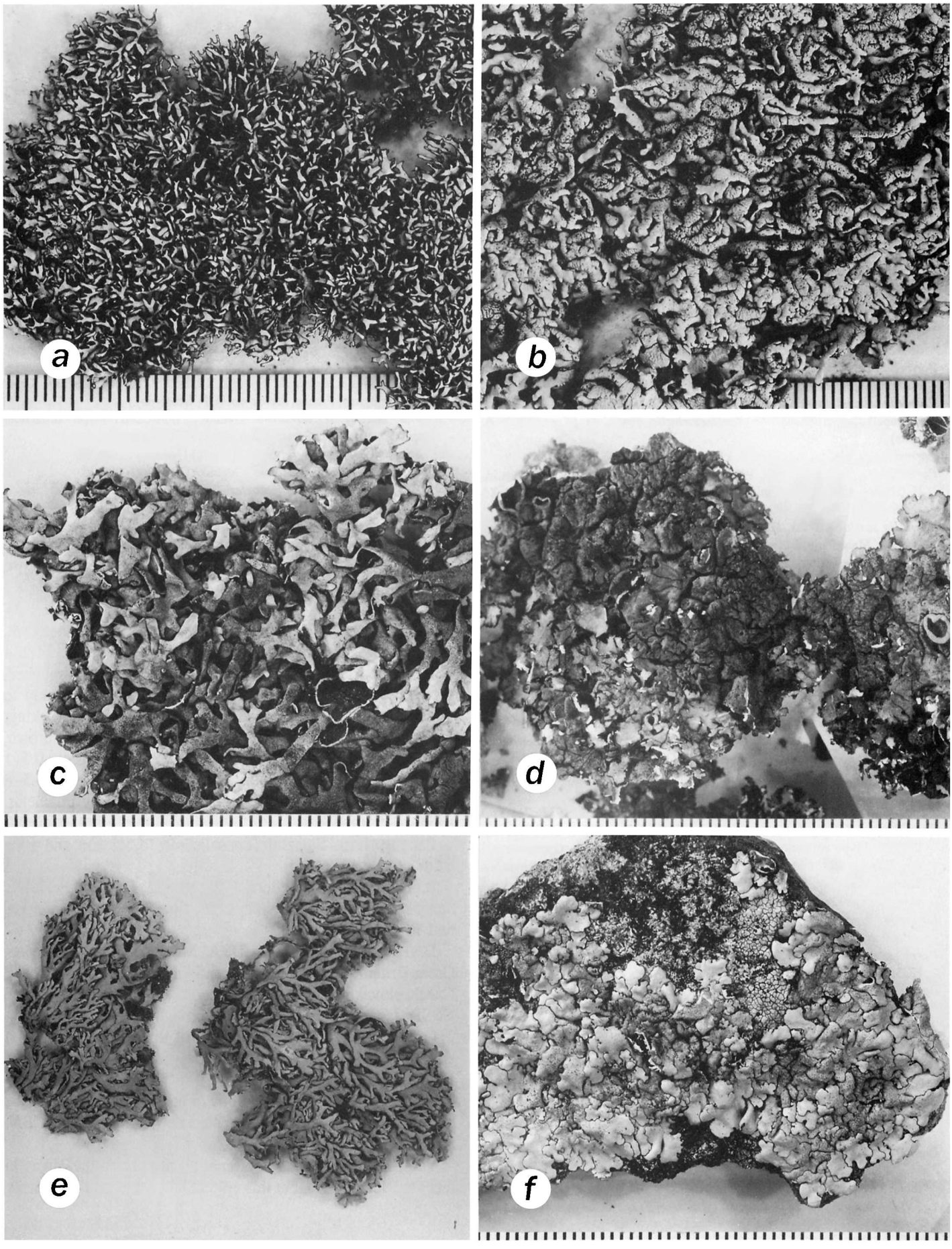
CHEMISTRY.—Salazinic, consalazinic, lobaric (±), and usnic acids.

ILLUSTRATIONS.—Anders, 1928, tab. 22, fig. 2 (as *Parmelia conspersa* f. *taeniata*); Jahns, 1980, fig. 412; Krog, Osthagen, and Tonsberg, 1980:213.

DISTRIBUTION.—Canada, USA, Mexico, Finland, Sweden, Great Britain, Germany, Austria, Switzerland, France, Spain, Czechoslovakia, Hungary, Roumania, Italy, Greece, Turkey, USSR, Japan, China, Mongolia, Korea, India, Pakistan.

COMMENTS.—The nomenclature of this widely distributed species has been confused for many years. I do not consider Heugel's reference (Heugel, 1855) to "Parmelia stenophylla" as validating the epithet *stenophylla* at the species rank, since he obviously did not intend to make a new combination (ICBN, Article 34.3 (Voss, 1983).

The first to make the combination at species level was in fact Du Rietz (1921), but this epithet had been used previously


a
b
c
d
e
f

for a species, *Parmelia stenophylla* Müller Argoviensis, now recognized in *Bulbothrix* (Hale, 1976b). A few authors (Szatala, 1929b; Magnusson and Zahlbruckner, 1944; Tavares, 1945; Lettau, 1957) continued to use Heugel as the combining author as late as 1957, but this does not constitute valid publication. While *stenophylla* would have been available in *Xanthoparmelia,* I in effect blocked this possibility in 1987 (Ahti et al., 1987) by recombining in *Xanthoparmelia* the next available epithet in *Parmelia, P. somloensis.*

Xanthoparmelia somloensis, a common species on more exposed boulders in Eurasia and eastern North America, is recognized by the loose adnation, generally elongate "stenophylloid" lobes (as noted by Heugel in 1855!), more or less distinct maculation on the upper surface, and pale brown lower surface. The only other salazinic acid-containing species with this combination of characters are terete-laciniate *X. durietzii* in China; terricolous, revolute-lobed *X. pseudohungarica*; and also in Europe *X. subdiffluens,* a terricolous flat-lobed species.

Krog (1978) first reported lobaric acid as an accessory substance; 80% of the Norwegian specimens tested had lobaric acid with lesser frequency on mainland Europe and very few in North America. Only one chemotype, *X. protomatrae* with fumarprotocetraric acid (Krog, 1978), is known.

Xanthoparmelia spargenosa

Xanthoparmelia spargenosa Elix and Johnston in Elix, Johnston, and Armstrong, 1986:322. [Type collection: Road to Crows Nest Falls, south of Kingaroy, Qsld., Australia, *Hale* 65004 (US, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock, firm, 4–10 cm broad, light yellowish green; lobes sublinear, 2–3 mm wide, contiguous to imbricate, sublaciniate and crowded at the center, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines, pale brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–7 µm. Apothecia common, substipitate, 2–6 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Exuviatic acid A (±), exuviatic acid B, and usnic acid.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 34.

DISTRIBUTION.—Australia (Qld, NSW, SA), New Zealand.

COMMENTS.—This species is very close to isidiate *X. exuviata,* which is more closely adnate. The structures of exuviatic acid A and B have not yet been determined.

FIGURE 65.—Species of *Xanthoparmelia: a, X. simulans* (*Hale* 74045, holotype in US); *b, X. skyrinifera* (*Hale* 74040, holotype in US); *c, X. somloensis* (*Kjellmert* s.n.); *d, X. springbokensis* (*Hale* 72249, holotype in US); *e, X. standaertii* (*Standaert* s.n., lectotype in BP); *f, X stuartensis* (*Elix* 21227, holotype in CBG). Scale in mm.

Xanthoparmelia spargens

Xanthoparmelia spargens (Brusse) Hale, 1988b:406.

Parmelia spargens Brusse, 1984:318. [Type collection: Seven Weeks Poort, Cape Province, South Africa, Grid 3321 AD, *Brusse* 3481, 8 May 1981 (PRE, holotype; LD, isotype).]

DESCRIPTION.—Thallus adnate on rock, 5–8 cm broad, yellowish green; lobes subirregular to sublinear, 1–2 mm wide, rather short, imbricate and rather crowded; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia subglobose to subcylindrical (Figure 19*g*), 0.08–0.15 mm in diameter, to 1 mm high, the tips epicorticate, pale, in part erumpent, coralloid branched with age; medulla white; lower surface plane, uniformly pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.5–1 mm long. Pycnidia rarely developed; conidia bifusiform, 0.5 × 5–7 µm. Apothecia rare, adnate, 2–3 mm in diameter; spores 5–6 × 8–11 µm.

CHEMISTRY.—Two undetermined fatty acids near protolichesterinic acid, usnic acid.

ILLUSTRATION.—Brusse, 1984, fig. 8.

DISTRIBUTION.—South Africa (Transvaal, Transkei, Natal, Cape Province, Ciskei), Swaziland.

COMMENTS.—This is one of the most common isidiate *Xanthoparmeliae* in the moist eastern foothills of the Drakensbergs. While *X. verrucigera* is externally similar, it contains stictic acid and has a black lower surface and nonerumpent, cylindrical isidia.

Xanthoparmelia springbokensis

FIGURE 65*d*

Xanthoparmelia springbokensis Hale, 1989a:559. [Type collection: Sloping granite domes in karoo, 1 km E of Springbok, N side of Hwy R64, elev. 1100 m, Cape Province, South Africa, Grid 2917 DB, *Hale* 72249, 27 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate on rock, rather brittle, 5–8 cm broad, dull olive green; lobes subirregular, 1.5–3 mm wide, short and irregularly branched, more or less suberect at the tips, imbricate; upper surface continuous to distinctly white-maculate, shiny, transversely cracked and strongly wrinkled-rugose with age; upper medulla white, rarely pale yellow, the lower part ochraceous in patches; lower surface plane, pale brown but often darkening at the tips, moderately rhizinate, the rhizines pale brown, 0.3–0.5 mm long, unbranched. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia well developed, substipitate, 2–5 mm in diameter; spores poorly developed, 5 × 9 µm.

CHEMISTRY.—Salazinic (major), consalazinic, norstictic (minor), protocetraric (trace), and usnic acids, chalybaeizans unknown and skyrin (det. J.A. Elix).

ILLUSTRATION.—Hale, 1989a, fig. 33.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Confined to upper Namaqualand, *X. springbokensis* differs from closely related *X. neosynestia* in more irregular, adnate lobes, distinctive olive green color, strong

rugosity, and presence of skyrin. Another Namaqualand species, *X. denudata*, is very close but has sublinear lobes and loosely adnate habit.

Xanthoparmelia standaertii

FIGURE 65*e*

Xanthoparmelia standaertii (Gyelnik) Hale, 1974b:489.

Parmelia standaertii Gyelnik, 1934c:164. [Type collection: Hacienda d'Angasmurca, Depto. Libertad, Peru, *Standaert* s.n. (BP, lectotype; TUR, isolectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia subconstrictans Vainio ex van der Byl, 1931:13. [Nomen nudum with no description given.]

Parmelia subconstrictans Vainio ex Lynge, 1937:88. [Nomen nudum with no locality given.]

DESCRIPTION.—Thallus loosely adnate to nearly free growing on soil, firm, pulvinate, 4–8 cm broad, dull yellowish green, darkening with age at the center; lobes sublinear, 0.8–1.5 mm wide, short, irregularly dichotomously branched, becoming weakly convoluted, contiguous to imbricate, sparsely laciniate with age; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines brown, simple, 0.3–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia rare, substipitate, 1–3 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Stictic, constictic, cryptostictic (trace), norstictic, connorstictic (±), and usnic acids.

DISTRIBUTION.—Venezuela, Ecuador, Peru.

COMMENTS.—Vainio apparently intended to publish this species as *P. subconstrictans* (in herb.), using the same duplicate specimen that Gyelnik had received from Bouly de Lesdain. It grows as small scattered pulvinate clumps on sandy soil in arid, high elevation localities in the Andes Mountains.

Xanthoparmelia stenosporonica

Xanthoparmelia stenosporonica Hale, 1986b:598. [Type collection: Summit of Swartberg Pass on Hwy R328, elev. 1585 m, Cape Province, South Africa, Grid 3322 AC, *Hale* 72117, 31 Jan 1986 (US, holotype; LD, PRE, isotypes).]

Parmelia stenosporonica (Hale) Brusse, 1988:539.

DESCRIPTION.—Thallus tightly adnate on rock, 1–2 cm broad, light yellowish green; lobes subirregular to sublinear, 0.2–0.7 mm wide, short, contiguous to imbricate, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, shiny, black, moderately rhizinate, the rhizines black, simple, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stenosporonic (major), colensoic, gyrophoric (±), divaronic (trace), norcolensoic (±), and usnic acids (det. J.A. Elix).

ILLUSTRATION.—Hale, 1986b, fig. 47.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This inconspicuous, black-rimmed species grows in exposed, high elevation habitats in southwestern Cape Province. The isidiate morph, *X. keralensis*, is known from Southern Africa and India. A related, chemosyndromic species, *X. colensoica*, contains colensoic acid as the major metabolite.

Xanthoparmelia streimannii

Xanthoparmelia streimannii (Elix and Armstrong) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:324.

Parmelia streimannii Elix and Armstrong, 1983:481. [Type collection: Teudts Hill, 5 km SW of Bundanoon, N.S.W., Australia, *Elix* 8977 (MEL, holotype).]

DESCRIPTION.—Thallus adnate on rock, 4–7 cm broad, dull yellowish green; lobes subirregular, 0.7–1.5 mm wide, contiguous to imbricate, black rimmed; upper surface continuous, emaculate, shiny, densely isidiate, the isidia cylindrical (Figure 19*h*), 0.07–0.10 mm in diameter, 0.1–0.5 mm high, the tips syncorticate, darkening, becoming densely branched and coralloid; medulla white; lower surface plane, shiny, pale brown but darker near the tips, moderately rhizinate, the rhizines brown, simple, 0.2–0.5 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–7 µm. Apothecia substipitate, 1–3 mm in diameter; spores 5 × 8 µm.

CHEMISTRY.—Norstictic, connorstictic, salazinic (±trace), and usnic acids.

ILLUSTRATION.—Elix and Armstrong, 1983, fig. 11.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Tas, SA), New Zealand.

COMMENTS.—Externally similar *X. antleriformis* from Australia has salazinic acid as the main component. Another Australian species, *X. segregata*, has both norstictic and salazinic acids in significant concentration.

Xanthoparmelia stuartensis

FIGURE 65*f*

Xanthoparmelia stuartensis Elix and Johnston, 1987:367. [Type collection: Mount Stuart, 10 km SSW of Townsville, Queensland, Australia, *Elix* 21227, 3 Jul 1986 (CBG, holotype).]

DESCRIPTION.—Thallus adnate on rock, 4–8 cm broad, firm, light yellowish green; lobes subirregular, 1–2 mm wide, short and irregularly branched, contiguous to imbricate, often black-rimmed; upper surface continuous, emaculate, shiny, transversely cracked with age, moderately isidiate, the isidia globose to short cylindrical, 0.05–0.08 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, dull, pale or brownish, sparsely branched; medulla white; lower surface plane, brown to dark brown, blackish toward the tips, moderately rhizinate, the rhizines brown to dark brown, simple, 0.2–0.4 mm long. Pycnidia lacking. Apothecia rare, substipitate, 1–4 mm in diameter; spores 4–6 × 8–10 µm.

CHEMISTRY.—Protocetraric (major), virensic (minor), and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1987, fig. 8.

DISTRIBUTION.—Australia (Qld).

COMMENTS.—*X. stuartensis* is known from a single collection in Queensland. It can be compared with another protocetraric acid-containing isidiate species, *X. fucina* from southern Africa, which has taller, distinctly cylindrical isidia.

Xanthoparmelia subamplexuloides

FIGURE 66*a*

Xanthoparmelia subamplexuloides Hale, 1989a:559. [Type collection: on sheltered schistose sandstone, 51 km S of Windhoek on west side of Hwy 1/5 (opposite entrance to Bergland), elev. 1700 m, South West Africa/ Namibia, Grid 2217 CC, *Hale* 81144, 26 Apr 1988 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus very tightly adnate to tightly adnate on rock, fragile, 4–7 cm broad, yellowish green; lobes subirregular, 0.4–1.3 mm wide, short and irregularly branched; upper surface continuous, emaculate, shiny, subrugose and transversely cracked with age, sparsely to moderately isidiate, the isidia mostly basally constricted and globose to subcylindrical, easily breaking off but not erumpent, 0.06–0.08 mm in diameter, to 0.5 mm high, the tips pale, weakly epicorticate, unbranched; medulla white; lower surface pale brown, sparsely rhizinate, the rhizines pale brown, simple, 0.1–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norlobaridone, unknowns, and usnic acid.

ILLUSTRATION.—Hale, 1989a, fig. 34.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—Near adnate South African *X. amplexuloides*, this Namibian species has smaller lobes and narrower isidia. *Xanthoparmelia subamplexuloides* grows widely in semi-arid uplands dominated by grassland and low shrubby Acacias; *X. amplexuloides* occurs in the moist Drakensberg escarpment.

Xanthoparmelia subbullata

FIGURE 66*b*

Xanthoparmelia subbullata Hale, 1989a:559. [Type collection: On doleritic outcrops along road, 8.5 km W of junction Hwy R396 and Hwy R393 near Moshesh's Ford, elev. 1900 m, Cape Province, South Africa, Grid 3027 DD, *Hale* 77072, 10 Oct 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate on rock, 5–7 cm broad, light yellowish green; lobes sublinear, 1–2 mm wide, rather short and irregularly branched, contiguous to crowded at the center; upper surface continuous, emaculate, shiny, rugose and densely bullate-isidiate with age, the isidia fragile, 0.2–0.3 mm in diameter, sometimes breaking open but not sorediate; medulla white; lower surface plane, brown, moderately rhizinate, the rhizines brown, simple, 0.5–1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 5–6 µm. Apothecia adnate, 1–2 mm in diameter; spores not developed.

CHEMISTRY.—Salazinic, consalazinic, connorstictic, and usnic acids, chalybaeizans unknown.

ILLUSTRATION.—Hale, 1989a, fig. 35.

DISTRIBUTION.—South Africa (Cape Province), Lesotho.

COMMENTS.—This species is obviously related to the widespread *X. chalybaeizans* but is differentiated by the abundant production of coarse bullate isidia. It is known from three collections in the Drakensberg escarpment.

Xanthoparmelia subcolorata

FIGURE 66*c*

Xanthoparmelia subcolorata Hale, 1986b:598. [Type collection: 19.9 km NW of Kango Caves on Swartberg Pass Road, elev. ca. 1100 m, Cape Province, South Africa, Grid 3322 AC, *Hale* 73014, 31 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely attached on rock, forming discrete, nearly umbilicate colonies, usually breaking apart when collected, 6–20 cm broad, dark yellowish green; lobes sublinear, 1.5–3 mm wide, crowded and imbricate, subascending; upper surface moderately to strongly white-maculate, shiny, deeply transversely cracked, isidia and soredia lacking; upper medulla white, lower medulla ochre; lower surface plane, pale or darker brown with ochre spots, blackening toward the tips, strongly rugose and in part eroding with age toward the center, rhizines lacking or very sparse, brown, coarse, to 1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 5–10 mm in diameter; spores 5–6 × 10–12 µm.

CHEMISTRY.—Protocetraric and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1986b, fig. 48.

DISTRIBUTION.—South Africa (Cape Province).

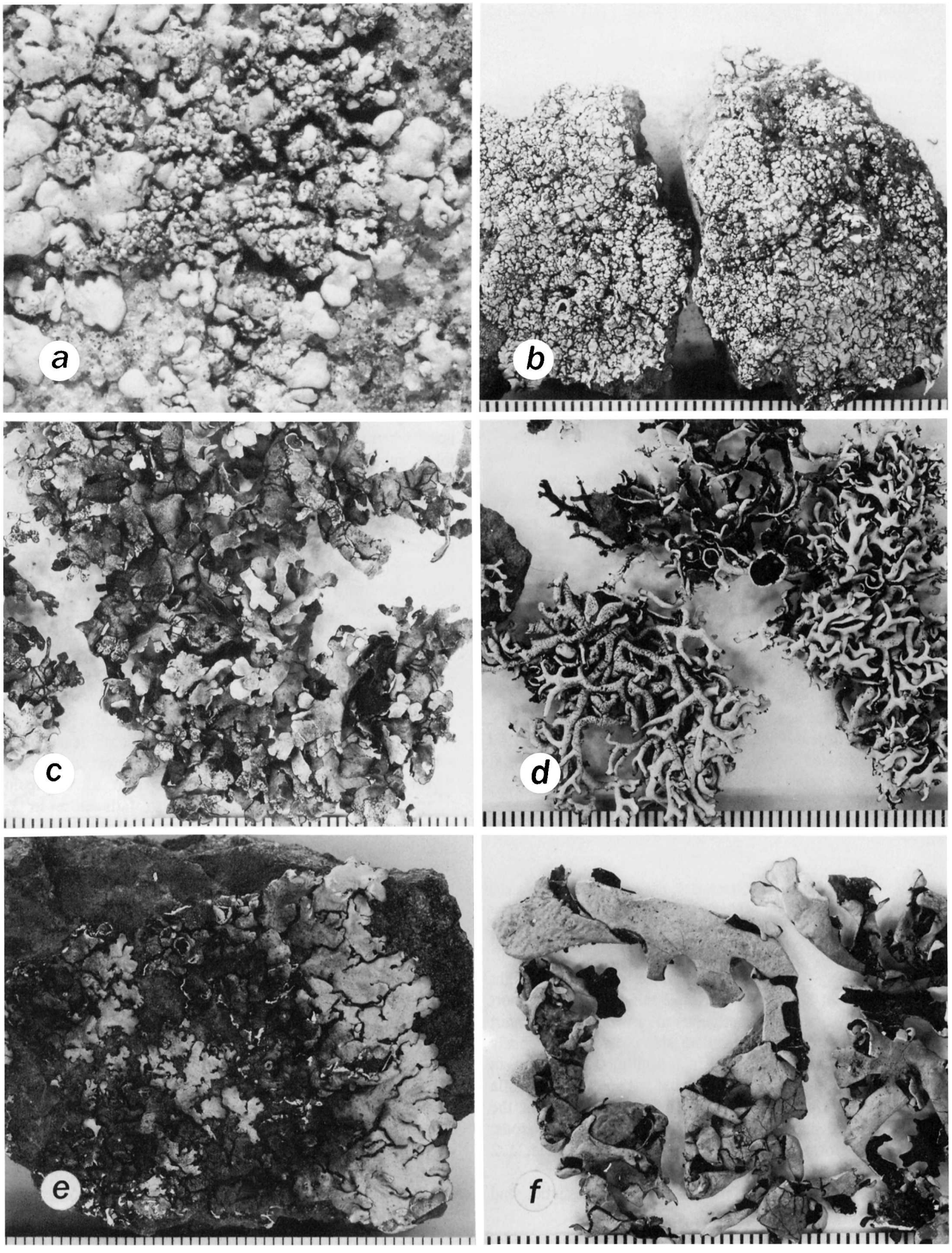
COMMENTS.—This loosely adnate, almost umbilicate lichen resembles *X. denudata*, which has a similar lower surface and skyrin but differs in having salazinic acid as the main component and narrower lobes. It also falls close to *X. austroafricana*, which has a more typically foliose thallus and lacks both skyrin and distinct maculae. It is most common in Namaqualand.

Xanthoparmelia subconvoluta

FIGURE 66*d*

Xanthoparmelia subconvoluta Hale, 1989a:561. [Type collection: Flat dolerite ridge in pasture, 6.8 km S of Sutherland on Hwy R354, elev. 1500 m, Cape Province, South Africa, Grid 3220 BC, *Hale* 74455, 29 Jan 1986 (US, holotype; ANUC, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate on pebbles, rarely in part free growing on adjacent soil, rather leathery, 6–8 cm broad, light yellowish green; lobes sublinear, 0.7–2 mm wide, elongate and little branched, weakly to moderately convoluted, separate to imbricate; upper surface continuous, emaculate, shiny, rugulose with age, soredia and isidia lacking; medulla white; lower surface plane, brown, moderately to densely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rhizinate, the rhizines comparatively long and protruding from below, dark brown, unbranched, 0.5–1 mm long. Pycnidia common; conidia weakly bifusiform, 0.5 × 5–6 µm. Apothecia well developed, substipitate, 1–2 mm in diameter with inrolled rim; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic (major), consalazinic, norstictic (trace), and usnic acid.

ILLUSTRATION.—Hale, 1989a, fig. 36.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Somewhat related to the vagrant *X. chlorochroa* group in overall habitus, *X. subconvoluta* is loosely attached to pebbles and is not so strongly convoluted as to hide the dense, protruding mass of rhizines. It is also close to canaliculate *X. amphixanthoides*, which has terete laciniae and occurs with it in Namaqualand and the Little Karoo.

Xanthoparmelia subcrustacea

Xanthoparmelia subcrustacea (Gyelnik) Hale, 1984:79.

Parmelia subcrustacea Gyelnik, 1935:30. [Based on *Parmelia conspersa* var. *stenophylloides* Müller Argoviensis.]

Parmelia conspersa var. *stenophylloides* Müller Argoviensis, 1892a:193. [Type collection: Everard Ranges, S.A., Australia, *Helms* 95 (G, lectotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 2–4 cm broad, dark yellowish green; lobes subirregular, 1–2 mm wide, contiguous to imbricate, crowded at the center; upper surface continuous, emaculate, shiny, rugulose, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 1–2 mm in diameter; spores 4 × 9 µm.

CHEMISTRY.—Hypostictic, hyposalazinic, hypoconstictic (±), constipatic (±), and usnic acids.

ILLUSTRATION.—Elix, 1981, fig. 16.

DISTRIBUTION.—Australia (NSW, ACT, Vic, SA, WA).

COMMENTS.—Müller Argoviensis listed three collections for his variety, of which Gyelnik (1935) chose *Helms* 95 as the lectotype. The other two represent *X. laxencrustans* (Everard Ranges, *Helms* 86) and *X. elixii* (Depot no. 1, *Helms* s.n.) (Elix, Johnston, and Armstrong, 1986).

Xanthoparmelia subdecipiens

FIGURE 66*e*

Xanthoparmelia subdecipiens (Vainio) Hale, 1974b:489.

Parmelia subdecipiens Vainio ex Lynge, 1937:89. [Type collection: Klapmuts, Cape Prov. South Africa, *v.d. Byl* [125] (TUR, lectotype).]

Parmelia brunnthaleri f. *irregularis* Gyelnik, 1938a:270. [Type collection: Rooidan, Calvinia Distr., South Africa, *v.d. Byl* s.n. (W, lectotype; BP, isolectotype).]

Parmelia irregularis (Gyelnik) Kurokawa in Kurokawa and Filson, 1975:41.

DESCRIPTION.—Thallus adnate to loosely adnate on rock, 5–12 cm broad, dull yellowish green; lobes subirregular to sublinear, 1.5–2.5 mm wide, contiguous to imbricate, at times laciniate, the laciniae plane, sublinear, 0.3–0.6 mm wide; upper surface continuous, emaculate, shiny, rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 3–15 mm in diameter; spores 6–7 × 10–12 µm.

CHEMISTRY.—Fatty "subdecipiens" unknowns 33 and 37 (major), protoconstipatic (±trace), dehydroconstipatic (±trace), constipatic (trace), and usnic acids, atranorin (±).

DISTRIBUTION.—North America, South Africa (Cape Province, Natal, OFS), Lesotho.

COMMENTS.—This is the most frequently collected fatty acid-containing species in southern Africa, occurring mostly in the eastern part of the continent and in the western states of USA. There is a considerable range of variation in adnation and lobe configuration.

Xanthoparmelia subdiffluens

FIGURE 66*f*

Xanthoparmelia subdiffluens Hale, 1987b:330.

Parmelia laxa var. *subdiffluens* (Zahlbruckner) Gyelnik, 1934c:158.

Parmelia conspersa var. *subdiffluens* Zahlbruckner, 1925, no. 619. [Type collection: Near Tatárszentgyörgy, Pest, Hungary, *Boros* s.n., *Flora Hungarica Exsiccata* 619 (W, lectotype; FH, H, UPS, US, isolectotypes). Nomen nudum without description.]

Parmelia conspersa f. *vaga* Mereschkowsky, 1918:28. [Type collection: Osinovaja, Charkov, Distr. Starobelsk, USSR, *Palebin* s.n. (G, lectotype).]

Parmelia subdiffluens (Zahlbruckner) Timkó in *Flora Hungarica Exsiccata*, 1925, no. 619. [Invalid combination based on a nomen nudum.]

Parmelia laxa f. *parvula* Gyelnik, 1934c:158. [Type collection: Agasegyházi, Izsák, Comit. Pest., Hungary, *Timkó* 4427 (BP, lectotype).]

Parmelia conspersa f. *parvula* (Gyelnik) Gyelnik, 1936:124.

Parmelia conspersa var. *heraultensis* Gyelnik, 1938a:272. [Type collection: Garrigues séches á Colombier, Hérault, France, *Augustin* s.n., 1899 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia taractica var. *subdiffluens* (Zahlbruckner) Poelt and Vězda, 1981:222. [Illegitimate combination. Basionym not cited.]

DESCRIPTION.—Thallus loosely adnate to free growing on soil, 3–7 cm broad but breaking apart into separate lobes, darkish yellow green; lobes sublinear, 2.5–7 mm wide, strap-shaped and little branched, weakly or less commonly strongly convoluted, separate; upper surface finely white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, brown to dark brown, moderately rhizinate, the rhizines brown, simple, 0.5–1 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

ILLUSTRATIONS.—Mereschkowsky, 1918, fig. 1 (as *Parmelia conspersa* f. *vaga)*; Hale (1987b), fig. 19.

FIGURE 66.—Species of *Xanthoparmelia*: *a*, *X. subamplexuloides* (*Hale* 81144, holotype in US (×10)); *b*, *X. subbullata* (*Hale* 77072, holotype in US); *c*, *X. subcolorata* (*Hale* 73014, holotype in US); *d*, *X. subconvoluta* (*Hale* 74455, holotype in US); *e*, *X. subdecipiens* (*Höeg* s.n.); *f*, *X. subdiffluens* (*Boros* 619, isotype in US). Scale in mm.

DISTRIBUTION.—Hungary, France, Spain, USSR.

COMMENTS.—This terricolous, vagrant lichen is especially common on arenaceous soils south of Budapest. It differs from *X. pseudohungarica* in the flattened lobes and fragmented thallus. A form with strongly convoluted lobes (var. *heraultensis*) occurs rarely in France and Spain. Less strongly convoluted f. *vaga* occurs in the Ukraine (Mereschkowsky, 1918).

Xanthoparmelia subdistorta

FIGURE 67*a*

Xanthoparmelia subdistorta (Kurokawa) Hale, 1974b:489.

Parmelia subdistorta Kurokawa, 1969:212. [Type collection: 6 mi W of Red Cliffs along Werrimull Road, Vict., Australia, *Kurokawa* 6617 (TNS, holotype; B, DUKE, M, US, isotypes).]

DESCRIPTION.—Thallus loosely adnate, less commonly free growing on soil, firm, 4–10 cm broad, yellowish green; lobes sublinear, 0.8–1.2 mm wide, rather strongly convoluted, dichotomously branched, separate to subimbricate, revolute near the tips, secondary subterete lobes sometimes developing toward the center; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane to canaliculate, usually with a conspicuous yellow rim, pale brown or darkening at the tips, sparsely to moderately rhizinate, the rhizines pale brown, simple, 0.2–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 µm. Apothecia substipitate, 2–5 mm in diameter; spores 6–7 × 9–10 µm.

CHEMISTRY.—Norlobaridone, loxodin, and usnic acid.

ILLUSTRATION.—Kurokawa, 1969, pl. 1: fig. 3.

DISTRIBUTION.—Australia (Vic, SA, WA).

COMMENTS.—This species occurs rather rarely in arid mallee scrub and shrublands. Another norlobaridone-containing soil species, *X. eilifii*, has broader, laciniate lobes that are not at all terete.

Xanthoparmelia subdomokosii

FIGURE 67*b*

Xanthoparmelia subdomokosii (Hale) Hale, 1974b:489.

Parmelia subdomokosii Hale, 1971a:353. [Type collection: 7 mi W of Heidelberg, Distr. Swellendam. Cape Prov., South Africa, *Hoeg* s.n. (TRH, holotype; LD, US, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm, 3–12 cm broad but sometimes coalescing into colonies 20–30 cm across, light yellowish green; lobes subirregular, 2–4 mm wide, more or less apically rotund, contiguous to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla in part ochre; lower surface plane, pale brown to brown with an orange tinge in places, moderately rhizinate, the rhizines pale brown simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–8 mm in diameter; spores 4–5 × 8–9 µm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1971a, fig. 3D.

DISTRIBUTION.—Lesotho, South Africa (Transvaal, Natal, OFS, Cape Province).

COMMENTS.—This conspicuous lichen, one of the most widespread and easily recognized in southern Africa, usually has a brilliantly pigmented lower surface. The specimens from Australia (Elix, Johnston, and Armstrong, 1986) lack skyrin and represent the related species *X. prodomokosii*.

Xanthoparmelia suberadicata

Xanthoparmelia suberadicata (des Abbayes) Hale, 1974b:489.

Parmelia suberadicata des Abbayes, 1961:89. [Type collection: Route d'Ivato Ambatofinandrahana, km 12, Centre Moyen, Madagascar, *des Abbayes* s.n. (REN, holotype; H, US, isotypes).]

DESCRIPTION.—Thallus loosely adnate on rock, pulvinate, 4–6 cm broad, light yellowish green; lobes linear, 0.5–1 mm wide, elongate and dichotomously branched, separate to subimbricate, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, rugose, rhizines lacking or very sparse, coarse, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–5 mm in diameter; spores absent.

CHEMISTRY.—Stictic, constictic, cryptostictic (trace), norstictic (±trace), and usnic acids.

ILLUSTRATION.—Des Abbayes, 1961, fig. 1.

DISTRIBUTION.—Australia (Vic), New Zealand, Madagascar.

COMMENTS.—This rare species belongs to a complex group of stictic acid-containing, nonisidiate lichens with a black lower surface. This group includes *X. austrocapensis*, *X. planilobata*, and *X. simulans*. The distinguishing features of *X. suberadicata* are the elongate lobes and a rugose, largely rhizine-free lower surface.

Xanthoparmelia subflabellata

Xanthoparmelia subflabellata (Steiner) Hale, 1974b:489.

Parmelia subflabellata Steiner, 1907:639. [Type collection: Stellenbosch, South Africa, *Duthie* 7 (W, lectotype; G, isolectotype).]

Parmelia tananarivensis Gyelnik, 1934c:165. [Type collection: Tananarive, Madagascar, *Decary* s.n. (PC, lectotype; BP, isolectotype).]

Parmelia laxa f. *subtananarivensis* Gyelnik, 1934c:160. [Type collection: Tananarive, Madagascar, *Decary* s. n. (PC, lectotype; BP, isolectotype).]

Parmelia vagans f. *subflabellata* (Steiner) Gyelnik, 1935:50.

Parmelia conspersa f. *subtananarivensis* (Gyelnik) Gyelnik, 1936:124.

Parmelia desertorum f. *subflabellata* (Steiner) Gyelnik, 1938b:6.

Xanthoparmelia tananarivensis (Gyelnik) Hale, 1974b:489.

DESCRIPTION.—Thallus loosely adnate to free growing on soil, forming rosettes 2–4 cm broad, easily breaking apart, light yellowish green; lobes sublinear, 0.8–1.6 mm wide, dichotomously branched, separate to contiguous; upper surface

continuous to very weakly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane to weakly canaliculate with an indistinct or pale rim, uniformly dark brown at the center, sparsely rhizinate, the rhizines brown, simple to furcate, 0.5–1 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 6–7 µm. Apothecia common, substipitate, 2–4 mm in diameter; spores 5–6 × 7–8 µm.

CHEMISTRY.—Stictic (major), constictic, cryptostictic, norstictic, and usnic acids.

DISTRIBUTION.—South Africa (Cape Province), Madagascar.

COMMENTS.—This soil lichen is known from only a few localities in Cape Province and in Madagascar. It is now extinct at the type locality near Stellenbosch. It is closely related to the Australian *X. amphixantha*, which has a more clearly white-maculate upper surface, a pale brown lower surface and more distinct rim below.

Xanthoparmelia sublaevis

FIGURE 67*c*

Xanthoparmelia sublaevis (Coutinho) Hale, 1988b:406.

Parmelia sublaevis Coutinho, 1916:71. [Type collection: Ad rupes syeniticas in Algarbiorum, Serra de Foia, Portugal, *Mendes* s.n., Sep 1915 (LISU, lectotype).]

Parmelia conspersa var. *hypoclysta* Nylander, 1860:391. [Type collection: France, [*Planchon* s.n.] (H-Nyl. herb. no. 34757, lectotype; G, isolectotype).]

Imbricaria conspersa var. *hypoclysta* (Nylander) Jatta, 1902:470.

Parmelia conspersa f. *hypoclysta* (Nylander) Mereschkowsky, 1920a:488.

Parmelia molliuscula var. *hypoclysta* (Nylander) Suza, 1930:26. [Invalid combination without citation of basionym.]

Parmelia conspersa var. *stenophylla* f. *hypoclysta* (Nylander) Hillmann, 1936:174.

Parmelia stenophylla f. *hypoclysta* (Nylander) Magnusson in Magnusson and Zahlbruckner, 1944:86.

Parmelia hypoclysta (Nylander) Klement, 1950:50.

Parmelia taractica f. *hypoclysta* (Nylander) Poelt and Vězda, 1981:222. [Illegitimate combination. No basionym cited.]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather firm, 5–8 cm broad, yellowish green; lobes subirregular to sublinear, 1.5–3 mm wide, the tips subrotund to obtuse, rather short and irregularly branched, imbricate, coarsely laciniate with age; upper surface continuous to very faintly white-maculate in patches, shiny, somewhat rugulose with age, soredia and isidia lacking; medulla white; lower surface plane, light brown, sparsely to moderately rhizinate, the rhizines brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia well developed, substipitate, 2–5 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

DISTRIBUTION.—France, Spain, Portugal.

COMMENTS.—This poorly known species was briefly mentioned by Tavares (1945) in a study of the lichen flora of Portugal, but he did not attempt to establish its identity. The ample type material is adnate on rock fragments and compares well with Nylander's identifications of *Parmelia conspersa* var. *hypoclysta*. It is closely related to *X. somloensis*, which has more strongly sublinear lobes and distinct white maculae, but it seems to be restricted to the Iberian Peninsula and Sardinia.

Xanthoparmelia subluminosa

Xanthoparmelia subluminosa Hale, 1989a:561. [Type collection: Coppins Crossing, elev. 600 m, Canberra, A.C.T., Australia. *Hale* 58524, 8 Jan 1982 (US, holotype; CBG, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, firm but easily breaking apart, 5–8 cm broad, light yellowish green; lobes subirregular, 1.5–3 mm wide, irregularly branched, dark brown rimmed, imbricate; upper surface continuous, emaculate, shiny, densely isidiate, the isidia cylindrical (Figure 19*i*), 0.10–0.15 mm in diameter, to 1 mm high, coarse, the tips syncorticate, black, simple to coralloid branched; upper medulla white, lower medulla in part dull reddish orange; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, coarse, unbranched, 0.4–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Salazinic (major), consalazinic (minor), norstictic (trace), and usnic acids, skyrin and a second unidentified anthraquinone (det. J.A. Elix).

ILLUSTRATION.—Hale, 1989a, fig. 37.

DISTRIBUTION.—Australia (ACT).

COMMENTS.—This is probably an isidiate morph of *X. luminosa*, another skyrin-containing lichen in Australia and South Africa. It is known only from the type collection near Canberra.

Xanthoparmelia submougeotii

FIGURE 67*d*

Xanthoparmelia submougeotii Hale, 1989a:561. [Type collection: Cordon Barril, Masafuera, Juan Fernandez, *C. and I. Skottsberg* 90, 1 Mar 1917 (NY, holotype; US, isotype).]

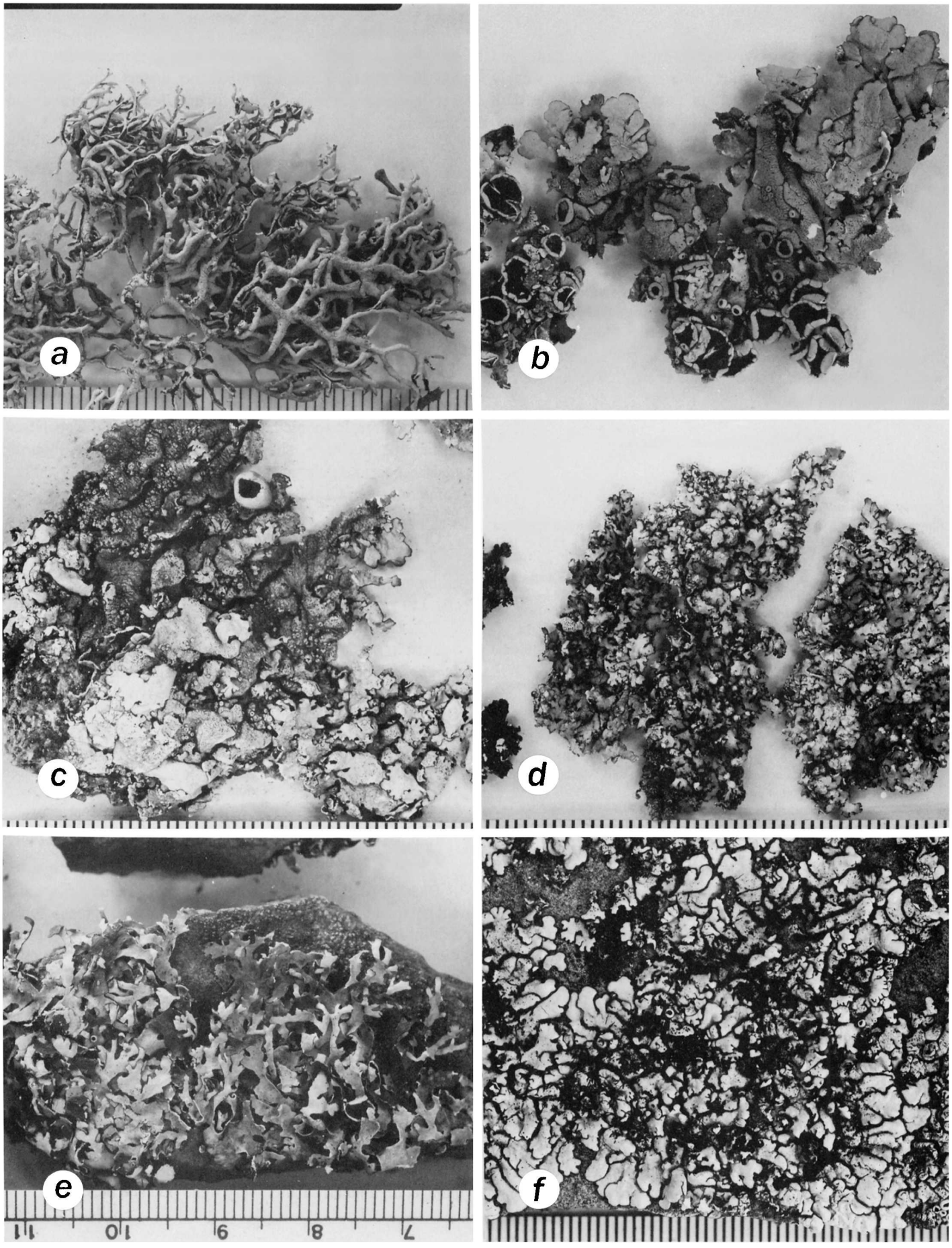
DESCRIPTION.—Thallus adnate on rock, rather brittle and subpulvinate, 3–4 cm broad, dull yellowish green; lobes sublinear, 0.6–1.2 mm wide, rather short and irregularly dichotomously branched, brown rimmed, imbricate; upper surface continuous, emaculate, shiny, sorediate, the soralia subterminal, capitate, 0.5–1 mm in diameter; medulla white; lower surface plane, dark brown at the tips but black at the center, shiny, rugulose, moderately rhizinate, the rhizines black, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 36.

DISTRIBUTION.—Chile (Juan Fernandez).

COMMENTS.—This rare sorediate species is related to *X. mougeotii*, a much smaller, very tightly adnate lichen.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Xanthoparmelia subnigra

Xanthoparmelia subnigra Hale, 1986b:600. [Type collection: Summit of Long Tom Pass on S side of Hwy R37, Farm De Kuiten 205, elev. 2140 m, Lydenburg, Transvaal, South Africa, Grid 2430 BA, *Hale* 72026, 16 Jan 1986 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus adnate to tightly adnate on rocks, 4–6 cm broad, light yellowish green; lobes subirregular to sublinear, 1–2.5 mm wide, contiguous to imbricate, black-rimmed; upper surface continuous, emaculate, shiny, minutely rugulose, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 µm. Apothecia numerous, adnate, 1–2 mm in diameter; spores 6–7 × 8–10 µm.

CHEMISTRY.—Fatty "subdecipiens" unknowns 33 and 37 (major), constipatic (minor), pertusaric (trace), and usnic acid.

ILLUSTRATION.—Hale, 1986b, fig. 50.

DISTRIBUTION.—South Africa (Transvaal).

COMMENTS.—No other nonisidiate constipatic acid series-containing species of *Xanthoparmelia* have a black lower surface, excepting *X. aliphatica*, which is a much larger, loosely adnate lichen, and Australian *X. nigraoleosa*, which contains constipatic acid. This one is rather rarely collected in the moist Drakensberg escarpment of Transvaal.

Xanthoparmelia subnuda

FIGURE 67*e*

Xanthoparmelia subnuda (Kurokawa) Hale, 1974b:489.

Parmelia subnuda Kurokawa in Kurokawa and Elix, 1971:114. [Type collection: Ardglen Gap, Liverpool Range, 5 mi N of Murrurundi, N.S.W., Australia, *Kurokawa* 5178 (TNS, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock, firm, often forming pulvinate colonies, 4–10 cm broad, yellowish green; lobes sublinear to linear, 1–2 mm wide, more or less dichotomously branched, elongate and subascending, contiguous to imbricate, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, becoming rugulose with age, sparsely to moderately rhizinate, the rhizines black, simple, 0.2–0.5 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 3–10 mm in diameter; spores 5 × 8–9 µm.

CHEMISTRY.—Norstictic (major), salazinic (±), connorstictic, and usnic acids. (Barbatic and rhizonic acids given in type description are incorrect and salazinic acid was omitted.)

ILLUSTRATION.—Kurokawa and Elix, 1971, fig. 2.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—This is a common lichen on rocks in drier mountain and subarid areas. *Xanthoparmelia rubrireagens*, an externally similar Australian species, has a rugose, sparsely rhizinate lower surface and salazinic acid as the main component.

Xanthoparmelia subochracea

FIGURE 67*f*

Xanthoparmelia subochracea Hale, 1986b:602. [Type collection: 78.6 km S of Sutherland on Hwy R354, elev. ca. 900 m, Cape Province, South Africa, Grid 3220 DC, *Hale* 73017, 29 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–6 cm broad, bright yellowish green; lobes subirregular to sublinear, 1.5–2.5 mm wide, apically rotund, black rimmed, contiguous; upper surface continuous, emaculate, shiny, convex, bullate toward the center, isidia and soredia lacking; upper medulla white, lower medulla ochre in part; lower surface plane, brown to dark brown, sparsely to moderately rhizinate, the rhizines brown, coarse, simple, ~0.5 mm long. Pycnidia common; conidia bifusiform, 5–6 µm. Apothecia poorly developed, adnate, 1–2.5 mm in diameter; spores 5–6 × 9 µm.

CHEMISTRY.—Protocetraric and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1986b, fig. 51.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This adnate lichen is related to *X. tumidosa*, which lacks skyrin. Both occur in Namaqualand and the Little Karoo region.

Xanthoparmelia subpallida

Xanthoparmelia subpallida Hale, 1987a:264. [Type collection: Robinson Pass (N of Mosselbaai), Cape Province, South Africa, Grid 3322 CD, *Hale* 77588 (US, holotype; PRE, isotype).]

DESCRIPTION.—Thallus very tightly adnate to tightly adnate on rock, 3–8 cm broad, dull yellowish green; lobes sublinear, 0.3–0.8 mm wide, little branched, separate to imbricate and crowded; upper surface continuous, emaculate, sparsely to moderately isidiate, the isidia cylindrical to irregularly inflated, 0.08–0.15 mm in diameter, to 0.3 mm high, the tips syncorticate, pale; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines pale, simple, delicate and nearly translucent, 75–90 µm in diameter, ~0.1 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1987, fig. 21.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Other stictic acid-containing species with a pale lower surface include *X. plittii* and *X. neopropagulifera*.

FIGURE 67.—Species of *Xanthoparmelia*: *a*, *X. subdistorta* (*Rogers* 1647); *b*, *subdomokosii* (*Höeg* s.n., holotype in LD); *c*, *X. sublaevis* (*Mendes* s.n., lectotype in LISU); *d*, *X. submougeotii* (*Skottsberg* 90, holotype in NY); *e*, *X. subnuda* (*Hale* 58491); *f*, *X. subochracea* (*Hale* 73017, holotype in US). Scale in mm.

Both of these species have broader lobes and more robust rhizines and are nowhere nearly as tightly adnate. Another species found in the moist Fynbos vegetation zone, *X. greytonensis*, has very similar delicate rhizines and tight adnation, very reminiscent of subcrustose *Karoowia*, but is easily distinguished by the black lower surface and lack of rhizines.

Xanthoparmelia subpigmentosa

FIGURE 68*a*

Xanthoparmelia subpigmentosa Hale, 1984:78. [Type collection: Blue Mountain Pass, Div. Maseru, Lesotho, *Kofler* 3669 (LD, holotype; US, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, firm and leathery, 8–12 cm broad, yellowish green; lobes sublinear, 2–5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; upper medulla white, lower medulla ochre in part; lower surface plane, pale brown to brown with an orange tinge in places, moderately to densely rhizinate, the rhizines pale brown, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 3–10 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1984, fig. 9.

DISTRIBUTION.—Lesotho, South Africa (Cape Province), Australia (NSW).

COMMENTS.—This large, conspicuous lichen resembles a robust *X. taractica* but the lower surface is pigmented. It is common at higher elevations on dolerite in Lesotho but also occurs on Cave sandstones at 2000 m in eastern Cape Province. It has been collected once in Australia at higher elevation.

Xanthoparmelia subplittii

FIGURE 68*b*

Xanthoparmelia subplittii Hale, 1987b:330. [Type collection: Arros Tobaty, Depto. Cordillera, Paraguay, *Schinini* 16262, Apr 1978 (US, holotype; CTES, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, rather fragile, 2–7 cm broad, light yellowish green; lobes subirregular to sublinear, 0.8–1.5 mm wide, dichotomously branched, sparsely lobulate-laciniate at the tips of older lobes, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia globose to subcylindrical (Figure 20*a*), 0.08–0.15 mm in diameter, 0.1–0.5 mm high, basally constricted, the tips epicorticate, pale or blackening, easily abrading, erumpent apically but not sorediate, mostly unbranched; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 20.

DISTRIBUTION.—Colombia, Venezuela, Brazil, Paraguay.

COMMENTS.—This widespread but rarely collected lowland tropical species is close to *X. plittii* except for the globose, erumpent isidia.

Xanthoparmelia subramigera

FIGURE 68*c*

Xanthoparmelia subramigera (Gyelnik) Hale, 1974b:489.

Parmelia subramigera Gyelnik, 1931b:281. [Type collection: Rainbow Fall, Hawaii, USA, *Faurie* 856 (BP, lectotype; BM, PC, isolectotypes; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia conspersa var. *hypoclysta* f. *isidiosa* Müller Argoviensis, 1883:47. [Type collection: Bourbon, *Lepervanche* [97] (G, lectotype).]

Parmelia dussii Vainio, 1904a:307. [Type collection: Basse-Terre, Guadeloupe, *Duss* 687 (YU, lectotype). Nomen nudum.]

Parmelia conspersa var. *ambigua* Zahlbruckner, 1911:30. [Type collection: Diamond Head, Oahu, Hawaiian Islands, *Rechinger* 2596 (W, lectotype).]

Parmelia lusitana var. *decipiens* Vainio, 1915:24. [Type collection: Buck-Island, St. Thomas, *Boergesen* s.n. (TUR, Vainio herb. no. 2836, lectotype (Gyelnik, 1938b:30); C, isolectotype).]

Parmelia ambigua (Zahlbruckner) Gyelnik, 1931b:287 and 1936:125. [Not *Parmelia ambigua* (Wulfen) Acharius, 1803:207 (= *Parmeliopsis*).]

Parmelia decipiens (Vainio) Gyelnik, 1931b:288. [Not *Parmelia decipiens* (Acharius) Martius, 1817:214 (= *Psora*).]

Parmelia canariensis Gyelnik, 1934c:153. [Type collection: Bajamar, Palma, Canary Islands, *Pitard* 66 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed). Not *Parmelia canariensis* Sprengel, 1827:278 (= *Usnea*).]

Parmelia hirosakiensis Gyelnik, 1934c:155. [Type collection: Castello Hirosaki-Aomori, Japan, *Faurie* 1077 (BP, lectotype; PC, isolectotype).]

Parmelia ambigua var. *isidiosa* (Müller Argoviensis) Gyelnik, 1936:125.

Parmelia abstrusa var. *subramigera* (Gyelnik) Gyelnik, 1938b:17.

Parmelia ambigua f. *indiana* Gyelnik, 1938a:269. [Type collection: St. John, Antigua, *Evans* 210 (BP, lectotype; YU, isolectotype).]

Parmelia gyelniki Dodge, 1959:62. [Based on *Parmelia conspersa* var. *hypoclysta* f. *isidiosa* Müller Argoviensis.]

Parmelia subhypoclysta Dodge, 1959:64. [Type collection: Andrangolaoka, Imerina, Madagascar, *Hildebrandt* s.n. (FH, holotype).]

Parmelia ambositrana des Abbayes, 1961:93. [Type collection: Between Ambositra and Fianarantsoa, Madagascar, *des Abbayes, Lich. Madag. Borb. Sel. Exs.* 4 (REN, holotype; LD, UPS, US, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather firm, 4–12 cm broad, dull yellowish green; lobes subirregular to sublinear, 1.5–4 mm wide, contiguous to imbricate; upper surface continuous to weakly white-maculate, shiny, moderately to densely isidiate, the isidia subglobose to cylindrical (Figure 20*b*), 0.08–0.15 mm in diameter, 0.2–1 mm high, the tips syncorticate, pale brown, simple to sparsely branched; medulla white; lower surface plane, pale brown to brown, variably sparsely to moderately rhizinate, the rhizines pale brown to brown, simple, 0.5–1 mm long. Pycnidia rarely

developed; conidia bifusiform, 0.5 × 5–6 μm. Apothecia common, substipitate, 2–10 mm in diameter; spores 5–6 × 10–11 μm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric (±), physodalic (±), and usnic acids.

DISTRIBUTION.—USA, Mexico, Costa Rica, Jamaica, Cuba, Dominican Republic, Dominica, St. Barthelemy, Venezuela, Colombia, Brazil, Hawaii, USSR, Zimbabwe, Angola, SWA/Namibia, South Africa (Transvaal, Venda, Natal, Cape Province, Ciskei), Swaziland, Lesotho, Kenya, Uganda, Madagascar, Saudi Arabia, Sudan, Japan.

COMMENTS.—One of the most widespread subtropical species in the genus, *X. subramigera* is quite variable in adnation and lobe configuration and width. Although all of the numerous described taxa share cylindrical isidia, a pale or darker brown lower surface and fumarprotocetraric acid, future workers may segregate some of the populations as distinct species. The black lower surface morphotype is *Xanthoparmelia mbabanensis* from Natal and Swaziland has a black lower surface. There is one chemotype (*X. natalensis*) with diffractaic acid in addition to fumarprotocetraric acid in Natal. This species may have evolved from *X. phaeophana*, a very common, distinctly white-maculate species in southern Africa.

Xanthoparmelia subruginosa

FIGURE 68*d*

Xanthoparmelia subruginosa Hale, 1986b:602. [Type collection: Oribi Gorge Nature Reserve, elev. 300 m, Natal, South Africa, Grid 3030 CB, *Hale* 74042, 3 Feb 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on flat rocks, 6–10 cm broad, bright yellowish green; lobes sublinear, dichotomously branched, usually subascending, 0.5–1.5 mm wide, divaricate to subimbricate; upper surface continuous to weakly white-maculate on some older lobes, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, smooth to rugose, black, the tips with a yellowish rim, rhizines absent. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic (major), constictic (minor), cryptostictic (trace), and usnic acids, unknown triterpene (trace), atranorin (trace) (det. J.A. Elix).

ILLUSTRATION.—Hale, 1986b, fig. 52.

DESCRIPTION.—South Africa (Natal), Zimbabwe.

COMMENTS.—This unusual erhizinate species is common on sandstones in Natal. Another nonisidiate stictic acid-containing species in South Africa which lacks rhizines, *X. albomaculata*, is generally more adnate, has shorter, more subirregular lobes, a coriaceous thallus and distinct maculae on the surface. *Xanthoparmelia suberadicata* from Madagascar has narrower, more elongate, divaricate lobes, usually not more than 1 mm wide.

Xanthoparmelia subsorediata

FIGURE 68*e*

Xanthoparmelia subsorediata Hale, 1987b:332. [Type collection: Páramo La Negra, Estado Mérida, Venezuela, elev. 3000 m, *López-Figueiras and Morales-Mendez* 29017, 25 Mar 1982 (US, holotype; MERF, isotype).]

DESCRIPTION.—Thallus adnate on rock, 5–8 cm broad; dark yellowish green; lobes sublinear, 0.7–1.5 mm wide, irregularly branched, crowded and imbricate; upper surface continuous, emaculate, shiny at the tips, dull with age, densely isidiate, the isidia globose (Figure 20*c*), 0.08–0.2 mm in diameter, 0.1–0.4 mm high, the tips epicorticate, brownish, erumpent and subsorediate, mostly unbranched to sparingly branched, soon crowded and covering most of the thallus; medulla white; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines brown, simple, 0.3–0.6 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 21.

DISTRIBUTION.—Dominican Republic, Venezuela, Ecuador.

COMMENTS.—This rare high elevation species is very similar to *X. cordillerana*, an Andean/Australasian species with salazinic acid.

Xanthoparmelia substenophylloides

Xanthoparmelia substenophylloides Hale, 1989a:562. [Type collection: Sandstone ledges, about 5 km E of Holy Forest (NW of Thohoyandou), elev. 1000 m, Venda, South Africa, Grid 2230 CD, *Hale* 79148 (US, holotype).]

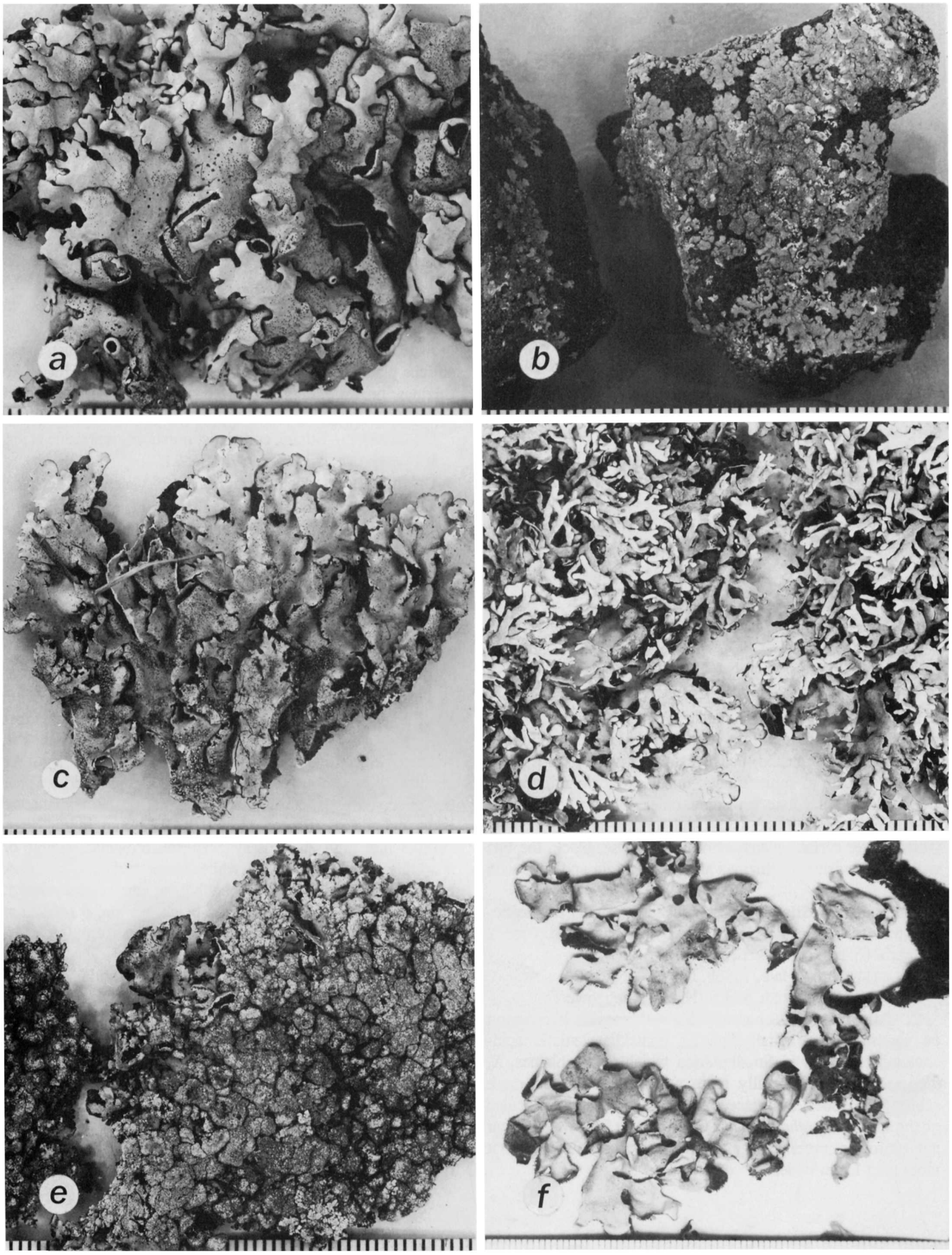
DESCRIPTION.—Thallus tightly adnate on rock, 2–6 cm broad, light yellowish green but darkening at the center; lobes sublinear, 0.4–1 mm wide, elongate, dichotomously branched, separate to contiguous, laciniate marginally with age, the laciniae dichotomously branched, 0.2–0.4 mm wide; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia cylindrical (Figure 20*d*), 0.06–0.13 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, brownish, simple or sparingly branched; medulla white; lower surface plane, dark brown at the tips but blackening at the center, shiny, moderately rhizinate, the rhizines black, simple, 0.1–0.2 mm long. Pycnidia rarely developed; conidia bifusiform, 0.5 × 5–6 μm. Apothecia lacking.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1989a, fig. 39 (as *X. stenophylloides*).

DISTRIBUTION.—USA, Panama, Venezuela, Brazil, Paraguay, South Africa (OFS, Venda).

COMMENTS.—This previously poorly understood but widespread species is characterized by the elongate, separate, little-branched lobes, and delicate pale-tipped isidia. The South African *X. pseudocongensis* is close but has shorter, black-rimmed, crowded lobes and black-tipped isidia. The Australa-


a
b
c
d
e
f

sian *X. mougeotina* has subglobose, black-tipped isidia and larger cylindrical conidia.

Xanthoparmelia substrigosa

FIGURE 68*f*

Xanthoparmelia substrigosa (Hale) Hale, 1974b:489.
Parmelia substrigosa Hale in Weber, 1971:338.
Parmelia conspersa var. *strigosa* Müller Argoviensis, 1896:90. [Type collection: Beechworth, Vict., Australia, *Falck* 12 (G, lectotype).]
Parmelia laxa f. *strigosa* (Müller Argoviensis) Gyelnik, 1935:30.
Parmelia conspersa f. *strigosa* (Müller Argoviensis) Gyelnik, 1936:123.

DESCRIPTION.—Thallus loosely adnate to nearly free growing on rocks, soil or loose pebbles, firm, 6–12 cm broad, yellowish green; lobes sublinear, 2.5–6 mm wide, strap-shaped, sparsely branched, contiguous to imbricate; upper surface continuous and emaculate to distinctly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, brown, densely rhizinate, the rhizines long and becoming furcate, brown, 0.3–1.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 3–12 mm in diameter; spores 5 × 9–10 µm.

CHEMISTRY.—Norstictic (major), connorstictic, salazinic (±), consalazinic (±), and usnic acids.

ILLUSTRATION.—Galloway, 1980, fig. 12.

DISTRIBUTION.—Australia (Qld, NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—This common Australasian species is characterized by the broad, strap-shaped lobes, dense furcate rhizines, production of norstictic acid, and frequent occurrence on soil. Rarer *X. barbellata* is similar in habit but has an ochre pigmented lower medulla.

Xanthoparmelia succedans

Xanthoparmelia succedans Elix and Johnston in Elix, Johnston, and Armstrong 1986:333.
Parmelia adpressa Krempelhuber ad int., 1876:72. [Type collection: Rio de Janeiro, Brazil, *Glaziou* 3842 (M, lectotype). Not *Parmelia appressa* Sprengel, 1807:58 (= *Lobaria*?).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 4–6 cm broad; lobes subirregular to sublinear, contiguous to imbricate, 1–2 mm wide; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia cylindrical to irregularly inflated (Figure 20*e*), 0.06–0.1 mm in diameter, 0.1–0.2 mm high, the tips syncorticate, pale, simple to branched; medulla white; lower surface plane, pale brown to brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia lacking. Apothecia rare, substipitate, 1–4 mm in diameter; spores 6 × 9 µm.

CHEMISTRY.—Stictic (major), salazinic (minor), constictic (minor), cryptostictic (trace), norstictic (trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 35.

DISTRIBUTION.—Australia (NSW, WA), Brazil.

COMMENTS.—This rare member of the *X. plittii* group is characterized by the unique combination of acids. Krempelhuber (1876:72), suggesting an affinity with *X. conspersa*, described the lower surface as "subtus niger" but the type is pale brown below.

Xanthoparmelia sulcifera

Xanthoparmelia sulcifera (Kurokawa) Hale, 1984:79.
Parmelia sulcifera Kurokawa, 1982:37. [Type collection: 9 mi E of Cooma on Numeralla Road, N.S.W., Australia, *Kurokawa* 6450 (TNS, holotype).]

DESCRIPTION.—Thallus loosely adnate to free growing on soil but remaining intact, pulvinate, 3–10 cm broad, light yellowish green; lobes sublinear, 0.7–2 mm wide, weakly to distinctly convoluted, subdichotomously branched, contiguous to imbricate, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown or darkening, moderately to densely rhizinate, the rhizines pale brown or darkening, simple or sparsely branched, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia rare, substipitate, 1–3 mm in diameter; spores 4–6 × 10–11 µm.

CHEMISTRY.—Hypostictic, hyposalazinic, hypoconstictic (±), and usnic acids.

ILLUSTRATION.—Kurokawa, 1982, pl. 2: fig. 2.

DISTRIBUTION.—Australia (NSW).

COMMENTS.—This remarkable species is very common in sandy fields at Mt. Canobolus and at the type locality. Morphologically the nearest relative of this rare Australian lichen appears to be *X. wyomingica*, a high elevation terricolous lichen in western North America with salazinic acid and more distinctly convoluted lobes.

Xanthoparmelia surrogata

FIGURE 69*a*

Xanthoparmelia surrogata Hale, 1986b:603. [Type collection: above Woodhead Reservoir (to Platteklip Gorge), Table Mountain Nature Reserve, elev. 800 m, Cape Province, South Africa, Grid 3318 CD, *Hale* 72084, 23 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather leathery, 6–10 cm broad, dull yellowish green; lobes sublinear-elongate, 1–2 mm wide, separate to subimbricate; surface continuous, emaculate, shiny, becoming finely fissured toward the center, isidia and soredia lacking; upper medulla white, lower medulla orange-red; lower surface plane, black, shiny, moderately rhizinate, the rhizines black, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

FIGURE 68.—Species of *Xanthoparmelia*: *a*, *X. subpigmentosa* (*Kofler* 3669, isotype in US); *b*, *X. subplittii* (*Schinini* 16262, holotype in US); *c*, *X. subramigera* (*Hale* 31739); *d*, *X. subruginosa* (*Hale* 74042, holotype in US); *e*, *X. subsorediata* (*López* 29017, holotype in US); *f*, *X. substrigosa* (*Falck* 12, lectotype in G). Scale in mm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids, skyrin.

ILLUSTRATION.—Hale, 1986b, fig. 53.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—*X. surrogata* differs from *X. luminosa*, the only other species with this chemistry and a black lower surface, in having narrower, sublinear lobes and a leathery texture. It is known only from Table Mountain.

Xanthoparmelia swartbergensis

FIGURE 69*b*

Xanthoparmelia swartbergensis Hale, 1987a:264. [Type collection: Swartberg Pass, east side of road, elev. 1600 m, Cape Province, South Africa, Grid 3322 AC, *Hale* 77623, 20 Oct 1986 (US, holotype; ANUC, PRE, isotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, appearing areolate at the center, 5–10 cm brown, dark yellowish green and darkening with age; lobes sublinear, 0.3–0.6 mm wide, rather elongate, sparingly dichotomously branched, 1–2 mm long, black rimmed, laciniate toward the center, the laciniae 0.1–0.2 mm wide; upper surface continuous to faintly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, shiny, black sparsely to moderately rhizinate, the rhizines black, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Fumarprotocetraric (major), protocetraric (trace), physodalic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 22.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species is morphologically similar to other nonisidiate, centrally areolate species in South Africa such as *X. xanthomelaena* (stictic acid) or *X. conspersula* (salazinic acid). It is known only from the type collection at windswept Swartberg Pass.

Xanthoparmelia synestia

FIGURE 69*c*

Xanthoparmelia synestia (Stirton) Hale, 1974b:489.

Parmelia synestia Stirton, 1877:214. [Type collection: Cave Mountain, South Africa, *M'Lea* [413] (BM, lectotype).]

Parmelia conspersa var. *synestia* (Stirton) Gyelnik, 1937b:133. [Invalid combination with no citation of basionym.]

Parmelia conspersa var. *synestia* (Stirton) Gyelnik, 1938b:41.

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rather fragile, 5–12 cm broad, dark yellowish green; lobes subirregular to sublinear, 1–3 mm wide, often rather elongate, contiguous to imbricate, laciniate at the center with age, black rimmed; upper surface white-maculate, shiny, transversely cracked, isidia and soredia lacking; medulla white; lower surface plane, dark brown to black with a narrow yellowish rim toward the tips, rugulose, sparsely to moderately rhizinate, the rhizines black, simple, 0.2–0.6 mm long. Pycnidia poorly developed; conidia bifusiform, 0.5 × 5–6 µm. Apothecia rather rare, substipitate, to 2–5 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids, chalybaeizans unknown (±trace).

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This common karoo lichen is often found on low, protected, near-vertical south faces of rock outcrops in sheep paddocks. It has a distinctive dark greenish color and conspicuous maculae. *Xanthoparmelia neosynestia* is closely related but has a brown lower surface.

Xanthoparmelia tablensis

FIGURE 69*d*

Xanthoparmelia tablensis Hale, Nash, and Elix in Hale, 1986b:603. [Type collection: Trail from Platteklip Gorge to Woodhead Reservoir, Table Mountain Nature Reserve, elev. 1000 m, Cape Province, South Africa, Grid 3318 CD, *Hale* 72033, 23 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate on rocks, 6–10 cm broad, bright yellowish green; lobes sublinear, 0.6–1.5 mm wide, elongated and dichotomously branched, becoming laciniate, imbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, 0.5–1 mm long, simple. Pycnidia poorly developed; conidia bifusiform, 0.5 × 5–6 µm. Apothecia adnate to substipitate, 1–3 mm in diameter; spores 6–7 × 9–11 µm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids and several unidentified minor components.

ILLUSTRATION.—Hale, 1986b, fig. 54.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Other loosely adnate, hypoprotocetraric acid-containing species include *X. hypoprotocetrarica*, a common effigurate-maculate lichen in South Africa and Australia, and *X. contrasta*, a skyrin-containing species in South Africa. The present species is known from Table Mountain and several nearby localities.

Xanthoparmelia taractica

FIGURE 69*e*

Xanthoparmelia taractica (Krempelhuber) Hale, 1974b:489.

Parmelia taractica Krempelhuber, 1878:439. [Type collection: Argentina, *Lorentz and Hieronymus* s.n. (M, lectotype; G, W, isolectotypes).]

Parmelia conspersa var. *polyphylloides* Müller Argoviensis, 1883:47. [Type collection: Fowlers Bay, Australia, *Richard* [118 p.p.] (G, lectotype; MEL, isolectotype).]

Imbricaria conspersa var. *polyphylloides* (Müller Argoviensis) Jatta, 1902:470.

Parmelia ioannis-simae Gyelnik, 1931b:283. [Type collection: Near Puebla, Santa Barbara, Estado Puebla, Mexico, *Nicolas* 5982 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia viridulo-umbrina var. *rotundata* (Gyelnik) Gyelnik, 1932a:211.

Parmelia imitans var. *ioannis-simae* (Gyelnik) Gyelnik, 1934b:372. [Invalid combination. Mentioned in a key without citing basionym.]

Parmelia laxa f. *pueblana* Gyelnik, 1934c:160. [Type collection: Totimehuaca, Hacienda Batan, Estado Puebla, Mexico, *Arsène* 8181 (BP, lectotype).]
Parmelia polyphylloides (Müller Argoviensis) Gyelnik, 1934b:371. [Invalid combination. Mentioned in a key without citing basionym.]
Parmelia polyphylloides (Müller Argoviensis) Gyelnik, 1935:28.
Parmelia conspersa f. *pueblana* (Gyelnik) Gyelnik, 1936:124.
Parmelia phaeophana f. *ioannis-simae* (Gyelnik) Gyelnik, 1938b:35.
Xanthoparmelia ioannis-simae (Gyelnik) Hale, 1974b:488.

DESCRIPTION.—Thallus adnate to loosely adnate on soil or rocks, 6–12 cm broad, yellowish green; lobes sublinear, 1–4 mm wide, dichotomously branched, laciniate with age, the laciniae plane, separate to imbricate; upper surface continuous, emaculate to very weakly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately to densely rhizinate, the rhizines pale brown, simple to furcate, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–7 µm. Apothecia common, substipitate, 2–8 mm in diameter; spores 4–5 × 8–9 µm.

CHEMISTRY.—Salazinic, consalazinic, lobaric (±), and usnic acids, undetermined fatty acids (±).

DISTRIBUTION.—Western USA, Mexico, Colombia, Bolivia, Argentina, Australia (NSW, ACT, Vic, Tas, SA, WA), New Zealand.

COMMENTS.—I had earlier used *X. taractica* in a very broad sense, including *X. coloradoensis* and *X. somloensis*, but concluded from further field studies that *X. taractica* is primarily a soil lichen. It is confined to the New World from Argentina northward into Mexico and to Australasia (Elix, Johnston, and Armstrong, 1986). Krempelhuber (1878:439) mentioned a specimen (the type?) that he sent to Nylander and identified by him as *Parmelia congruens* but felt that *P. taractica* was distinct.

Xanthoparmelia tasmanica

FIGURE 69*f*

Xanthoparmelia tasmanica (Hooker and Taylor) Hale, 1974b:489.
Parmelia tasmanica Hooker and Taylor, 1844:644. [Type collection: Van Diemans Land, Australia, [*Gunn* s.n.] (FH-Tayl, lectotype; BM, isolectotype).]
Parmelia incisa Taylor, 1847:162. [Type collection: Swan River, Australia, *Drummond* s.n. (FH-Tayl, lectotype; G, H-Nyl, BM, isolectotypes). Not *Parmelia incisa* Fries, 1825:284 (= *Lecanora*).]
Parmelia conspersa var. *laxa* Müller Argoviensis, 1883:47. [Type collection: Upper Ovens [Owens] River, Australia, *M'Cann* s.n. (G, lectotype; BM, M, isolectotypes).]
Parmelia subconspersa var. *incisa* (Taylor) Stizenberger, 1890:153.
Parmelia stramineonitens Zahlbruckner, 1896:195. [Type collection: Lord Howe Island, *Moore* 17 (W, lectotype; G, isolectotype).]
Imbricaria conspersa var. *laxa* (Müller Argoviensis) Jatta, 1902:470.
Parmelia conspersa var. *incisa* (Taylor) Zahlbruckner, 1929:132.
Parmelia pulvinaris var. *lacinulata* Gyelnik, 1931b:283. [Type collection: Pearce's Creek, N.S.W., Australia, *Watts* 16 (BP, lectotype).]
Parmelia hypofusca Gyelnik, 1934c:155. [Type collection: Between Sta. Barbara and Cristo sur l'Alseseca, Estado Puebla, Mexico, *Arsène* 4202 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]
Parmelia laxa (Müller Argoviensis) Gyelnik, 1935:26.
Parmelia conspersa f. *lacinulata* (Gyelnik) Gyelnik, 1936:123.
Parmelia laxa var. *lacinulata* (Gyelnik) Gyelnik, 1934b:372. [Invalid combination without citation of basionym.]
Parmelia laxa f. *lacinulata* (Gyelnik) Gyelnik, 1934c:159. [Invalid combination without citation of basionym.]
Parmelia taractica f. *laxiza* Gyelnik, 1938a:293. [Type collection: Westbrook, Connecticut, USA, *Evans* 1419 (BP, lectotype; YU, isolectotype).]

DESCRIPTION.—Thallus adnate to usually loosely adnate on rock, rather firm, 6–15 cm broad, light yellowish green; lobes sublinear, 2–5 mm wide, contiguous to imbricate, more or less black rimmed; upper surface continuous, emaculate, shiny to dull, irregularly cracked and rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate, the rhizines black, simple, 0.3–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–7 µm. Apothecia common, substipitate, 2–10 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic, consalazinic (±), norstictic (±trace), protocetraric (±trace), and usnic acids.

ILLUSTRATION.—Filson and Rogers, 1979, pl. 13B.

DISTRIBUTION.—Canada, USA, Mexico, Peru, Argentina, Australia (Qld, NSW, ACT, Vic, Tas, SA, WA), New Zealand, Kenya, South Africa (Cape Province, Natal).

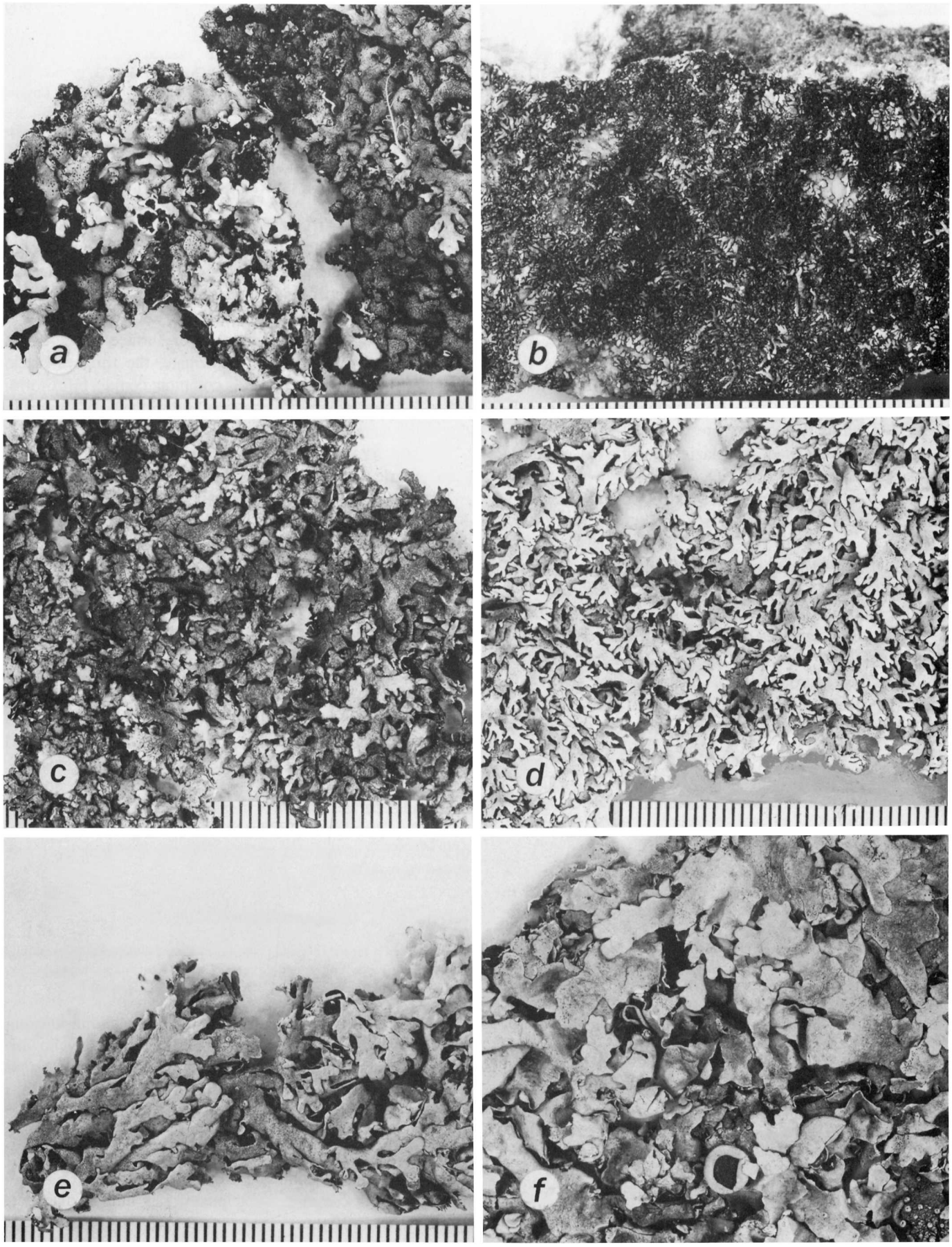
COMMENTS.—This is a very widespread species, large and conspicuous, easily recognized by the jet black lower surface, lack of maculae, and presence of salazinic acid. It is especially common in southern and eastern Australia, where it is quite uniform, and in South Africa, where numerous atypical populations differing in adnation and lobe configuration may represent distinct species. In Africa it may be confused and apparently intergrades with *X. africana*, which is pulvinate and white-maculate and has long dense rhizines, and with *X. neotasmanica*, which has strong white maculae. The absence of skyrin separates it from *X. luminosa* and *X. surrogata*.

Müller Argoviensis (1888c) correctly recognized the identity of *P. incisa*, *P. tasmanica* and *P. conspersa* var. *laxa* but chose to use varietal rank.

Xanthoparmelia tegeta

Xanthoparmelia tegeta Elix and Johnston in Elix, Johnston, and Armstrong, 1986:339. [Type collection: Diggers Creek, Kosciusko National Park, N.S.W., Australia, *Elix* 1718 (CBG, holotype; MEL, isotype).]

DESCRIPTION.—Thallus adnate on rock, sometimes forming loose, brittle, pulvinate mats, 6–9 cm broad, dark yellowish green; lobes sublinear to irregularly constricted, 0.7–1.5 mm wide, contiguous to imbricate, black rimmed; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, black, moderately rhizinate, the rhizines black, simple to rarely branched, 0.2–0.5 mm long. Pycnidia common; conidia cylindrical, 0.5 × 6–7 µm. Apothecia common, substipitate, 1–3 mm in diameter; spores 5–6 × 9–10 µm.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CHEMISTRY.—Stictic (major), constictic, norstictic, cryptostictic, and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 36.

DISTRIBUTION.—Australia (NSW, ACT, Vic, Tas, WA), New Zealand, South Africa (Cape Province).

COMMENTS.—The thallus often becomes densely imbricate and forms compact mats. A related terricolous American species, *X. planilobata*, has nearly bare, strongly rugulose lower surface and separate to subimbricate lobes. Another closely related species by reason of the chemistry and cylindrical conidia is *X. xanthomelaena*, which is centrally areolate.

Xanthoparmelia tenacea

FIGURE 70*a*

Xanthoparmelia tenacea Knox and Hale in Hale, 1987b:332. [Type collection: Namib Kalunda Farm, escarpment slope of the highland, South West Africa/Namibia, *H. and E. Walter* 5131, 28 Apr 1975 (US, holotype; M, isotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 2–4 cm broad, dull yellowish green; lobes subirregular, 0.6–1.8 mm wide, short, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia globose to subcylindrical (Figure 20*f*), 0.09–0.15 mm in diameter, 0.1–0.15 mm high, the tips in part epicorticate, erumpent and easily eroding but not sorediate, unbranched; medulla white; lower surface brown to dark brown, moderately rhizinate, the rhizines simple, 0.1–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, norstictic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 22.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This species occurs in the semi-arid central highlands of Namibia. Externally similar to the Australian *X. praegnans*, it is a smaller lichen with a dark brown lower surface. Another erumpent South African species, *X. geesterani*, has a black lower surface.

Xanthoparmelia tenuiloba

FIGURE 70*b*

Xanthoparmelia tenuiloba Hale, 1987b:332. [Type collection: On sheltered ledges, N side of Dutoits Pass on hwy N1, elev. 850 m, Cape Province, S. Africa, Grid 3319 CA, *Hale* 78259, 26 Oct 1986 (US, holotype; ANUC, PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate on rock, somewhat pulvinate, brittle, 4–6 cm broad, dark yellowish green; lobes sublinear to linear, 0.3–0.9 mm wide, dichotomously branched, rather elongate and laciniate, imbricate; upper surface continuous, emaculate, dull, isidia and soredia lacking; medulla white; lower surface plane to barely canaliculate, pale brown, sparsely rhizinate, the rhizines pale brown, simple to furcate, 0.5–1 mm long. Pycnidia common; conidia weakly bifusiform, 0.5 × 5–6 µm. Apothecia not seen.

CHEMISTRY.—Norlobaridone (major), isonorlobariol (trace), unknown $R_{fc}12$, and usnic acid (det. J.A. Elix).

ILLUSTRATION.—Hale, 1987b, fig. 23.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This species is known from only two collections in the Dutoits Pass area, on ledges exposed to mists of the prevailing SW wind. *Xanthoparmelia metamorphosa* from Australia has a shiny, faintly white-maculate upper surface, black-rimmed lobes, a nearly bare lower surface with short coarse rhizines, and a more loosely spreading thallus. This species is known only from two collections in the Dutoits Pass area, on ledges frequently exposed to mists of the prevailing strong southwesterly wind.

Xanthoparmelia terrestris

FIGURE 70*d*

Xanthoparmelia terrestris (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:341.

Parmelia terrestris Kurokawa and Filson in Filson, 1982:574. [Type collection: 6 mi W of Red Cliffs along Werrimull Road, Victoria, Australia, *Kurokawa* 6615 (TNS, holotype; MEL, isotype).]

DESCRIPTION.—Thallus loosely adnate on soil or small pebbles, 6–9 cm broad, yellowish green; lobes sublinear, 1–2 mm wide, in part weakly convoluted, becoming dissected and imbricate with development of somewhat revolute, subterete secondary lobes toward the center; upper surface continuous, emaculate, shiny to dull, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple to furcate, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia rare, substipitate, 2–8 mm in diameter; spores 6–7 × 8–10 µm.

CHEMISTRY.—Norstictic (major), salazinic, connorstictic, protocetraric (trace), and usnic acids.

ILLUSTRATION.—Filson, 1982, fig. 19.

DISTRIBUTION.—Australia (Vic, SA, WA).

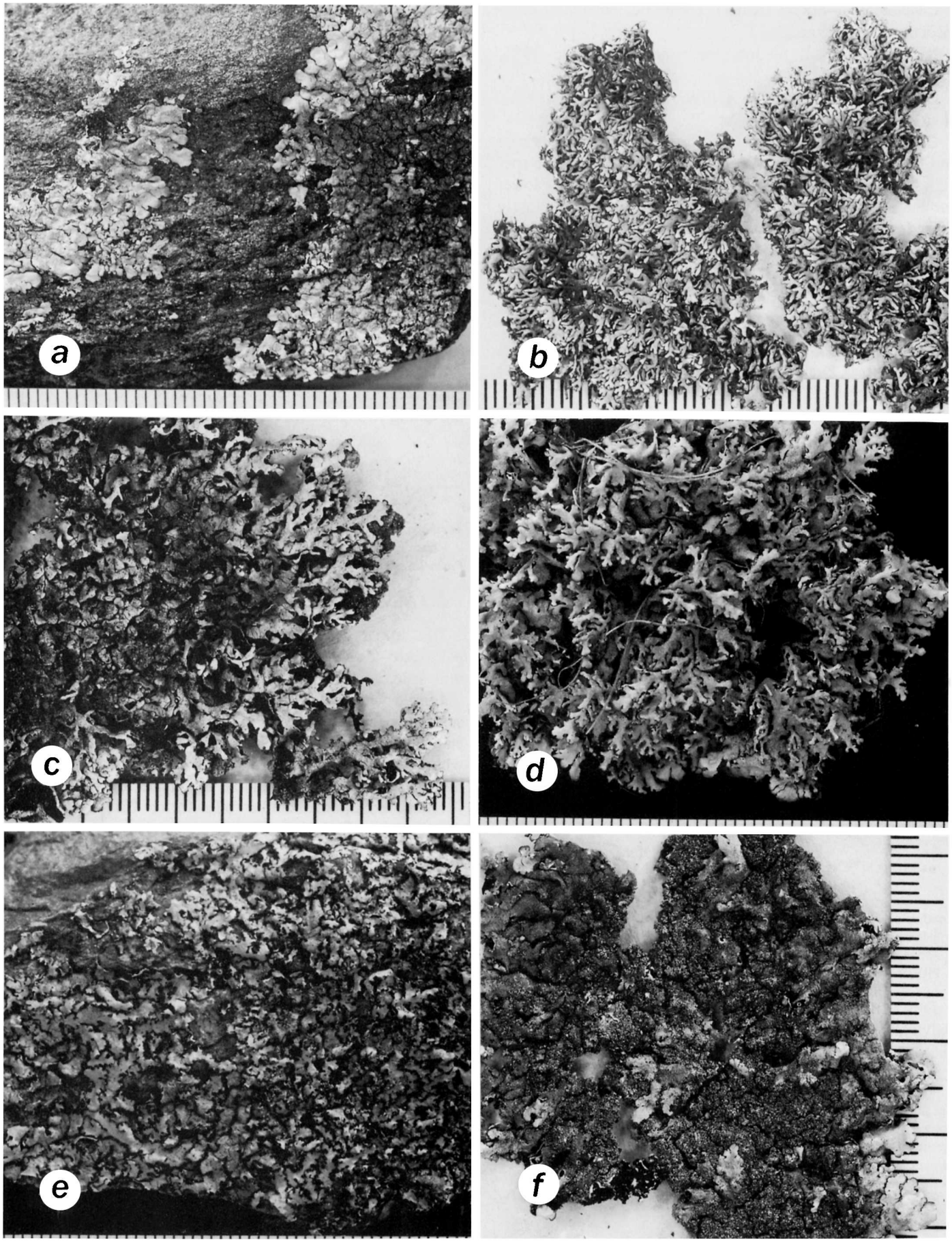
COMMENTS.—This is another endemic Australian soil lichen, usually rather firmly attached to the soil and found chiefly in mallee scrub. It is nearest in habit to *X. eilifii*, which contains norlobaridone as the major component.

Xanthoparmelia terricola

FIGURE 70*c*

Xanthoparmelia terricola Hale, Nash, and Elix in Hale, 1986b:603. [Type collection: Brandwagsrot, Golden Gate National Park, elev. ca. 1900 m, Orange Free State,South Africa, Grid 2828 BC, *Hale* 74036, 11 Feb 1986 (US, holotype; LD, PRE, isotypes).]

FIGURE 69.—Species of *Xanthoparmelia*: *a*, *X. surrogata* (*Hale* 72084, holotype in US); *b*, *X. swartbergensis* (*Hale* 77623, holotype in US); *c*, *X. synestia* (*Hale* 72137); *d*, *X. tablensis* (*Hale* 72033, holotype in US); *e*, *X. taractica* (*Scarabina* 17414); *f*, *X. tasmanica* (*Gunn* s.n., lectotype in FH-Tayl). Scale in mm.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DESCRIPTION.—Thallus adnate to loosely attached on rocks, pebbles and soil, often with the same thallus extending from soil to adjacent rocks, 6–15 cm broad, rather firm, yellowish green but darkening with age at the center; lobes sublinear, 1–1.5 mm wide, dichotomously branched, contiguous to imbricate; upper surface continuous, emaculate, shiny, emaculate, transversely cracked and somewhat rugose with age, isidia and soredia lacking; medulla white; lower surface plane, brown to dark brown, moderately rhizinate, the rhizines brown, 0.5–1 mm long, simple or furcate with white tips when young. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 3–8 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Salazinic, consalazinic, norstictic (trace), protocetraric (trace), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 55.

DISTRIBUTION.—South Africa (Transvaal, OFS, Natal), Zimbabwe.

COMMENTS.—This is the most common soil-inhabiting lichen at higher elevations (2000–3000 m) in the Drakensberg escarpment in South Africa. It has rather uniform, sublinear lobes with a brown to dark brown lower surface. Skyrin-containing *X. subpigmentosa* is the only comparable species in southern Africa.

Xanthoparmelia thamnoides

FIGURE 70*e*

Xanthoparmelia thamnoides (Kurokawa) Hale, 1974b:489.

Parmelia thamnoides Kurokawa, 1969:213. [Type collection: Freshwater Gorge, NW of Cairns, Qsld., Australia, *Kurokawa* 5723 (TNS, holotype; MEL, isotype).]

DESCRIPTION.—Thallus adnate on rock, 4–10 cm broad, dark yellowish green; lobes subirregular, 1–1.5 mm wide, contiguous to imbricate, more or less black rimmed; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia cylindrical (Figure 20*g*), 0.07–0.15 mm in diameter, 0.2–0.5 mm high, the tips syncorticate, darkening, becoming coralloid branched with age; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, simple, 0.2–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norlobaridone, loxodin (±), conorlobaridone (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±), scabrosin 4,4′dibutyrate (±), and usnic acid.

ILLUSTRATIONS.—Galloway, 1980, fig. 14; Kurokawa, 1969, pl. 1: fig. 4.

DISTRIBUTION.—Australia (Qld, NSW, Vic, Tas), New Zealand.

COMMENTS.—This is close to *X. amplexula* but has a black lower surface. It is much rarer than *X. amplexula*, occurring in eastern Australia and rarely in New Zealand.

FIGURE 70.—Species of *Xanthoparmelia*: *a*, *X. tenacea* (*Walter* 5131, holotype in US); *b*, *X. tenuiloba* (*Hale* 78259, holotype in US); *c*, *X. terricola* (*Hale* 74036, holotype in US); *d*, *X. terrestris* (*Elix* 2768); *e*, *X. thamnoides* (*Kurokawa* 5723); *f*, *X. thamnolica* (*Hale* 72034, holotype in US). Scale in mm.

Xanthoparmelia thamnolica

FIGURE 70*f*

Xanthoparmelia thamnolica Hale, 1986b:604. [Type collection: 25 km S of Clanwilliam along Hwy N7, elev. ca. 300 m, Cape Province, South Africa, Grid 3218 BD, *Hale* 72034, 25 Jan 1986 (US, holotype; PRE, isotype).

Parmelia thamnolica (Hale) Brusse, 1988:539.]

DESCRIPTION.—Thallus adnate on rocks, easily breaking apart, 5–8 cm broad, dark yellowish green; lobes subirregular to sublinear, 1.3–2.5 mm wide, imbricate; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia becoming dense with age, cylindrical (Figure 20*h*), 0.08–0.14 mm in diameter, 0.1–0.3 mm high, the tips syncorticate, becoming richly branched; medulla white; lower surface plane, black with a dark brown zone at the tips, moderately to densely rhizinate, the rhizines black, 0.5–2 mm long, simple to furcate. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypothamnolic (major), echinocarpic, caperatic, and usnic acids, unknown E-1 and unidentified pigments (det. A. Johnson).

ILLUSTRATION.—Hale, 1986b, fig. 56.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—Superficially *X. thamnolica* looks like a rather large *X. verrucigera*, a common species with stictic acid in South Africa. It is highly restricted to southern Namaqualand. The original report of thamnolic acid was incorrect. The main component is hypothamnolic acid, the first occurrence of this acid in the genus. The only species in *Xanthoparmelia* with thamnolic acid remains *X. cedrus-montana*.

Xanthoparmelia tinctina

FIGURE 71*a*

Xanthoparmelia tinctina (Maheu and Gillet) Hale, 1974b:489.

Parmelia tinctina Maheu and Gillet, 1925:860. [Type collection: Boulhaut, Morocco, [*Gillet* 115x] (PC, lectotype).]

Parmelia conspersa var. *isidiosa* Nylander, 1881:450. [Type collection: [Spain, *Lazaro* 51] (H, Nyl. herb. no. 34764, lectotype).]

Parmelia isidiata var. *isidiosa* (Nylander) Gyelnik, 1930b:31.

Parmelia korosi-csomae Gyelnik, 1931a:156. [Type collection: Yalta, Caucasus, USSR, *Lojka* 87 (BP, lectotype).]

Parmelia rosea Gyelnik, 1931b:285. [Type collection: Taurica Peninsula, near Yalta, USSR, *Lojka* 88 (BP, lectotype).]

Parmelia tokajensis Gyelnik, 1931a:154. [Type collection: Mt. Tokaji, Comit. Zemplén, Hungary, *Gyelnik* s.n. (BP, lectotype).]

Parmelia algeriensis Bouly de Lesdain in Gyelnik, 1938a:268. [Type collection: Opuntia an 78 km de la route de Mila á F. doulés, Prov. Constantine, Algeria, *herb. Flagey* s.n. (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia rosea f. *adventiva* Gyelnik, 1938a:287. [Type collection: St. Bonnet le Chateau, Loire, France, *Parrique* 39 (BP, lectotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on rock, rarely on bark, 4–8 cm broad, dull yellowish green; lobes subirregular, 1.5–4 mm wide, apically rotund, contiguous to imbricate; upper surface continuous, emaculate, shiny, moder-

ately to densely isidiate, the isidia barrel-shaped to irregularly inflated (Figure 20*i*), 0.1–0.2 mm in diameter, 0.1–0.3 mm high, the tips syncorticate to weakly epicorticate, pale, rarely weakly erumpent, becoming dense with age but little branched; medulla white; lower surface plane, black with a brown zone at the tips, moderately rhizinate, the rhizines brown to black, coarse, the tips whitish splayed when young, simple, 0.2–0.6 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 µm. Apothecia rarely developed, substipitate, 2–10 mm in diameter; spores 5 × 9–10 µm.

CHEMISTRY.—Salazinic, consalazinic, norstictic (±), and usnic acids.

DISTRIBUTION.—Sweden, France, Spain, Portugal, Italy, Hungary, Roumania, Yugoslavia, Greece, Bulgaria, USSR, Algeria, Morocco, Pakistan.

COMMENTS.—This globose-isidiate lichen is well known to European lichenologists, Maheu and Gillet having mentioned the verruciform isidia in the original description They noted a "C+ rougeatre ou legrement rose" reaction and called the species "tinctina" because of these "pigments chromogenes." There seems to be no chemical basis for such a reaction. Gyelnik himself (1938b:29) finally realized that his *P. korosi-czomae* was a synonym of *P. tinctina*. He differentiated *P. rosea* by "medulla rosea," obviously a discoloration caused by decomposition of salazinic acid.

Xanthoparmelia tolucensis

FIGURE 71*b*

Xanthoparmelia tolucensis Hale, 1987b:334. [Type collection: Above crater lake at Volc n de Toluca, Estado México, Mexico, elev. 4160 m, *H.H. and C.M. Iltis* 3202 (US, holotype; WIS, isotype).]

DESCRIPTION.—Thallus adnate to loosely adnate on mosses and humus or on rock, pulvinate, rather brittle, 6–8 cm broad, darkish yellow green; lobes sublinear, 0.8–1.5 mm wide, crowded and imbricate, lobulate-dissected at tips and center of thallus, the lobulae becoming dense, suberect, digitate-terete, 0.2–0.3 mm in diameter, black tipped; upper surface continuous, emaculate, shiny at the tips but dull with age, isidia and soredia lacking; medulla white; lower surface plane, dark brown, moderately to densely rhizinate, the rhizines brown, simple, 0.3–0.6 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1987b, fig. 24.

DISTRIBUTION.—Mexico.

COMMENTS.—This rare high elevation lichen is near *X. cumberlandia* but has terete laciniae, a rare trait in New World species.

Xanthoparmelia toninioides

FIGURE 71*c*

Xanthoparmelia toninioides Hale, 1986b:606. [Type collection: 1 km east of Springbok on north side of Hwy R64, elev. 1100 m, Cape Province, South Africa, Grid 2917 DB, *Hale* 72086, 27 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate to adnate on rocks, 4–6 cm broad, light yellow green; lobes subirregular, 1–2 mm wide, short, contiguous, becoming strongly bullate at the center; upper surface continuous, emaculate, shiny, dull, becoming densely pruinose, isidia and soredia lacking; medulla white; lower surface plane to concave, dark brown to black, moderately to densely rhizinate, the rhizines black or brown, simple, 0.3–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 57.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The conspicuous bullate folds of the thallus are filled with a flocculent medulla. The species is rather common on granite domes in arid northern Namaqualand.

Xanthoparmelia transvaalensis

Xanthoparmelia transvaalensis Hale, Nash, and Elix in Hale, 1986b:606. [Type collection: summit of Long Tom Pass, Farm De Kuiten 205, S side of Hwy R37, elev. 2140 m, Lydenburg, Transvaal, South Africa, Grid 2430 BA, *Hale* 72038, 16 Jan 1986 (US, holotype; LD, PRE, isotypes).]
Parmelia transvaalensis (Hale, Nash, and Elix) Brusse, 1988:539.

DESCRIPTION.—Thallus adnate on rock, 6–8 cm broad, darkish yellow green; lobes subirregular to sublinear, 1–2 mm wide, imbricate with small marginal laciniae ~0.5 mm wide; upper surface continuous, emaculate, shiny, densely isidiate, isidia crowded, globose, basally constricted, 0.15–0.20 mm in diameter, 0.15–0.4 mm high, the tips epicorticate, breaking off apically, mostly unbranched; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines brown or blackening, 0.5–1 mm long, simple. Pycnidia poorly developed; conidia not found. Apothecia rare, substipitate, 2–5 mm in diameter; spores poorly developed, 5 × 7–8 µm.

CHEMISTRY.—Fatty "subdecipiens" unknowns 33 and 37 (major), constipatic (trace), protoconstipatic (trace), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 58.

DISTRIBUTION.—South Africa (Transvaal).

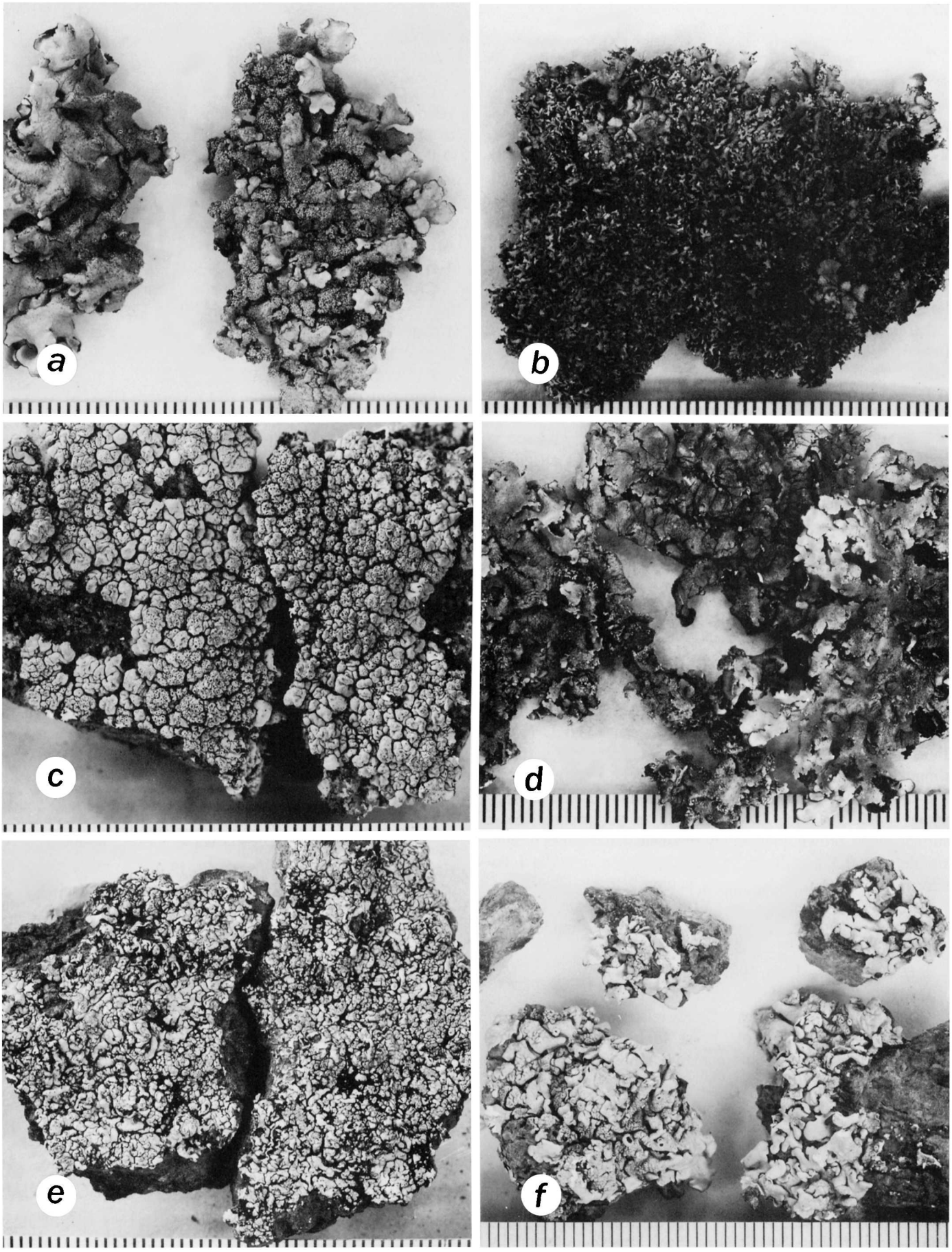
COMMENTS.—This rarely collected species has the same chemistry and black lower surface as nonisidiate *X. subnigra*, another species collected so far only in the Drakensbergs of Transvaal.

Xanthoparmelia treurensis

FIGURE 71*d*

Xanthoparmelia treurensis Hale, Nash, and Elix in Hale, 1986b:608. [Type collection: Treur River near Bourkes Luck, elev. 1200 m, Pilgrims Rest,

FIGURE 71.—Species of *Xanthoparmelia*: *a*, *X. tinctina* (*Vězda* 918); *b*, *X. tolucensis* (*Iltis* 3202, holotype in US); *c*, *X. toninioides* (*Hale* 72086, holotype in US); *d*, *X. treurensis* (*Hale* 72037, holotype in US); *e*, *X. tsekensis* (*Hale* 81451, holotype in US); *f*, *X. tucsonensis* (*Nash* 6203). Scale in mm.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Transvaal, South Africa, Grid 2430 DB, *Hale* 72037, 14 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate to loosely adnate on rocks, firm, 6–8 cm broad, darkish yellowish green; lobes sublinear, 2–5 mm wide, contiguous; upper surface continuous to weakly or strongly maculate in older parts, shiny, transversely cracked, moderately isidiate, the isidia tall, cylindrical (Figure 21*a*), 0.08–0.15 mm in diameter, 0.5–2 mm high, the tips syncorticate, shiny, blackening, simple to densely branched; medulla white; lower surface plane, rugose, rhizines absent or very sparsely developed, black, coarse, simple, 0.3–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, cryptostictic, norstictic (trace), connorstictic (trace), constipatic (±trace), and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 59.

DISTRIBUTION.—South Africa (Transvaal), Kenya.

COMMENTS.—This species appears to be closely related to isidiate *X. albomaculata*, which has more distinct effigurate maculae. In South Africa it occurs on large sandstone outcrops in the escarpment region of Transvaal.

Xanthoparmelia tsekensis

FIGURE 71*e*

Xanthoparmelia tsekensis Hale, 1989a:562. [Type collection: On crumbling dolerite boulder along river, 5.2 km NW of Thaba Tseka junction on Moteng Pass-Sani Pass road, elev. ca. 2900 m, Lesotho, Grid 2928 BD, *Hale* 81451, 7 May 1988 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, leathery, 6–8 cm broad, darkish yellow green; lobes sublinear, 0.6–1 mm wide, irregularly branched, short and crowded, short-laciniate, the laciniae in part subascending, black rimmed; upper surface continuous, emaculate, shiny, bullate and transversely cracked with age, isidia and soredia lacking; upper medulla white, lower medulla in part ochre; lower surface plane, brown, moderately rhizinate, the rhizines brown, simple, 0.2–0.3 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Stenosporonic (major), salazinic (major), colensoic, norstictic, and usnic acids, 2–3 unidentified anthraquinones.

ILLUSTRATION.—Hale, 1989a, fig. 40.

DISTRIBUTION.—Lesotho.

COMMENTS.—This species is closely related to *X. naudesnekia*, which also occurs on dolerite at high elevations in the Drakensberg escarpment and contains hypostictic acid as the major component together with stenosporonic acid. It is known only from the type collection.

Xanthoparmelia tucsonensis

FIGURE 71*f*

Xanthoparmelia tucsonensis (Nash) Egan, 1975:218.

Parmelia tucsonensis Nash, 1974b:234. [Type collection: W side of Tucson Mountains, NW slope above St. Mary's Road, Pima Co., Arizona, USA, *Nash* 6203 (ASU, holotype).]

DESCRIPTION.—Thallus adnate on rock, 3–6 cm broad, yellowish green; lobes subirregular, 1–2 mm wide, contiguous to imbricate, crowded; upper surface continuous, emaculate, dull, rugose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines pale brown, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 µm. Apothecia common, substipitate, 1–3 mm in diameter; spores 4–6 × 10–12 µm.

CHEMISTRY.—Diffractaic (major), barbatic (minor), 3-α-hydroxybarbatic (trace), squamatic (±trace), constipatic (±trace), 4-*O*-demethylbarbatic (trace), 2-*O*-methylobtusatic, and usnic acids (Chester and Elix, 1979a).

ILLUSTRATION.—Nash, 1974b, fig. 2.

DISTRIBUTION.—Australia (SA), western USA, Mexico.

COMMENTS.—Morphologically, *X. tucsonensis* resembles *X. barbatica*, another western North American/Australian species with barbatic acid as the major component.

Xanthoparmelia tumidosa

FIGURE 72*a*

Xanthoparmelia tumidosa Hale, 1986b:608. [Type collection: 1 km S of Nuwerus on Hwy R363, E of N7, elev. ca. 500 m, Cape Province, South Africa, Grid 3118 AB, *Hale* 72027, 26 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus adnate on rocks, leathery, 3–6 cm broad, bright yellowish green; lobes subirregular to sublinear, 1.5–2.0 mm wide, little branched, contiguous but becoming crowded and bullate at the center; upper surface continuous, emaculate, shiny to dull, convex-bullate, isidia and soredia lacking; medulla white; lower surface plane to somewhat grooved, pale brown to darker brown, sparsely to moderately rhizinate, the rhizines pale brown, ~0.5 mm long, coarse, unbranched. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia numerous, adnate, 1.5–2.5 mm in diameter, the rim rolling inward; spores 5–6 × 9–10 µm.

CHEMISTRY.—Protocetraric and usnic acids, unidentified fatty acids.

ILLUSTRATION.—Hale, 1986b, fig. 60.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—The coriaceous, convex, adnate, almost inflated lobes distinguish this Namaqualand-southwestern Cape karoo lichen. Morphologically identical *X. neotumidosa* contains protocetraric acid together with 4-*O*-demethyldiffractaic acid. A third protocetraric acid-containing species, *X. subochracea*, produces skyrin in the lower medulla.

Xanthoparmelia ulcerosa

FIGURE 72*b*

Xanthoparmelia ulcerosa (Zahlbruckner) Hale, 1974b:490.

Parmelia conspersa var. *obtecta* Zahlbruckner, 1924:386. [Type collection: Chinihua, Santiago, Chile, *Espinosa* s.n. (W, lectotype).]
Quebrada de las Casas, Masafuera, Juan Fernandez, *C. and I. Skottsberg*

Parmelia conspersa var. *obtecta* Zahlbruckner, 1924:386. [Type collection: Quebrada de las Casas, Masafuera, Juan Fernandez, *C. and I. Skottsberg* s.n. (W, lectotype; S, isolectotype).]
Parmelia tegulicola Zahlbruckner, 1931:85. [Type collection: Villa Alegre de Lencomilla, Chile, *Espinosa* s.n. (W, lectotype; BP, isolectotype).]
Parmelia teresiana Gyelnik, 1931b:280. [Type collection: La Mesa, near Bogotá, Colombia, *Apollinaire* 29 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]
Parmelia obtecta (Zahlbruckner) Gyelnik, 1935:27.
Parmelia obtecta var. *tegulicola* (Zahlbruckner) Gyelnik, 1935:50.
Parmelia soredians f. *ulcerosa* (Zahlbruckner) Gyelnik, 1935:51.
Parmelia neosoredians Gyelnik, 1938c:84. [Type collection: Los Quebrachitos, Argentina, *Hosseus* 109, [10 May 1934] (BP, lectotype).]
Parmelia rugulosa var. *subirregularis* Gyelnik, 1938c:85. [Type collection: La Estancita, Prov. Córdoba, Argentina, *Hosseus* 88 (BP, lectotype).]

DESCRIPTION.—Thallus adnate on rock, rarely on wood, 2–8 cm broad, yellowish green; lobes subirregular, 1.5–4 mm wide, apically rotund, contiguous to imbricate; upper surface continuous, emaculate, shiny, sorediate, the soralia orbicular but soon fusing into diffuse masses; medulla white; lower surface plane, pale to dark brown, moderately rhizinate, the rhizines brown, simple, 0.3–1 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 5–6 µm. Apothecia rare, substipitate, 1–4 mm in diameter; spores 5 × 7–8 µm.

CHEMISTRY.—Salazinic, gyrophoric (±), and usnic acids.

DISTRIBUTION.—Venezuela, Colombia, Ecuador, Argentina, Chile.

COMMENTS.—There is considerable variation in lobe width in this common South American species. It is very close to *X. microspora*, another sorediate lichen in South America, which has a black lower surface and is more common in the northern Andes. The lectotype specimen of *Parmelia neosoredians* is a mixture of *X. ulcerosa* and stictic acid-containing *X. farinosa*.

Xanthoparmelia umtamvuna

FIGURE 72*c*

Xanthoparmelia umtamvuna Hale, 1987a:266. [Type collection: Umtamvuna Nature Reserve, elev. ca. 200 m, Natal, South Africa, Grid 3130 AA, *Hale* 76731, 6 Oct 1986 (US, holotype; ANUC, LD, PRE, isotypes).]
Parmelia umtamvuna (Hale) Brusse, 1989a:403.

DESCRIPTION.—Thallus very tightly adnate, 5–7 cm broad, dull yellowish green; lobes sublinear, 0.3–0.7 mm wide, separate, dichotomously branched; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia globose (Figure 21*b*), 0.1–0.2 mm in diameter, 0.1–0.3 mm high, the tips epicorticate, pale, erumpent and more or less bursting at maturity, unbranched; medulla white; lower surface plane, brown, sparsely to moderately rhizinate, the rhizines brown, simple, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic (major), constictic, barbatic, and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 23.

DISTRIBUTION.—South Africa (Natal).

COMMENTS.— This humid lowland species resembles *X. victoriana* externally but is distinguished by the production of barbatic acid (erroneously reported as diffractaic acid in the original description). The same combination is known in *X. darlingensis* from Australia, a nonisidiate species with a black lower surface.

Xanthoparmelia unctula

FIGURE 72*d*

Xanthoparmelia unctula (Brusse) Hale, 1988b:406.
Parmelia unctula Brusse, 1984:319. [Type: Seven Weeks Poort, Cape Province, South Africa, Grid 3321 AD, *Brusse* 3582 (PRE, holotype; LD, isotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, appearing areolate toward the center, 4–6 cm broad, dull or darker yellowish green; lobes sublinear, 0.5–1 mm wide, contiguous to subimbricate; upper surface continuous, emaculate, shiny, deeply irregularly fissured with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines delicate, pale brown, in part translucent, simple, to 0.2 mm long. Pycnidia common; conidia cylindrical, 0.5 × 5–7 µm. Apothecia numerous, adnate, 0.6–1 mm in diameter; spores 5–6 × 8–9 µm.

CHEMISTRY.—Fatty "subdecipiens" fatty 33 and 37 (major), constipatic (trace), protoconstipatic (trace), and usnic acids.

ILLUSTRATION.—Brusse, 1984, fig. 9.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This rare lichen in the Swartberg Mountains has the same chemistry as *X. subdecipiens* but is much smaller, possibly the tightly adnate morphotype.

Xanthoparmelia ustulata

Xanthoparmelia ustulata (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:344.
Parmelia ustulata Kurokawa and Filson, 1975:46. [Type collection: Memory Cove, Cape Catastrophe, Eyre Peninsula, S.A., Australia, *Filson* 11834 (MEL, holotype).]

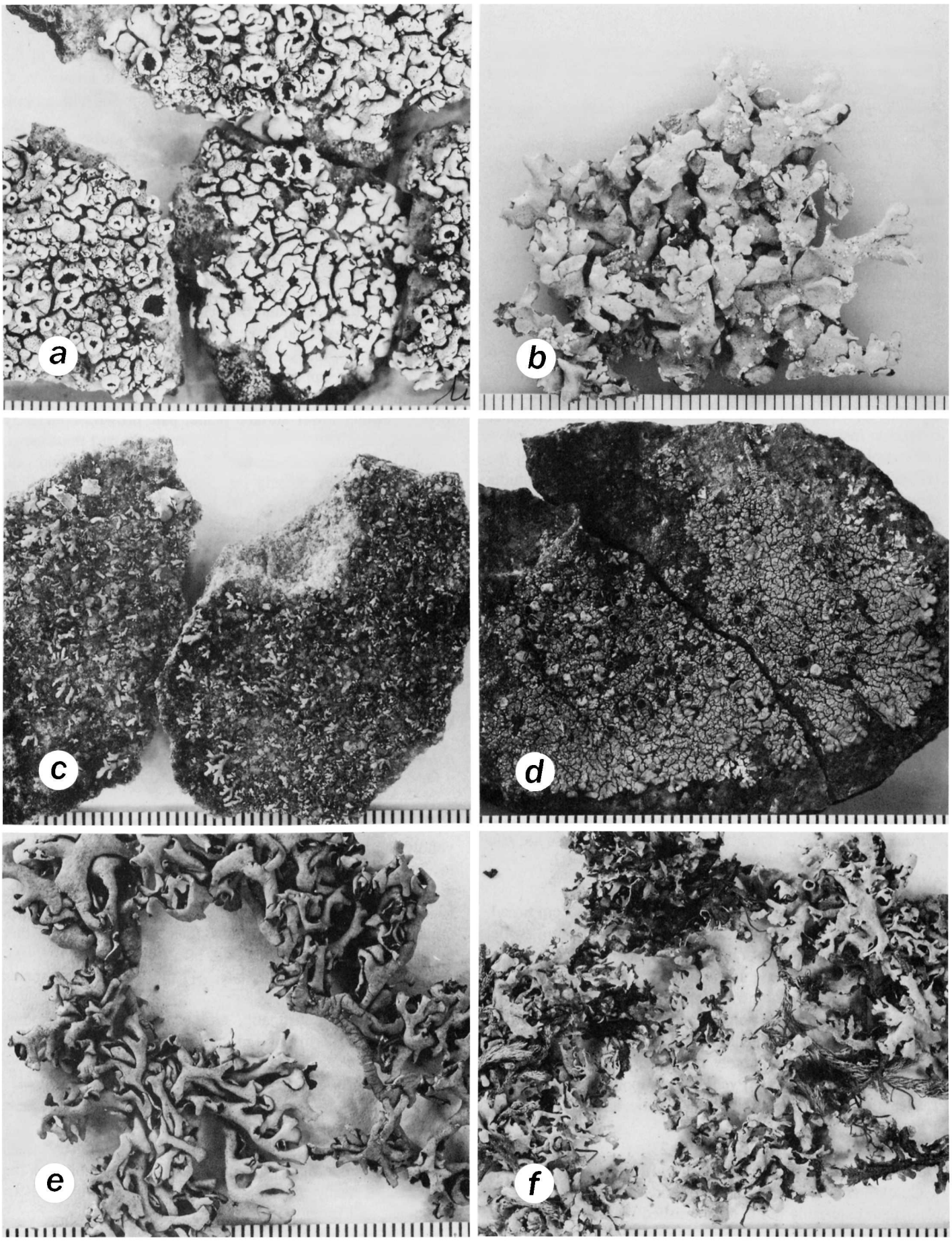
DESCRIPTION.—Thallus adnate on rock, 3–6 cm broad, dull yellowish green; lobes subirregular, 1–4 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, transversely cracked and rugulose with age, isidia and soredia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, the rhizines pale, simple, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 2–7 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Constipatic, protoconstipatic (±), dehydroconstipatic (±), pertusaric (±), unknown fatty acid, and usnic acids.

ILLUSTRATION.—Kurokawa and Filson, 1975, pl. 4: fig. 4.

DISTRIBUTION.—Australia Qld, NSW, ACT, Vic, SA), New Zealand.

COMMENTS.—This species has the same chemistry as *X. oleosa*, a smaller tightly adnate lichen in Australia and the Americas. Closely related *X. subdecipiens* from southern Africa has a different profile of fatty acids.


a
b
c
d
e
f

Xanthoparmelia vagans

FIGURE 72*e*

Xanthoparmelia vagans (Nylander) Hale, 1974b:490.
Endocarpon? *vagans* Nylander, 1858:13. [Type collection: Chimborazo, Ecuador, *Bonpland* s.n. (H, Nyl. herb. no. 1730, lectotype).]
Parmelia molliuscula var. *vagans* (Nylander) Nylander, 1860:393.
Parmelia vagans (Nylander) Nylander, 1869a:293.
Parmelia conspersa ssp. *molliuscula* var. *vagans* (Nylander) Elenkin, 1901a:20.
Parmelia molliuscula ssp. *vagans* (Nylander) Cretzoiu, 1933:364.
Parmelia subvagans Gyelnik, 1938a:292. [Type collection: Esperanza, Estado Puebla, Mexico, *Arsène* 8148 (BP, lectotype; US, isolectotype; designated type in Bouly de Lesdain herbarium destroyed).]
Parmelia desertorum f. *neovagans* (Gyelnik) Gyelnik, 1938b:6.
Parmelia stenophylla var. *vagans* (Nylander) Lettau, 1957:203.
Parmelia taractica var. *vagans* (Nylander) Poelt and Vězda, 1981:223. [Illegitimate combination (basionym not cited).]

DESCRIPTION.—Thallus vagrant, free growing on soil, firm but often breaking apart, 2–3 cm broad, light yellowish green; lobes sublinear, 1–3 mm wide, separate to subimbricate; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface strongly convoluted but only partially inrolled, brown or darkening, especially at the tips, moderately to densely rhizinate, the rhizines brown, simple, 0.2–0.6 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

DISTRIBUTION.—Canada, western USA, Mexico, Ecuador, Chile.

COMMENTS.—This species is closely related to the salazinic acid-containing *X. chlorochroa*, both species occurring only in the New World, *X. vagans* having a more southerly range into South America. The confusion over the incorrect use of the epithet *vagans* in Europe is discussed above under *X. camtschadalis* and *X. molliuscula*.

Xanthoparmelia vendensis

FIGURE 72*f*

Xanthoparmelia vendensis Hale, 1987a:266. [Type collection: Tshikadeni Mine site, SSE of Masisi, elev. 500 m, Venda, South Africa, Grid 2231 CB, *Hale* 79138, 13 Nov 1986 (US, holotype; LD, PRE, isotype).]

DESCRIPTION.—Thallus loosely adnate to nearly free growing on sandy soil, 4–6 cm broad but coalescing into large colonies, rather fragile, light yellow green; lobes sublinear, 1–2.5 mm wide, irregularly branched and divided apically into narrow elongate laciniae, 0.2–0.4 mm wide; upper surface continuous, emaculate to weakly white-maculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, shiny, pale brown, sparsely rhizinate, the rhizines brown, simple, 0.5–1 mm long. Pycnidia numerous; conidia not developed. Apothecia numerous, adnate, 1–4 mm in diameter; spores 5–6 × 9–10 µm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, and usnic acids.

ILLUSTRATION.—Hale, 1987a, fig. 24.

DISTRIBUTION.—South Africa (Venda).

COMMENTS.—The only other terricolous species with fumarprotocetraric acid, *X. leonora*, has a firmer thallus and moderately convoluted lobes. *Xanthoparmelia phaeophana*, which does not usually grow on soil, is much firmer with a strongly white-maculate upper surface. *Xanthoparmelia vendensis* is so far confined to sandy soils in the distinctive *Androstachys* veld community of Venda and northern Transvaal.

FIGURE 72.—Species of *Xanthoparmelia*: *a*, *X. tumidosa* (*Hale* 72027, holotype in US); *b*, *X. ulcerosa* (*Santesson* 2907); *c*, *X. umtamvuna* (*Hale* 76731, holotype in US); *d*, *X. unctula* (*Hale* 74164); *e*, *X. vagans* (*Hayden* s.n. in FH-Tuck); *f*, *X. vendensis* (*Hale* 79138, holotype in US). Scale in mm.

Xanthoparmelia verdonii

FIGURE 73*a*

Xanthoparmelia verdonii Elix and Johnston in Elix, Johnston, and Armstrong, 1986:346. [Type collection: 19 km E of Cann River township, Alfred National Park, Australia, *Elix* 5252 (CBG, holotype).]

DESCRIPTION.—Thallus adnate on rock, 4–7 cm broad, firm, yellowish green but darkening at the center; lobes subirregular to sublinear, 1–2.5 mm wide, black-rimmed, contiguous to imbricate; upper surface continuous, emaculate, shiny, becoming densely isidiate, the isidia globose or subcylindrical to irregularly inflated (Figure 21*c*), 0.08–0.15 mm in diameter, to 0.3 mm high, coarse, the tips syncorticate, black, simple to branched, at least in part erumpent and becoming pustulate; medulla white; lower surface plane, black, sparsely to moderately rhizinate, the rhizines black, simple, 0.4–0.8 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Norlobaridone, loxodin, and usnic acid, scabrosin 4,4′-diacetate (±), scabrosin 4-acetate-4′-butyrate (±), scabrosin 4-acetate-4′-hexanoate (±), scabrosin 4,4′-dibutyrate (±).

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 37.

DISTRIBUTION.—Australia (NSW, Vic, Tas), New Zealand.

COMMENTS.—This is a probable morph of *X. scabrosa* with a black lower surface. It is extremely rare in southeastern Australia and New Zealand.

Xanthoparmelia verecunda, new combination

Parmelia verecunda Brusse, 1988:538. [Type collection: Outeniqua Pass, 10 km from George to Oudtshoorn, Cape Province, South Africa, *Brusse* 4790 (PRE, holotype (not seen); BM, COLO, isotypes).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, very fragile, 1–3 cm broad, dark yellowish green; lobes sublinear, 0.5–0.8 mm wide, irregularly branched, imbricate, short laciniate with age, in part black-rimmed; upper surface, continuous but the cortex fragile, easily breaking away to reveal the pigmented medulla, emaculate, shiny, finely reticulate-foveolate with age, soredia and isidia lacking;

medulla deep orange-red throughout; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, simple. 0.2–0.3 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Schenckiana pigments, secalonic acid complex, and usnic acid.

ILLUSTRATION.—Brusse, 1988, fig. 8.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—This conspicuously pigmented species has the same chemical profile as *X. endochromatica*, a rare Table Mountain endemic with strongly black-rimmed, opuntioid-constricted lobes, and an unknown substance near gyrophoric acid. It is known only from the type collection.

Xanthoparmelia verruciformis

Xanthoparmelia verruciformis Elix and Johnston in Elix, Johnston, and Armstrong, 1986:348. [Type collection: Bolla Bollana Copper Smelter, 7.5 km NW of Arkaroola, Flinders Ranges, S.A., Australia, *Elix* 18080b, 31 Oct 1984 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, firm, 3–6 cm in diameter, light yellow green; lobes subirregular, 1.5–2.5 mm wide, contiguous to imbricate, crowded, becoming rugulose and transversely cracked toward the center, soredia and isidia lacking; medulla white; lower surface plane, pale brown, moderately rhizinate, rhizines pale brown, slender, unbranched, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Protocetraric and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 38.

DISTRIBUTION.—Australia (SA), South Africa (Transvaal).

COMMENTS.—While known only from a single small specimen in Australia, *X. verruciformis* is much more common in southern Africa. Of the 12 protocetraric acid-containing species lacking isidia and having a pale lower surface, only this one occurs in Australia, all the others being confined to southern Africa, where the closest relative is pigmented *X. dichromatica*.

Xanthoparmelia verrucigera, new combination

FIGURE 73*b*

Parmelia verrucigera Nylander, 1872:426. [Type collection: [Fougère], France, *Delise* s.n. (H-Nyl herb. no. 34780, lectotype).]

Parmelia conspersa var. *isidiophora* Trevisan, 1869:48. [Type collection: Near Mt. Bolca, Prov. Verona, Italy, *Trevisan, Lichenotheca Veneta* 48 (UPS, lectotype; FH, H, M, isolectotypes).]

Parmelia lusitana Nylander, 1881:449. [Type collection: Portugal, *Newton* s.n. (H, Nyl. herb. no. 34775, lectotype).]

Parmelia tarpatakensis Gyelnik, 1930b:32. [Type collection: Magas-Tátra, Comit. Szepes, Hungary, *Timkó* 3058 (BP, lectotype).]

Parmelia conspersa var. *loxodes* f. *lusitana* (Nylander) Boistel, 1903:64.

Parmelia conspersa var. *verrucigera* (Nylander) Boistel, 1903:64.

Parmelia servitiana Gyelnik in Servit, 1931:273. [Type collection: Hercegnovi, Dalmatia, *Servit* s.n. (BP, lectotype).]

Parmelia pulvinaris var. *mediterranea* Gyelnik, 1931b:277. [Type collection: Hercegnovi, Yugoslavia, *Servit* s.n. (BP, lectotype).]

Parmelia conspersa var. *verrucigera* f. *lusitana* (Nylander) Kušan, 1932:30.

Parmelia pseudoservitiana Gyelnik, 1934c:163. [Type collection: Amelie les Bains, Pyrenees, France, *Marc, Harm. Lich. Gall. Rar. Exs.* 113 (BP, lectotype; DUKE, isolectotype).]

Parmelia isidiigera f. *ligustica* Gyelnik, 1938a:281. [Type collection: Foiche, Ligustica, Italy, *Sbarbaro* 39 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).]

Parmelia pseudoservitiana f. *exornata* Gyelnik, 1938a:287. [Type collection: Herkulasfürdö, Roumania, *Gyelnik* s.n. (BP, lectotype).]

Xanthoparmelia lusitana (Nylander) Krog, 1987:384.

DESCRIPTION.—Thallus adnate on rock, 5–10 cm broad, yellowish green; lobes subirregular, 1–3 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia cylindrical (Figure 21*d*), 0.1–0.2 mm in diameter, 0.2–1 mm high, the tips syncorticate, darkening, sparsely branched; medulla white; lower surface plane, black, shiny, moderately rhizinate, the rhizines black, simple, 0.3–0.6 mm long. Pycnidia rare; conidia bifusiform, 0.5 × 6–7 µm. Apothecia not commonly developed, substipitate, 2–7 mm in diameter, the rim isidiate; spores 5–6 × 7–9 µm.

CHEMISTRY.—Stictic, constictic, cryptostictic, mennegazziac, and usnic acids and an unknown yellow spot below norstictic acid (lusitana unknown).

DISTRIBUTION.—Roumania, Hungary, Spain, Portugal, France, Italy, Kenya, South Africa (Transvaal, Natal, OFS, Transkei, Ciskei, Cape Province), Lesotho.

COMMENTS.—All of the type specimens listed above contain stictic acid with the lusitana unknown and lack norstictic acid. This is the prime difference from *X. conspersa*, a more northern species with norstictic acid (K+ yellow turning red) along with the stictic acid series (K+ persistent yellow). Many early authors, including not only Nylander (1881:449) but also Harmand (1909) and Gyelnik (1938a:271), were in fact able to separate *Parmelia isidiata* (= *X. conspersa*) and *P. verrucigera* (as *P. lusitana*) with very careful medullary color tests. Asahina's (1959) report from Japan is not correct since he demonstrated norstictic acid in the specimens. Nylander himself (1881:449) acknowledged that his *P. lusitana* was very close to this species and some authors later listed *P. verrucigera* as a synonym of *P. lusitana* (e.g., Olivier, 1894:58), without realizing that *P. verrucigera* was the older name.

The type of *P. verrucigera* is unfortunately very scrappy with somewhat globose, apparently malformed isidia, rarely seen in other lusitana unknown-containing specimens. It is mixed with a scrap of typical *X. conspersa*. The type of *Parmelia lusitana* has normal cylindrical isidia, and I am synonymizing it here because of the unusual chemistry.

Xanthoparmelia versicolor

Xanthoparmelia versicolor Hale, 1974b:490.

Parmelia versicolor Müller Argoviensis, 1881:506. [Type collection: "Nova

Hollandia australi," *Richard* [71] (G, lectotype). Not *Parmelia versicolor* (Persoon) Acharius 1803:190 (=*Lecanora*).]

Parmelia callifolia Kurokawa in Kurokawa and Filson, 1975:42. [New name for *P. versicolor* Müller Argoviensis.]

DESCRIPTION.—Thallus loosely adnate on soil, more or less pulvinate, 4–15 cm broad, light yellowish green; lobes sublinear, 1–3 mm wide, contiguous to imbricate, becoming laciniate toward the center with age, the laciniae 0.5–1 mm wide, weakly convoluted and canaliculate with a yellowish rim; upper surface continuous, emaculate, shiny, rugose with age, isidia and soredia lacking; medulla white; lower surface plane, dark brown to black in the center, sparsely to moderately rhizinate, the rhizines black, simple, 0.5–1 mm long. Pycnidia lacking. Apothecia very rare, substipitate, 1–4 mm in diameter; spores 4–7 × 7–9 µm.

CHEMISTRY.—Salazinic (major), norstictic (trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 39.

DISTRIBUTION.—Australia (Qld, NSW, Vic, SA, WA).

COMMENTS.—This species occurs in arid shrubland such as the mallee scrub across southern Australia. Externally it resembles *X. terrestris*, which is pale below and contains norstictic acid as the main component.

Xanthoparmelia vicaria

Xanthoparmelia vicaria Elix and Johnston in Elix, Johnston, and Armstrong, 1986:352. [Type collection: Gunners Quoin, Tasmania, Australia, *M.A. Cutliffe* 73/553 (HO 42734, holotype).]

DESCRIPTION.—Thallus adnate on rock, rather brittle, 4–8 cm broad, yellowish green, darkening with age; lobes subirregular, 1–2 mm wide, black-rimmed, contiguous to imbricate; upper surface continuous, emaculate, shiny, rugulose with age, moderately to densely isidiate, the isidia cylindrical (Figure 21*e*), 0.06–0.1 mm in diameter, to 0.8 mm high, the tips syncorticate, dark, simple to coralloid-branched; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate, the rhizines black, 0.5–1 mm long, unbranched. Pycnidia and apothecia lacking.

CHEMISTRY.—Barbatic, 4-*O*-demethylbarbatic, 3-α-hydroxybarbatic (trace), and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 40.

DISTRIBUTION.—Australia (Tas).

COMMENTS.—Known only from the type collection, *X. vicaria* resembles *X. neotinctina* (norstictic acid) and *X. nashii* (diffractaic acid), both Australasian species.

Xanthoparmelia victoriana

Xanthoparmelia victoriana Elix and Johnston, 1987:367. [Type collection: Whipstick, Millwood Road, 11.5 km NNE of Huntly, Bendigo District, Vict., Australia, *Johnston* 1592, 11 Dec 1984 (CBG, holotype; MEL, isotype).]

DESCRIPTION.—Thallus very tightly adnate to tightly adnate on rock, sometimes appearing areolate at the center, rather fragile, 2–4 cm broad, yellowish green but darkening with age; lobes sublinear, 0.2–0.8 mm wide, separate to contiguous or subimbricate; upper surface continuous, emaculate, shiny to opaque, transversely cracked with age, moderately to densely isidiate, the isidia globose to distorted cylindrical, inflated, 0.08–0.12 mm in diameter, 0.1–0.3 mm high, the tips epicorticate, dull brownish, eventually erumpent but not clearly sorediate, unbranched; medulla white; lower surface plane, pale brown to brown, sparsely rhizinate, the rhizines brown, simple, 0.1–0.3 mm long. Pycnidia lacking. Apothecia rare, sessile, about 1 mm in diameter; spores 5–6 × 7–9 µm.

CHEMISTRY.—Stictic, constictic, norstictic, cryptostictic (trace), and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1987, fig. 9.

DISTRIBUTION.—Australia (Vic), South Africa (Natal, Transvaal).

COMMENTS.—Another tightly adnate, globose-isidiate species, *X. congensis*, has a black lower surface. This species is known from the type locality in Victoria and from moist sandstone outcrops in the Drakenbergs in South Africa.

Xanthoparmelia villamiliana

FIGURE 73*c*

Xanthoparmelia villamiliana Nash, Elix, and Johnston, 1987:289. [Type collection: 1 km west of Cacheuta along route 7, Province of Mendoza, Argentina, *Nash* 23907 (ASU, holotype; ANUC, BAFC, US, isotypes).]

DESCRIPTION.—Thallus adnate on soil, over mosses on soil, or rarely on rock, 3–5 cm broad, yellow green; lobes subirregular to sublinear, 0.8–2 mm wide, imbricate, the apices rounded or shallowly notched; upper surface shiny, rugose, moderately to densely isidiate, the isidia cylindrical, robust, 0.16–0.22 mm in diameter, up to 2 mm high, the tips syncorticate, pale, becoming richly coralloid-branched; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines short, black, simple, coarse, 0.2–0.5 mm long. Pycnidia lacking. Apothecia rare, to 4 mm in diameter; spores 3–6 × 9–11 µm.

CHEMISTRY.—Stictic, constictic, norstictic, cryptostictic, and usnic acids.

ILLUSTRATION.—Nash, Elix, and Johnston, 1987, fig. 5.

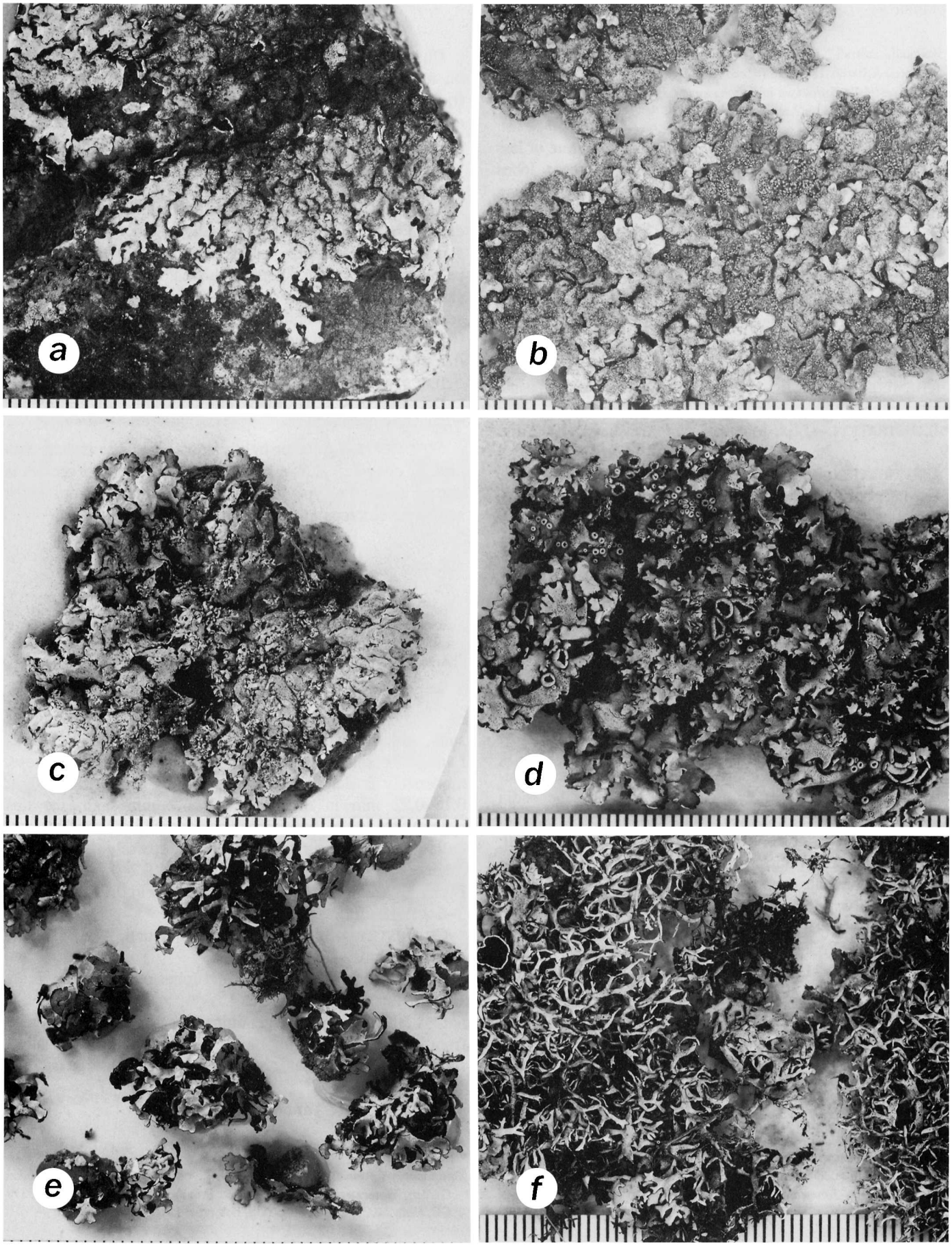
DISTRIBUTION.—Argentina.

COMMENTS.—This Argentinian species is differentiated from *X. conspersa* by the soil habitat, more adnate thallus, somewhat broader lobes, and disproportionately large isidia.

Xanthoparmelia viridis

FIGURE 73*d*

Xanthoparmelia viridis Hale, 1986b:609. [Type collection: Karoo Botanical Garden, Worcester, elev. 300 m, Cape Province, South Africa, Grid 3319 CC, *Hale* 74023, 20 Jan 1986 (US, holotype; LD, PRE, isotypes).]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DESCRIPTION.—Thallus adnate to loosely adnate on rock, 6–10 cm broad, greenish yellow; lobes subirregular to sublinear, 1.2–2.5 mm wide, imbricate, irregularly laciniate; upper surface faintly to distinctly maculate, shiny, isidia and soredia lacking; medullea white; lower surface plane, brown but blackening at the center, uniformly moderately rhizinate, the rhizines black, simple, 1–1.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–7 μm. Apothecia numerous, substipitate, 2–4 mm in diameter; spores 5–7 × 9–10 μm.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 61.

DISTRIBUTION.—South Africa (Cape Province).

COMMENTS.—*X. viridis*, known only from the Karoo Botanical Garden, is related to fumarprotocetraric acid-containing *X. phaeophana*, a common southern African lichen which is brown below. It is also related to *X. synestia*, a more widely distributed species in South Africa with salazinic acid.

Xanthoparmelia walteri

FIGURE 73*e*

Xanthoparmelia walteri Knox in Knox and Brusse, 1983:157. [Type collection: Namibwuste 10–20 km N of Swakopmund, SWA, Namibia, *Moisel* 5168 (US, isotype).]

DESCRIPTION.—Thallus loosely adnate on pebbles, more rarely free growing on soil, firm, 3–6 cm broad, dull yellowish green; lobes sublinear to linear, 0.5–1.5 mm wide, subascending and curling up, separate to loosely imbricate; upper surface to weakly to distinctly white-maculate, shiny, transversely cracked and rugose with age, isidia and soredia lacking; medulla white; lower surface plane, black but sometimes turning dark brown at the center with age, strongly reticulately rugose, very sparsely rhizinate, the rhizines black, coarse, simple, 0.1–0.5 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, norstictic (±trace), and usnic acids.

ILLUSTRATION.—Knox and Brusse, 1983, fig. 11.

DISTRIBUTION.—SWA/Namibia.

COMMENTS.—This is the commonest *Xanthoparmelia* in the coastal fog zone of Namibia, forming a desert lichen cover many kilometers in extent and imparting a blackish tint to the landscape. It is usually firmly attached to pebbles but the tips are free and ascending. A variant species in Namaqualand, *X. hyporhytida*, is larger on the average and produces the chalybaeizans unknown in addition to salazinic acid.

Xanthoparmelia weberi

Xanthoparmelia weberi (Hale) Hale, 1974b:490.

Parmelia weberi Hale, 1971b:92. [Type collection: Desert Mts., 3 mi SW of Superior, just south of Picketpost Mountain, near Southwestern Arboretum, Pinal Co., Arizona, *Weber and McCleary* S1897 (COLO, holotype; US, isotype).]

DESCRIPTION.—Thallus adnate on rock, rarely on lignum, 3–6 cm broad, light yellowish green; lobes subirregular, 2–3 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, moderately to densely rhizinate, the isidia initially globose, cylindrical to irregularly inflated at maturity (Figure 21*f*), 0.1–0.2 mm in diameter, 0.1–0.8 mm high, the tips epicorticate, dull brown, very weakly erumpent, becoming branched with age; medulla white; lower surface plane, pale brown or rarely darkening, moderately rhizinate, the rhizines pale brown, simple, 0.3–0.5 mm long. Pycnidia rarely developed; conidia bifusiform, 0.5 × 5–6 μm. Apothecia rare, substipitate, 2–4 mm in diameter; spores 5–6 × 10–12 μm.

CHEMISTRY.—Hypoprotocetraric, 4-*O*-demethylnotatic, and usnic acids.

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 41.

DISTRIBUTION.—Western USA, Mexico, Australia (SA, NT, WA), South Africa (Transvaal, Natal), SWA/Namibia, Kenya, Uganda.

COMMENTS.—The range of variation in this common species is not yet fully understood. Australian specimens are rather tightly adnate whereas the American populations are only moderately adnate and cannot be told from *X. mexicana* without a chemical test. The isidia are extremely variable in size, with some specimens appearing to be erumpent, others not at all. SEM photographs show most isidia to be more or less epicorticate. In Africa it can be confused with *X. neoweberi*, a smaller lichen with skyrin and a darker brown lower surface.

Xanthoparmelia wesselsii

FIGURE 73*f*

Xanthoparmelia wesselsii Hale, 1986b:609. [Type collection: summit of Long Tom Pass on S side of Hwy R37, Farm De Kuiten, Lydenburg, elev. 2140 m, Transvaal, South Africa, Grid 2430 BA, *Hale* 72043, 16 Jan 1986 (US, holotype; LD, PRE, isotypes).]

DESCRIPTION.—Thallus loosely adnate on soil and humus, easily breaking apart, 4–7 cm broad; lobes sublinear, 0.5–1.5 mm wide, elongate and sometimes weakly constricted, more or less weakly convoluted, dichotomously branched, separate to divaricately imbricate, the ultimate branches becoming terete, subascending; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, shiny, light to darker brown in flaring parts of lobes, interrupted by yellowish constricted parts, sparsely rhizinate, the rhizines brown to dark brown, simple, 0.5–1 mm long. Pycnidia not well developed; conidia not seen. Apothecia adnate, 3–4 mm in diameter; spores 5–6 × 9–10 μm.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

ILLUSTRATION.—Hale, 1986b, fig. 62.

FIGURE 73.—Species of *Xanthoparmelia*: *a*, *X. verdonii* (*Elix* 5252); *b*, *X. verrucigera* (*Hale* 72440); *c*, *X. villamiliana* (*Lamb* 5770 in FH); *d*, *X. viridis* (*Hale* 74023, holotype in US); *e*, *X. walteri* (*Moisel* 5168, holotype in US); *f*, *X. wesselsii* (*Hale* 72043, holotype in US). Scale in mm.

DISTRIBUTION.—South Africa (Transvaal).

COMMENTS.—This soil-inhabiting lichen from higher elevations in the Drakensbergs escarpment of Transvaal has a lower surface consisting of flattened, flaring light brown parts a few mm long and intervening constricted areas concolorous with the upper surface. Another terricolous lichen in the Drakensbergs, *X. terricola*, has broader, more appressed lobes.

Xanthoparmelia wildeae

FIGURE 74*a*

Xanthoparmelia wildeae (Dodge) Hale, 1974b:490.

Parmelia wildeae Dodge, 1959:66. [Type collection: St. Helena, *Wilde* s.n. (BM, holotype).]

DESCRIPTION.—Thallus loosely adnate on rock, more or less pulvinate, fragile, 4–13 cm broad, yellowish green; lobes sublinear, 0.5–1 mm wide, contiguous to imbricate, becoming laciniate with age at the center, the laciniae short, 0.2–0.3 mm wide; upper surface continuous, emaculate, shiny, sorediate, the soralia orbicular, ~1 mm in diameter; medulla white; lower surface plane, pale to brown, sparsely rhizinate, the rhizines brown, 0.1–0.4 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, protocetraric (trace), and usnic acids.

DISTRIBUTION.—St. Helena.

COMMENTS.—Although known only from the type collection on St. Helena, *X. wildeae* is unique in lobe configuration and abundant soralia. South American *X. ulcerosa* has much broader lobes (1.5–4 mm wide) and *X. cotopaxiensis* from Ecuador has narrow lobulate-laciniate lobes.

Xanthoparmelia willisii

FIGURE 74*b*

Xanthoparmelia willisii (Kurokawa and Filson) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:355.

Parmelia willisii Kurokawa and Filson in Filson, 1982:577. [Type collection: Nullarbor Region, Eyre Highway, 11 mi E of Koonalda, S.A., Australia, *Willis* s.n., 18 Oct 1961 (MEL, holotype; TNS, isotype).]

DESCRIPTION.—Thallus loosely adnate to free growing on soil, firm, forming rosettes 2–3 cm broad, becoming subpulvinate, light yellowish green; lobes sublinear, 0.6–2 mm wide, dichotomously branched, separate to subimbricate, subascending; upper surface white maculate, shiny, isidia and soredia lacking; medulla white; lower surface canaliculate, pale brown or concolorous with the upper surface with a raised yellowish rim, very sparsely rhizinate, the rhizines, simple to branched, blackening, simple to furcate, 0.5–1 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Fumarprotocetraric, succinprotocetraric, protocetraric (±trace), physodalic (±trace), and usnic acids.

ILLUSTRATION.—Filson, 1982, fig. 20.

DISTRIBUTION.—Australia (Qld, NSW, SA, WA, Tas).

COMMENTS.—This is a member of the *X. amphixantha* group, distinguished by the presence of fumarprotocetraric acid and broad maculate lobes that are concolorous below. A very closely related species with the same chemistry, *X. reptans*, is more distinctly rhizinate and has a pale brown lower surface.

Xanthoparmelia wisangerensis

FIGURE 74*c*

Xanthoparmelia wisangerensis Elix and Johnston, 1987:368. [Type collection: Wisanger Hills Homestead, 7 km WSW of Emu Bay, Kangaroo Island, South Australia, Australia, *Elix* 19648, 27 Oct 1985 (CBG, holotype; MEL, isotype).]

DESCRIPTION.—Thallus adnate on rock, 3–6 cm broad, light yellowish green; lobes subirregular to sublinear, 1–2 mm wide, contiguous to imbricate, black-rimmed toward the tips, developing linear-elongate, subdichotomously divided, subterete, revolute or canaliculate secondary laciniae toward the center, the laciniae 0.2–0.4 mm wide; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower surface plane, pale tan but darkening toward the tips, sparsely to moderately rhizinate, the rhizines brown, slender, simple, 0.2–0.5 mm long. Pycnidia common; conidia subbifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 1–3 mm in diameter; spores 4–6 × 7–10 µm.

CHEMISTRY.—Norstictic, salazinic, connorstictic, consalazinic, and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1987, fig. 10.

DISTRIBUTION.—Australia (SA).

COMMENTS.—This species is known only from the type locality. It is superficially close to the North American *X. californica*, which lacks secondary laciniae.

Xanthoparmelia worcesteri

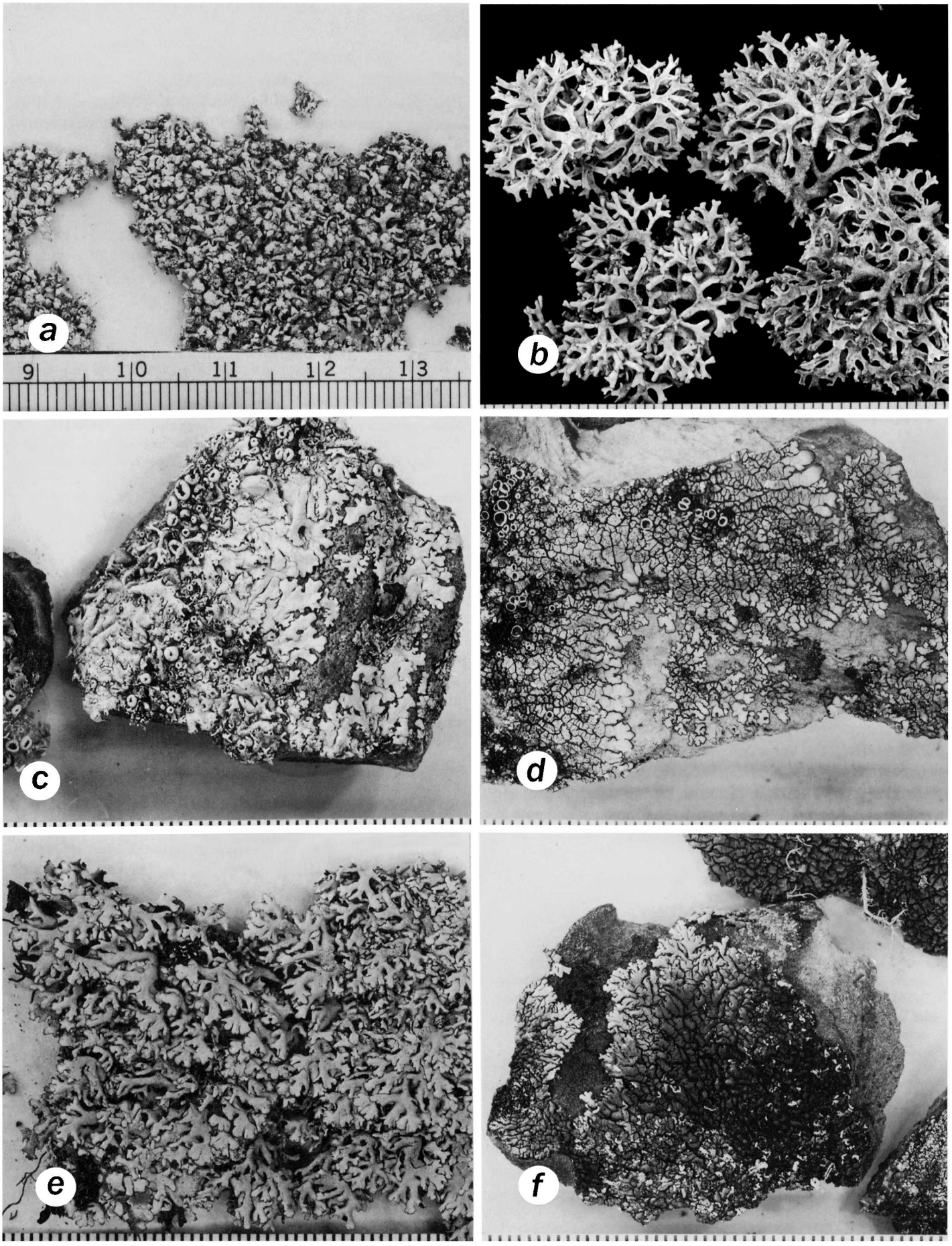
FIGURE 74*d*

Xanthoparmelia worcesteri (Steiner and Zahlbruckner) Hale, 1974b:490.

Parmelia worcesteri Steiner and Zahlbruckner in Zahlbruckner, 1926:511. [Type collection: Worcester, Cape Prov., South Africa, *Brunnthaler* s.n. (WU, lectotype; W, isolectotype).]

DESCRIPTION.—Thallus very tightly adnate, appearing areolate in the center, 3–8 cm broad, light yellowish green; lobes sublinear, 0.5–1 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, rugose at the center, isidia and soredia lacking; medulla white; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, adnate, 1–4 mm in diameter; spores 6 × 9–10 µm.

FIGURE 74.—Species of *Xanthoparmelia*: *a*, *X. wildeae* (isotype (?) in NY); *b*, *X. willisii* (*Bratt* 69/449); *c*, *X. wisangerensis* (*Elix* 19648, holotype in CBG); *d*, *X. worcesteri* (*Hale* 74400); *e*, *X. wyomingica* (*Shushan* 4716); *f*, *X. xanthomelaena* (*Hale* 66593). Scale in mm.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CHEMISTRY.—Lecanoric and usnic acids.

DISTRIBUTION.—South Africa (Cape Province), SWA/Namibia.

COMMENTS.—This is the most typical and widespread of the tightly adnate karoo lichens in southern Africa. Gyelnik (1935:53) examined the type, noting the C+ red medullary reaction, which Zahlbruckner had used as a diagnostic character. Zahlbruckner also compared it with his own *X. brunnthaleri*, which contains scabrosin derivatives and is C-. Two other species in this group, *X. applicata* (barbatic acid) and *X. sigillata* (evernic acid), also occur in the Great Karoo and are distinguished by chemistry.

Xanthoparmelia wrightiana

Xanthoparmelia wrightiana Nash, Elix, and Johnston, 1987:290. [Type collection: Sierra de la Ventana, Partido Tornquist, Province of Buenos Aires, Argentina, *Nash* 23878 (ASU, holotype; ANUC, isotype).]

DESCRIPTION.—Thallus adnate on rocks, up to 6 cm broad, yellow green; lobes subirregular, 1.5–3 mm wide, separate to imbricate; upper surface continuous, emaculate, shiny, moderately to densely isidiate, the isidia globose or short-cylindrical at first, 0.1–0.2 mm in diameter, to 0.7 mm high, in part erumpent and subsorediate at maturity, unbranched; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate, the rhizines black, stout, simple, 0.3–0.5 mm long. Pycnidia lacking. Apothecia rare, to 4 mm in diameter; spores 4–6 × 8–10 µm.

CHEMISTRY.—Stictic, constictic, norstictic, cryptostictic (trace), hypostictic (trace), connorstictic (trace), and usnic acids.

ILLUSTRATION.—Nash, Elix, and Johnston, 1987, fig. 6.

DISTRIBUTION.—Venezuela, Argentina.

COMMENTS.—A related species in the Andes Mountains and Australia, *X. cordilleriana*, differs in having salazinic acid and a pale brown to brown lower cortex. The Mexican endemic *X. amableana* has dark-tipped, branched isidia.

Xanthoparmelia wyomingica

FIGURE 74*e*

Xanthoparmelia wyomingica (Gyelnik) Hale, 1974b:490.
Parmelia wyomingica (Gyelnik) Hale, 1971a:344.
Parmelia digitulata var. *wyomingica* Gyelnik, 1938a:277. [Type collection: Soldiers Park, N fork of Clear Creek, Big Horn Mountains, Wyoming, USA, *Williams, Decades N.A. Lich.* 316 (BP, lectotype; FH, US, YU, isolectotypes).]
Parmelia austroafricana f. *wyomingica* (Gyelnik) Gyelnik, 1938b:22.

DESCRIPTION.—Thallus loosely adnate to free growing on pebbles and soil, firm, forming intact rosettes 4–8 cm broad, yellowish green; lobes sublinear, 1–3 mm wide, more or less convoluted, separate to subimbricate, laciniate with age, the laciniae rarely subterete; upper surface continuous, emaculate, shiny, isidia and soredia lacking; medulla white; lower plane, pale to dark brown, moderately to densely rhizinate, the rhizines brown, simple, 0.2–1 mm long, projecting out below. Pycnidia common; conidia bifusiform, 0.5 × 5–6 µm. Apothecia common, substipitate, 1–3 mm in diameter; spores 4 × 8 µm.

CHEMISTRY.—Salazinic, consalazinic (±), and usnic acids.

ILLUSTRATION.—Egan, 1975, fig. 2.

DISTRIBUTION.—Western North America.

COMMENTS.—This terricolous lichen is restricted to exposed habitats at high elevation (above 3000 m) and alpine areas in the Rocky Mountains, well above the open, sandy grazing land where closely related *X. chlorochroa* is found.

Xanthoparmelia xanthomelaena

FIGURE 74*f*

Xanthoparmelia xanthomelaena (Müller Argoviensis) Hale, 1987b:334.
Parmelia xanthomelaena ["xanthomelana"; spelling corrected by Vainio (1900:6)] Müller Argoviensis, 1883:48. [Type collection: Grampian Mountains, Australia, *Sullivan* 28 (G, lectotype).]
Pseudoparmelia xanthomelaena (Müller Argoviensis) Hale, 1974a:191.
Paraparmelia xanthomelaena (Müller Argoviensis) Elix and Johnston in Elix, Johnston, and Verdon, 1986:281.

DESCRIPTION.—Thallus very tightly adnate to tightly adnate on rock, the central part appearing areolate, 4–5 cm broad, dull yellowish green, brownish and darkening with age at the center; lobes sublinear, 0.2–0.8 mm wide, irregularly dichotomous branched, the tips sometimes ascending, contiguous to subimbricate, more or less black rimmed, sublaciniate with age; upper surface continuous, emaculate, shiny, transversely cracked with age, isidia and soredia lacking; medulla white; lower surface plane, black, shiny, sparsely to moderately rhizinate, the rhizines, black, rather coarse, simple, 0.2–0.3 mm long. Pycnidia rare; conidia cylindrical, 0.5 × 7–9 µm. Apothecia adnate, 0.5–1.5 mm in diameter; spores 5–6 × 8–10 µm.

CHEMISTRY.—Stictic, constictic, norstictic, and usnic acids.

ILLUSTRATION.—Hale, 1976a, fig. 18e. (as *Pseudoparmelia xanthomelaena*).

DISTRIBUTION.—Australia (NSW, Vic), New Zealand, South Africa (Cape Province).

COMMENTS.—In his original description Müller described the center of the thallus as "subgranulato-areolatus" and this is indeed a typical centrally areolate species. On the basis of microcrystal tests I had earlier assigned this species to *Pseudoparmelia* (Hale, 1974a, 1976a), although Vainio (1900:6) noted its resemblance to *X. mougeotii*. Recent analyses with TLC and HPLC by Dr. J. A. Elix, however, indicate the presence of usnic acid, not atranorin, in the cortex. This rather rare species is most closely related to *X. tegeta*, which is more loosely adnate, may form compact mats, and occurs in Australia and South Africa. Some specimens from South Africa have been redetermined as *X. greytonensis*, which has delicate

rhizines, a generally lighter yellow-green thallus, and pale-rimmed lobes.

Xanthoparmelia xanthomelanoides

FIGURE 75*a*

Xanthoparmelia xanthomelanoides Elix and Johnston, 1988b:363. [Type collection: 6.5 km W of Springton, High Eden road, Mt. Lofty Ranges, South Australia, Australia, *Elix* 2252, 20 May 1976 (CBG, holotype; MEL, isotype).]

DESCRIPTION.—Thallus very tightly adnate to tightly adnate on rock, 2–3 cm broad, yellow green but darkening with age; lobes sublinear, 0.5–1 mm wide, dichotomously branched, subimbricate; upper surface continuous, emaculate, shiny, transversely cracked with age, soredia and isidia lacking; medulla white; lower surface plane, pale tan to brown, sparsely rhizinate, the rhizines pale tan to brown, simple, robust, ~0.1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 5–9 µm. Apothecia substipitate, ~1 mm in diameter; spores 6–7 × 8–9 µm.

CHEMISTRY.—Stictic (major), constictic, norstictic (minor), cryptostictic (trace), and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1988b, fig. 10.

DISTRIBUTION.—Australia (SA, WA).

COMMENTS.—Externally similar *X. xanthomelaena* has the same chemistry but the lower surface is black.

Xanthoparmelia xanthosorediata

FIGURE 75*b*

Xanthoparmelia xanthosorediata (Elix) Elix and Johnston in Elix, Johnston, and Armstrong, 1986:357.

Parmelia xanthosorediata Elix, 1981:373. [Type collection: Kowen Forest, 16 km E of Canberra, A.C.T., Australia, *Elix* 1830 (MEL, holotype; CBG, isotype).]

DESCRIPTION.—Thallus tightly adnate to adnate on rock, 3–5 cm broad, yellowish green; lobes subirregular, 1–1.5 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, transversely cracked, sorediate, the soredia powdery-granular, soralia orbicular, becoming diffuse; medulla white; lower surface plane, pale brown to chestnut brown, moderately rhizinate, the rhizines brown, simple, 0.2–0.4 mm long. Pycnidia lacking. Apothecia rare, substipitate, 1–3 mm in diameter; spores 6 × 8 µm.

CHEMISTRY.—Norlobaridone, loxodin, conorlobaridone, conloxodin, constipatic, protoconstipatic, and usnic acids.

ILLUSTRATION.—Elix, 1981, fig. 18.

DISTRIBUTION.—Australia (NSW, ACT, WA).

COMMENTS.—The distinguishing features of this rare lichen are soredia and the production of conloxodin and conorlobaridone as well as loxodin and norlobaridone. *Xanthoparmelia filarszkyana* is a possible nonsorediate morph.

Xanthoparmelia xerophila

FIGURE 75*c*

Xanthoparmelia xerophila Elix and Johnston in Elix, Johnston, and Armstrong, 1986:358. [Type collection: Mt. Remarkable, Melrose, Flinders Ranges, S.A., Australia, *Elix* 17752, 26 Oct 1984 (CBG, holotype).]

DESCRIPTION.—Thallus very tightly adnate on rock, 1–3 cm broad, the center appearing areolate, dark yellowish green with age; lobes sublinear, 0.2–0.5 mm wide, irregularly branched and short, contiguous to subimbricate, the tips brownish; upper surface continuous, emaculate, shiny, moderately isidiate, the isidia papillate to cylindrical (Figure 21*g*), 0.06–0.08 mm in diameter, 0.1–0.15 mm high, the tips syncorticate, black, unbranched to sparingly branched; medulla white; lower surface plane, black, sparsely rhizinate, the rhizines black, 0.1–0.15 mm long. Pycnidia and apothecia lacking.

CHEMISTRY.—Barbatic (major), protoconstipatic, 4-*O*-demethylbarbatic, and usnic acids, atranorin (±trace).

ILLUSTRATION.—Elix, Johnston, and Armstrong, 1986, fig. 42.

DISTRIBUTION.—Australia (SA).

COMMENTS.—This inconspicuous lichen is externally similar to the South African *X. keralensis* with stenosporonic acid. Two other Australasian species, stictic acid-containing *X. mougeotina* (black below) and norlobaridone-containing *X. exillima* (pale below) have the same external appearance.

Xanthoparmelia xizangensis

FIGURE 75*d*

Xanthoparmelia xizangensis Hale, 1988b:406.

Parmelia tinctina var. *xizangensis* Wei, 1983:223. [Type collection: Changdu, Xizang (Tibet), China, *Zong et al.*, 218-1, 1 Jun 1976 (HMAS, holotype).]

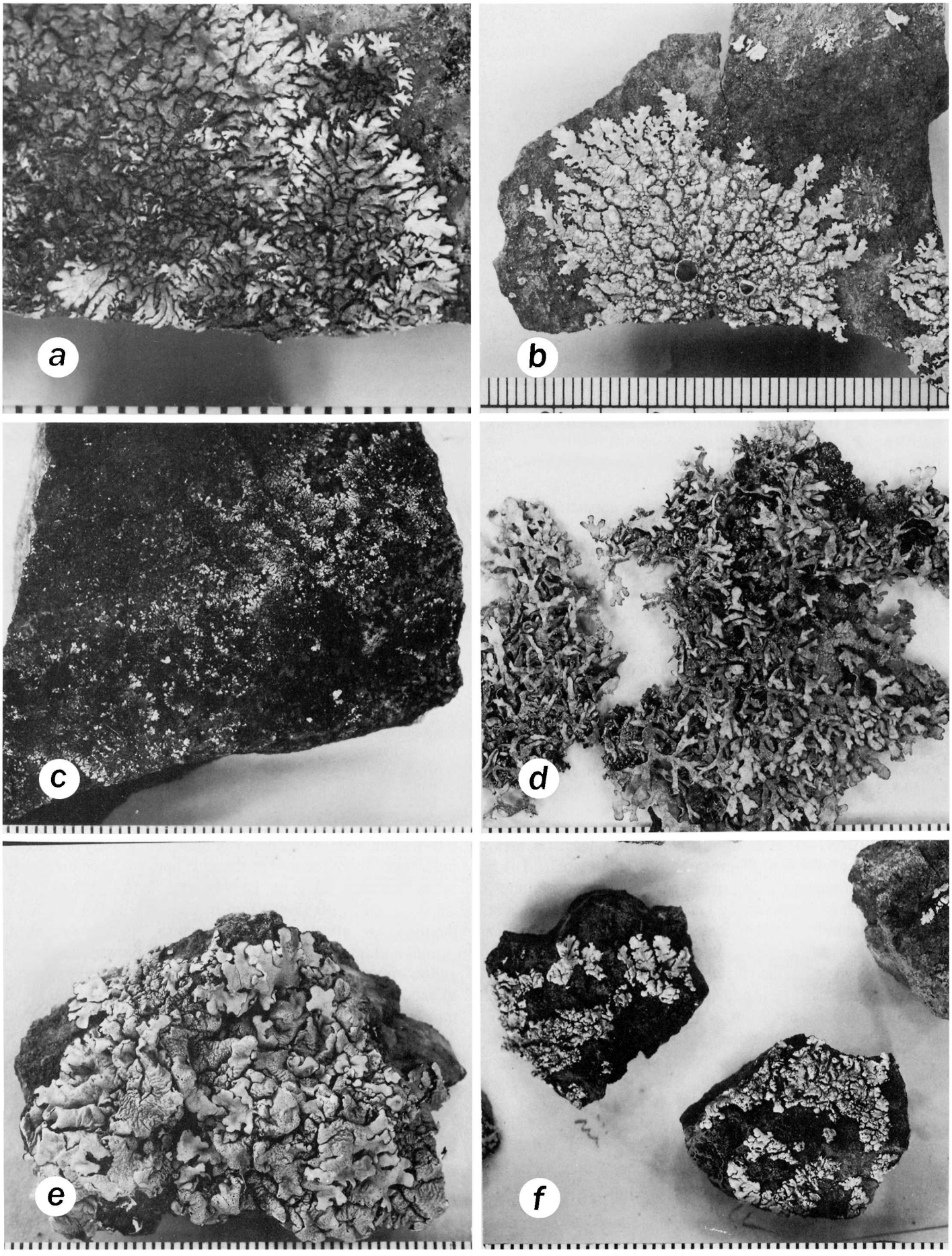
DESCRIPTION.—Thallus loosely adnate on rock, rather brittle, 4–6 cm broad, darkish yellow green; lobes sublinear, 0.8–1.5 mm wide, dichotomously branched, loosely divaricate-imbricate, brown-rimmed at the tips; upper surface uniformly white maculate, shiny, moderately isidiate, the isidia cylindrical (Figure 21*h*), 0.15–0.2 mm in diameter. to 0.8 mm high, the tips syncorticate, pale to brownish, sparsely branched; medulla white; lower surface plane, dark brown and weakly yellow-rimmed at the tips, blackening at the center, sparsely to moderately rhizinate, the rhizines black, simple, 0.3–0.6 mm long. Pycnidia well developed; conidia bifusiform, 0.5 × 4–5 µm. Apothecia lacking.

CHEMISTRY.—Salazinic, consalazinic, and usnic acids.

ILLUSTRATION.—Wei, 1983 fig. 1.

DISTRIBUTION.—China (Tibet).

COMMENTS.—This is one of the few white-maculate species in the genus with isidia. It is known only from the type collected in Tibet. While superficially similar, *X. tinctina* has a continuous upper surface and globose isidia.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b
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Xanthoparmelia yowaensis

FIGURE 75*e*

Xanthoparmelia yowaensis Elix and Johnston, 1987:369. [Type collection: The Bluff, Yowa Opal Field, near Cunnamulla, Queensland, Australia, *Ballingall* 1668B, 2 Sep 1984 (CBG, holotype).]

DESCRIPTION.—Thallus adnate to loosely on rock, 3–6 cm broad, yellowish green; lobes subirregular to sublinear, 1.5–3 mm wide, crowded, short and irregularly branched, contiguous to imbricate, black-rimmed toward the tips; upper surface effigurate maculate, shiny to opaque, distinctly rugulose and wrinkled with age, irregularly cracked, isidia and soredia lacking; medulla white; lower surface plane, black, rugulose, sparsely to moderately rhizinate, the rhizines black, simple, robust, 0.3–0.5 mm long. Pycnidia poorly developed; conidia bifusiform, 0.5 × 5–6 µm. Apothecia lacking.

CHEMISTRY.—Fumarprotocetraric (major), succinprotocetraric, protocetraric (trace), lobaric (±trace), and usnic acids.

ILLUSTRATION.—Elix and Johnston, 1987, fig. 11.

DISTRIBUTION.—Australia (Qld, WA).

COMMENTS.—The effigurate-maculate surface relates this species to the *X. hypoleia* group, especially Australian *X. pseudohypoleia*, but the thallus is adnate and the lobes are relatively short and subirregular. A parallel case is adnate, effigurate-maculate *X. karoo*, a hypoprotocetraric acid-containing species from South Africa, and loosely adnate, elongate-lobed *X. hypoprotocetrarica*. It is known only from the type locality and a collection from Western Australia.

Xanthoparmelia zonata

FIGURE 75*f*

Xanthoparmelia zonata Elix and Johnston, 1987:369. [Type collection: Castles area, 14 km S of Yowa Opal Field, W of Cunnamulla, Queensland, Australia, *Ballingall* 1746A, 25 Sep 1984 (CBG, holotype).]

DESCRIPTION.—Thallus tightly adnate on rock, 1–3 cm broad, yellowish green but darkening with age; lobes subirregular, 0.5–1.3 mm wide, contiguous to imbricate; upper surface continuous, emaculate, shiny, becoming rugulose and areolate with age, transversely cracked, moderately isidiate, the isidia globose and coarse, becoming short cylindrical (Figure 21*i*), 0.15–0.2 mm in diameter, 0.1–1 mm high, the tips weakly epicorticate, grayish or darkening, sparsely branched; upper medulla white, lower medulla ochre in part; lower surface plane, pale to light brown or darker toward the tips, shiny, sparsely to moderately rhizinate, the rhizines pale to light brown, simple, 0.2–0.5 mm long. Pycnidia and apothecia lacking.

FIGURE 75.—Species of *Xanthoparmelia*: *a*, *X. xanthomelaenoides* (*Elix* 2252, holotype in CBG); *b*, *X. xanthosorediata* (*Elix* 1830); *c*, *X. xerophila* (*Elix* 17752, holotype in CBG); *d*, *X. xizangensis* (*Zong* 218-1, holotype in HMAS); *e*, *X. yowaensis* (*Ballingall* 1668B, holotype in CBG); *f*, *X. zonata* (*Ballingall* 1764A, holotype in CBG). Scale in mm.

CHEMISTRY.—Lobaric (major), constipatic, protoconstipatic, colensoic (trace), and usnic acids, scabrosin 4-acetate-4′butyrate, scabrosin 4-acetate-4′-hexanoate, scabrosin 4,4′-dibutyrate, scabrosin 4,4′-diacetate (trace), and skyrin.

ILLUSTRATION.—Elix and Johnston, 1987, fig. 12.

DISTRIBUTION.—Australia (Qld).

COMMENTS.—This species, known only from the type locality, is unique in having lobaric acid as the major component. It is morphologically similar to *X. ballingalliana* and *X. immutata*, both of which contain scabrosin derivatives.

List of Nomina Inquirenda and Excluded or Untypified Names

The following names have been incorrectly assigned to "Xanthoparmelia" or are not typifiable because the type specimens could not be found.

Imbricaria centrifuga (L.) Koerber, 1855:82.
See entry under *Lichen centrifugus*.

Imbricaria incurva (Persoon) Koerber, 1855:82.
See entry under *Lichen incurvus*.

Imbricaria subconspersa (Nylander) Jatta, 1902:470.
See entry under *Parmelia subconspersa*.

Lichen hottentottus Acharius, 1798:155.
TYPE COLLECTION.—Cape of Good Hope, South Africa, *Thunberg* s.n. (UPS, lectotype). This is now recognized as *Xanthomaculina hottentotta* (Acharius) Hale (Hale, 1985b).

Lichen centrifugus L., 1753:1142.
TYPE COLLECTION.—Sweden (LINN, Linn. herb. 1273.58, lectotype). This is *Arctoparmelia centrifuga* (L.) Hale (Hale, 1986a).

Lichen incurvus Persoon, 1794:24.
TYPE COLLECTION.—[Sudetan, Germany, s.c.] (L, neotype). This is *Arctoparmelia incurva* (Persoon) Hale (Hale, 1986a).

Lichen ceranoides Lamarck, 1789:487.
TYPE COLLECTION.—Cape of Good Hope, South Africa, *Sommerat* s.n. (G, lectotype). This is a later homonym of *Lichen ceranoides* Hedwig (Bryophyta) and a synonym of *Xanthomaculina hottentotta* (Acharius) Hale (Hale, 1985b).

Lichen multifidus Dickson, 1793, pl. 16, table 9, fig. 7.
TYPE COLLECTION.—England, *Pl. Crypt. Fasc.* 16 (BM, lectotype). This is a synonym of *Arctoparmelia centrifuga* (L.) Hale (Hale, 1986a).

Omphalodium convolutum Hue, 1900:111.
TYPE COLLECTION.—Walwich Bay, Africa, *Duparquet* s.n. (PC, lectotype). This is *Xanthomaculina convoluta* (Hue) Hale (Hale, 1985b).

Omphalodium pachythallum (Sprengel) Dodge, 1959:190.
See entry under *Parmelia pachythalla*.

Omphalodium stictellum (Massalongo) Dodge, 1959:186.
See entry under *Parmelia stictella*.

Parmelia adhaerens Nylander in Crombie, 1876a:19 and 1876b:168.
TYPE COLLECTION.—Table Mountain, Cape of Good Hope, South Africa, *Eaton* s.n. (BM, lectotype; H-Nyl, herb. no. 34823, isolectotype). This species is now recognized as *Karoowia adhaerens* (Nylander) Hale (Hale, 1989c).

Parmelia adpressa var. *stenophylloides* Müller Argoviensis, 1888b:56.
TYPE COLLECTION.—Paraguay, *Balansa* s.n. (G). This is a species of *Xanthoparmelia* but too fragmentary to characterize, except for the presence of stictic acid.

Parmelia aleuritica Nylander, 1875:103.
TYPE COLLECTION.—[Padasjoki], Finland, *Norrlin* s.n. (H-Nylander herb. no. 34674, lectotype). This is a member of *Arctoparmelia*: *A. aleuritica* (Nylander) Hale (Hale, 1986a).

Parmelia antarctica Vainio, 1903:13.
TYPE COLLECTION.—Cap van Beneden, Terre de Danco, Detroit de Gerlache, *Gerlache* 226 p.p. (TUR, Vainio herb. no. 12839, lectotype). This is *Flavoparmelia gerlachei* (Zahlbruckner) Hale (Hale, 1986c).

Parmelia benguellensis (Vainio) Dodge, 1959:70.
See entry under *Parmelia subconspersa* var. *benguellensis* Vainio.

Parmelia bipindensis Dodge, 1959:59.
TYPE COLLECTION.—Bipinde, Cameroon, *Zenker* 4053 p.p. (BM, holotype). This belongs in the genus *Pseudoparmelia* and is a synonym of *P. sphaerospora* (Nylander) Hale (Hale, 1976a).

Parmelia birulae Elenkin, 1906:36.
TYPE COLLECTION.—Jenisseisk, Zaria Station, Siberia, USSR, *Birula* s.n. (not seen). This is a synonym of *Arctoparmelia separata* (T. Fries) Hale (Hale, 1986a).

Parmelia birulae var. *angustior* Elenkin, 1909:19.
TYPE COLLECTION.—Negri, Tajmyr Distr., USSR, *Birula* s.n. (not seen). This is presumed to be *Arctoparmelia separata* (T. Fries) Hale (Hale, 1986a).

Parmelia birulae var. *grumosa* Llano, 1951:197.
TYPE COLLECTION.—Anaktuvuk Pass, Alaska, USA, *Llano* 236 (US, lectotype). This is also a synonym of *Arctoparmelia separata* (T. Fries) Hale (Hale, 1986a).

Parmelia bouly de lesdainii ["bouly de lesdaini"] Gyelnik, 1931b:281.
TYPE COLLECTION.—Hacienda d'Angasmurca, 160 km from Trujillo, Libertad, Peru, *Standaert* s.n.(BP, lectotype). This is a synonym of *Psiloparmelia distincta* (Nylander) Hale (Hale, 1989b).

Parmelia brunnthaleri f. *regularis Gyelnik*, 1938a:270. This is a nomen nudum.

Parmelia centrifuga (L.) Acharius, 1803:206.
See entry under *Lichen centrifugus*.

Parmelia centrifuga var. *dealbata* T. Fries, 1871:129.
TYPE COLLECTION.—Nerica, Gothlunda, Sweden, *Blomberg* s.n. (UPS, lectotype).This is *Arctoparmelia aleuritica* (Nylander) Hale (Hale, 1986a).

Parmelia centrifuga var. *groenlandica* (Lynge) Lynge, 1947:349.
This is *Arctoparmelia subcentrifuga* (Oxner) Hale (Hale, 1986a).

Parmelia centrifuga var. *muscivaga* Nylander, 1887:201.
TYPE COLLECTION.—Lawrence Bay, Behring Sea, *Almquist* s.n. (H-Nylander 34677, lectotype). This is *Arctoparmelia separata* (T. Fries) Hale (Hale, 1986a).

Parmelia centrifuga f. *viridescens* Gyelnik, 1932a:211.
TYPE COLLECTION.—Tavastia media, Finland, *Norrlin* in *Nylander and Norrlin, Lichenes Fennici* 202 (BP, holotype). This is *Arctoparmelia centrifuga* (L.) Hale (Hale, 1986a).

Parmelia chlorea Stizenberger, 1890:151.
TYPE COLLECTION.—Orange Free State, South Africa, *Orpen* s.n. (ZT, lectotype). This peculiar, widespread South African lichen lacks usnic acid and appears to be a species of *Paraparmelia*.

Parmelia congruens Acharius, 1810:491.
TYPE COLLECTION.—America borealis, Mus. D. D. Profess. et Equit. Swartz (H-Ach, not located). This species has never been typified. Tuckerman (1860:383) was mystified by its identity and Müller (1889a:64), who saw a poor specimen in herb. Swartz from Muhlenberg, could only conclude "non amplius distinguere possum." A scrap in UPS-Ach appears to be a *Xanthoparmelia* and contains hypoprotocetraric and usnic acids. However, Swartz did not collect in areas where such a species would occur (no eastern North American species contain hypoprotocetraric acid) and the substrate ("in arboribus") conflicts, I recently described similar material from South Africa as *Xanthoparmelia neocongruens* Hale (1984:76).

Parmelia conspersa var. *caespitosa* Müller Argoviensis, 1896:90.
TYPE COLLECTION.—Grampian Mountains, Victoria, Australia, *Sullivan* s.n. Type specimen not found at G, BP, MEL, or W (Filson, 1986), although Gyelnik (1935:23) had seen it in G.

Parmelia conspersa f. *incolorata* Parrique, 1906:139.
TYPE COLLECTION.—Forez Mountains, France, *Parrique* s.n. (type destroyed at Dunquerque).

Parmelia conspersa f. *irreagens* Trass, 1963:208.
TYPE COLLECTION.—Kozyrevsk, Kamczatka, USSR, *Trass* s.n. (TAA, Ka-915; requested but not seen).

Parmelia conspersa var. *isidiosula* Hillmann, 1923:65.
TYPE COLLECTION.—Wetzenow, Germany, [*Hillmann* s.n.]. The type was destroyed in WW II. Material so identified by Hillmann at Leiden and in Erichsen's herbarium is *Xanthoparmelia conspersa* (Acharius) Hale.

Parmelia conspersa var. *stenophylla* f. *microphylla* Hillmann, 1936:175.
TYPE COLLECTION.—Olbernhau, Germany, *Flossner* s.n. (type destroyed).

Parmelia conspersa var. *stenophylla* f. *angustissima* Hillmann, 1938:174.
TYPE COLLECTION.—Odry, Prov. Pomerellens, Poland, *Krawiec* s.n. The type was destroyed in WW II.

Parmelia conspersa var. *subconspersa* (Nylander) B. Stein, 1890:316.
See entry under *Parmelia subconspersa*.

Parmelia conspersa var. *subconspersa* (Nylander) Olivier, 1894:57.
See entry under *Parmelia subconspersa*.

Parmelia conspersa f. *subconspersa* (Nylander) Kušan, 1932:26.
See entry under *Parmelia subconspersa*.

Parmelia conturbata var. *exornata* Zahlbruckner, 1932:251.
TYPE COLLECTION.—Mt. Steinkopf, Namaqualand, South Africa, *Meyer* s.n. (W, lectotype). This species is pseudocyphellate and belongs in a new genus, *Namakwa exornata* (Zahlbruckner) Hale (Hale, 1988a).

Parmelia convoluta (Hue) Zahlbruckner, 1929:272.
This is *Xanthomaculina convoluta* (Hue) Hale (Hale, 1985b).

Parmelia cuprea Persoon, 1827:196.
TYPE COLLECTION.—Cape of Good Hope, South Africa, s.c. (not located). This is a synonym of *Xanthomaculina hottentotta* (Acharius) Hale (Hale, 1985b).

Parmelia diffugiens Zahlbruckner, 1927:348.
TYPE COLLECTION.—Mt. Komagatake, Shinano, Japan, *Asahina* 542 (W, lectotype; TNS, isolectotype). This is *Arctoparmelia separata* (T. Fries) Hale (Hale, 1986a).

Parmelia distincta Nylander, 1861:374.
TYPE COLLECTION.—Bolivia, Andes, *D. Mandon* s.n. (H-Nyl, lectotype; G, M, isolectotypes). This is *Psiloparmelia distincta* (Nylander) Hale (Hale, 1989b).

Parmelia distincta f. *bouly de lesdainii* (Gyelnik) Gyelnik, 1938b:26.
See entry under *Parmelia bouly de lesdainii*.

Parmelia distincta f. *subcongruens* (Müller Argoviensis) Gyelnik, 1938b:26.
See entry for *Parmelia congruens*.

Parmelia encrustans Hale, 1971a:348.
TYPE COLLECTION.—Between O'kiep and Springbok, Distr. Namaqualand, Cape Province, South Africa, *Almborn* 4792 (LD, holotype; US, isotype). This species is now assigned to *Karoowia: K. perspersa* (Stizenberger) Hale (Hale, 1989c).

Parmelia exornata (Zahlbruckner) Brusse, 1984:321.
See entry under *Parmelia conturbata* var. *exornata*.

Parmelia flavobrunnea Müller Argoviensis, 1891:379.
TYPE COLLECTION.—Azangaro, Peru, *Lechler* 1766 (BM, lectotype; G, isolectotype). This Andean species is a synonym of *Psiloparmelia distincta* (Nylander) Hale (Hale, 1989b).

Parmelia frondosa Hale, 1971a:349.
TYPE COLLECTION.—Upper Witels Kloof, Distr. Ceres, Cape Province, South Africa, *Esterhuysen* 21848 (LD, holotype; US, isotype). This is an umbilicate species, now placed in *Xanthomaculina frondosa* (Hale) (Hale 1985b).

Parmelia fuegiensis Dodge, 1966:346.
TYPE COLLECTION.—Mt. Dorothea, Tierra del Fuego, Chile, *Siple et al.* 392z (FH-Dodge, lectotype; designated type in US not found). This is a *Flavoparmelia*.

Parmelia gerlachei Zahlbruckner, 1929:137.
Based on *Parmelia antarctica* Vainio (= *Flavoparmelia gerlachei* (Zahlbruckner) Hale (Hale, 1986c)) not *P. antarctica* Bitter, 1901:248 (= *Hypogymnia*).

Parmelia groenlandica Lynge in Lynge and Scholander, 1932:73.
TYPE COLLECTION.—Rohssfjorden, Davysundet, Kong Oscars Fjorden,

Lynge s.n. (O, not seen). Not *P. groenlandica* (Retzius) Acharius, 1803:220 (= Nephroma). This is *Arctoparmelia subcentrifuga* (Oxner) Hale (Hale, 1986a).

Parmelia halseyana Tuckerman, 1841:442.
TYPE COLLECTION.—Notch of White Mountains, New Hampshire, USA, *Tuckerman* s.n. (FH-Tuck, lectotype). This is *Arctoparmelia centrifuga* (L.) Hale (Hale, 1986a).

Parmelia hanszeni Gyelnik, 1938a:278.
TYPE COLLECTION.—Near Buenos Aires, Argentina, *Lillie* 936 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed). This is a synonym of *Flavoparmelia papillosa* (Lynge) Hale (Hale, 1986c).

Parmelia hottentotta (Acharius) Acharius, 1803:219.
TYPE COLLECTION.—[South Africa], Thunberg herb. (UPS, lectotype). This well-known species is now classified in *Xanthomaculina* as *X. hottentotta* (Acharius) Hale (Hale, 1985b).

Parmelia hottentotta var. *diachrosta* Stirton, 1877:215.
TYPE COLLECTION.—[Somerset], South Africa, *MacOwan* s.n. (BM, lectotype). This is *Xanthomaculina hottentotta* (Acharius) Hale (Hale, 1985b).

Parmelia hueana Gyelnik, 1931b:288.
A nomen novum for *Parmelia convoluta* (Hue) Zahlbruckner, 1929:272 (not *Parmelia convoluta* Kremplhuber, 1881:337), now recognized as *Xanthomaculina convoluta* (Hue) Hale (Hale, 1985b).

Parmelia hystrix Meyer, 1825:99.
TYPE COLLECTION.—Vom Cap [South Africa], s.c. The type has not been located but it is almost certainly a synonym of *Xanthomaculina hottentotta* (Acharius) Hale (Hale, 1985b).

Parmelia implexa Stirton, 1873:20.
TYPE COLLECTION.—Wellington, New Zealand, *Buchanan*. The type could not be located at BM or GLAM.

Parmelia incurva (Persoon) Fries, 1826:31.
See entry under *Lichen incurvus*.

Parmelia incurva f. *annularis* Anders, 1922:313.
TYPE COLLECTION.—Aschendorf and Rehdorfel, North Bohemia, *Anders* s.n. (PRM, not seen). This is presumed to be *Arctoparmelia incurva* (Persoon) Hale (Hale, 1986a).

Parmelia incurva f. *lignicola* Koskinen, 1955:80.
TYPE COLLECTION.—[Vaheri], Jämsä, Tavastia Australis, Finland, *Koskinen* s.n., 19 July 1952 (H, lectotype). This is a synonym of *Arctoparmelia incurva* (Persoon) Hale (Hale, 1986a).

Parmelia interrupta Stizenberger, 1890:154.
TYPE COLLECTION.—Near Ceres, Warme Bokkeveld Mountains, South Africa, *MacOwan* s.n. (ZT, lectotype). This is a synonym of *P. adhaerens* Nylander (= *Karoowia adhaerens* (Nylander) Hale) (Hale, 1989c).

Parmelia isidiigera (Müller Argoviensis) "Vainio," 1900:6.
While this combination at species rank is listed in Zahlbruckner's Catalogus, Vainio did not make the combination; he merely listed "F. *isidiigera* Müll. Arg." on a separate line. *Parmelia isidiigera* (Müller Argoviensis) Gyelnik, 1935:27 is a distinct species (*X. isidiigera* (Müller Argoviensis) Elix and Johnston) related to *X. australasica* Galloway.

Parmelia laxa f. *caespitosa* (Müller Argoviensis) Gyelnik, 1935:23.
See entry under *Parmelia conspersa* var. *caespitosa*.

Parmelia lecanoracea Müller Argoviensis, 1888d:529.
TYPE COLLECTION.—Near Arisdrift, Oranjemund, South Africa, *Schenck* 543 (G, lectotype). This unique lichen contains evernic acid and abundant skyrin (pigment not observed by Müller but later reported by Vainio, 1900:4) but lacks atranorin as well as usnic acid in the cortex. It is not a *Xanthoparmelia*, although superficially close to the *X. equalis* Namibian desert species group, but a member of the genus *Paraparmelia*, *P. lecanoracea* (Müller Argoviensis) Elix, Johnston, and Verdon, 1986).

Parmelia molliuscula var. *robusta* B. Stein, 1890:317.
TYPE COLLECTION.—Kilimandscharo, *Meyer* s.n. Nomen nudum without a description.

Parmelia molliuscula var. *kilimandscharoensis* B. Stein, 1890:317.
TYPE COLLECTION.—Kilimandscharo, *Meyer* s.n. Nomen nudum without a description.

Parmelia moniliformis Babington in Hooker, 1855:287.
TYPE COLLECTION.—Colenso, New Zealand (BM, lectotype). The excellent color plate (Tab. CXXVII, fig. 3) indicates a *Xanthoparmelia* of the *molliuscula* type. A specimen in PC is *Pannoparmelia angustata* (D. Galloway, pers. comm.).

Parmelia mougeotii var. *dealbata* Massalongo f. *leptophylla* Massalongo, 1861:51.
TYPE COLLECTION.—Cape of Good Hope, *Wawra* s.n. (VER, lectotype). This is *Paraparmelia xanthomelanoides* Elix and Nash in Nash and Elix (1987).

Parmelia mougeotii var. *dealbata* Massalongo f. *platyphylla* Massalongo, 1861:50 (= var. *dealbata*).
TYPE COLLECTION.—Cape of Good Hope, *Wawra* s.n. (VER, lectotype). This is *Paraparmelia xanthomelanoides* Elix and Nash in Nash and Elix (1987).

Parmelia mougeotii f. *reagens* Hillmann, 1936:180.
TYPE COLLECTION.—Dresden, Germany, *Schade* s.n. (type destroyed).

Parmelia mougeotii var. *reagens* (Hillmann) Erichsen, 1957:317.
This is an illegitimate name with no basionym cited.

Parmelia multifida (Dickson) A. L. Smith, 1918:141.
This is *Arctoparmelia centrifuga* (L.) Hale (Hale, 1986a).

Parmelia muscivaga (Nylander) Gyelnik, 1935:23.
See entry for *Parmelia centrifuga* var. *muscivaga*.

Parmelia neoverrucigera Gyelnik, 1938a:284.
TYPE COLLECTION.—Montis Kriván (Tatra), Hungary, *Lojka* [4632] (W, lectotype). This is *Parmeliopsis ambigua* (Wulfen) Nylander.

Parmelia njalensis Dodge, 1959:65.
TYPE COLLECTION.—Njala, Kori, Sierra Leone, *Deighton* M5642 (BM, holotype). This is a synonym of *Bulbothrix goebelii* (Zenker) Hale (Hale, 1976b:15).

Parmelia osseoalba Vainio, 1921:39.
TYPE COLLECTION.—Doi Sutep, Thailand, *Hosseus* (TUR, Vainio herb. no. 2999). It is not a *Xanthoparmelia* at all, as earlier suggested by Gyelnik (1938b:32) but a species of *Hypotrachyna, H. osseoalba* (Vainio) Park and Hale, 1989:88.

Parmelia pachythalla Sprengel in Nylander, 1860:399.
TYPE COLLECTION.—Cape of Good Hope, South Africa, *Drege* 73 s.n. (W, lectotype). This is a synonym of *Xanthomaculina hottentotta* (Acharius) Hale (Hale, 1985b).

Parmelia papillosa Lynge in Gyelnik, 1935:43.
TYPE COLLECTION.—La Paz, Canelones, Uruguay, *Felippone* 752 (W, lectotype). This is *Flavoparmelia papillosa* (Lynge) Hale (Hale, 1986c).

Parmelia papillosa f. *squamaecola* Gyelnik, 1938a:285.
TYPE COLLECTION.—Estancia Siete Cerros, Rocha, Uruguay, *Hosseus* 32. The type has not yet been located at BP or M.

Parmelia papillosa var. *exornata* Gyelnik, 1938a:285.
TYPE COLLECTION.—Estancia Siete Cerros, Rocha, Uruguay, *Hosseus* 30. The type has not yet been located at BP or M.

Parmelia pernambucana Kurokawa, 1974:298.
TYPE COLLECTION.—Ibimirim, Pernambuco, Brazil, *Kurokawa* 8094 (TNS, holotype). This appears to be a species of *Flavoparmelia*, perhaps *F. leucoxantha* (Müller Argoviensis) Hale (Hale, 1986c).

Parmelia perspersa Stizenberger, 1890:152.
TYPE COLLECTION.—Mt. Lion, Cape Town, South Africa, *MacOwan* s.n. (ZT, lectotype). Known only from the type collection, this is *Karoowia perspersa* (Stizenberger) Hale (Hale, 1989c).

Parmelia pomifera Zahlbruckner, 1941:106.
TYPE COLLECTION.—Mt. Matthews, Tararua Mountains, New Zealand, *Beddie* ZA200 (W, lectotype). This is a species of *Parmotrema*.

Parmelia portugalica Gyelnik, 1931b:282.
TYPE COLLECTION.—Povoa de Leanhoso, Portugal, *Sampaio* 6 p.p. (BP). The type could not be found at BP and no duplicate specimens were located in LISU.

Parmelia propagulifera Vainio, 1899b:(123).

TYPE COLLECTION.—Bogotá, Colombia, *Weir* 72 (BM, lectotype). Vainio's name is based on a species of *Hypotrachyna microblasta* (Vainio) Hale (Hale, 1975). Gyelnik (1938b:39), however, recombined *Parmelia stenophylloides* var. *propagulifera*, a *Xanthoparmelia*, as *P. propagulifera* (Vainio) Gyelnik, which is a later homonym of *P. propagulifera* Vainio (1899b). He then proposed a new name, *P. neopropagulifera*, for the *earlier* (1899b) taxon referred to *Hypotrachyna!* I erroneously recombined the epithet *neopropagulifera* in *Xanthoparmelia* (Hale, 1987b), and the correct name for Vainio's (1890) species is *X. neopropaguloides*.

Parmelia propagulifera (Vainio) Gyelnik, 1938b:39.
See entry under *Parmelia propagulifera* Vainio.

Parmelia recurva Acharius, 1803:201.
TYPE COLLECTION.—Sweden, s.c. (H-Ach., lectotype). This is *Arctoparmelia incurva* (Persoon) Hale (Hale, 1986a).

Parmelia redacta Stirton, 1900:76.
TYPE COLLECTION.—Illawarra, N.S.W., Australia, *Kirton* s.n. (BM, lectotype). This species can be identified with *Dirinaria applanata* (Fée) Awasthi in Awasthi and Agarwal (1970:135).

Parmelia saxeti Stizenberger, 1890:153.
TYPE COLLECTION.—Lubombo Mountains, Transvaal, South Africa, *Wilms* s.n. (ZT, lectotype). This subcrustose, effigurate-lobate species is now placed in the genus *Karoowia* as *K. saxeti* (Stizenberger) Hale (Hale, 1989c).

Parmelia scholanderi Dodge, 1966:346.
TYPE COLLECTION.—Puerto Eden, Wellington Island, Magallanes, Chile, *Scholander* s.n. (FH-Dodge, holotype). Although Dodge indicated "Parmelia (Xanthoparmelia) scholanderi," the type can be identified with *Hypotrachyna sinuosa* (Smith) Hale (Hale, 1975).

Parmelia separata T. Fries, 1880:353.
TYPE COLLECTION.—Westward-Ho! Valley, [Ellesmere Island], Canada, *Feilden* s.n. (UPS, lectotype). This is now *Arctoparmelia separata* (T. Fries) Hale (Hale, 1986a).

Parmelia seto-maritima Asahina, 1961:228.
TYPE COLLECTION.—Marugame, Shikoku, Japan, *Togashi* 61511 (TNS, holotype; H, isotype). This is a *Karoowia* species and a synonym of *K. saxeti* (Stizenberger) Hale (Hale, 1989c).

Parmelia squamariaeformis Gyelnik, 1934c:163.
TYPE COLLECTION.—Tamsui, Taiwan, *Faurie* 76 (BP, lectotype). This is a synonym of *Karoowia saxeti* (Stizenberger) Hale (Hale, 1989c).

Parmelia stenophylla var. *subconspersa* (Nylander) Trass, 1963:210.
See entry under *Parmelia subconspersa*.

Parmelia stictella Massalongo, 1861:52.
TYPE COLLECTION.—Cape of Good Hope, South Africa, *Wawra* s.n. (VER, lectotype). This is a synonym of *Xanthomaculina hottentotta* (Acharius) Hale (Hale, 1985b).

Parmelia subcentrifuga Oxner, 1940:39.
TYPE COLLECTION.—Based on *Parmelia groenlandica* Lynge. This is now *Arctoparmelia subcentrifuga* (Oxner) Hale (Hale, 1986a).

Parmelia subcongruens Müller Argoviensis, 1889a:64.
TYPE COLLECTION.—Argentina, *Lorentz & Hieronymus* s.n. (M, lectotype; G, W, isolectotypes). This is *Psiloparmelia distincta* (Nylander) Hale (Hale, 1989b).

Parmelia subcongruens var. *bouly de lesdainii* (Gyelnik) Gyelnik, 1935:21.
See entry under *Parmelia bouly de lesdainii*.

Parmelia subconspersa Nylander, 1869b:293.
TYPE COLLECTION.—N. Hollandia, *Lindsay* in 1862 (Nylander herb. no. 34698, lectotype). The lectotype specimen is *Flavoparmelia rutidota* (Taylor) Hale, selected by Gyelnik (1935:49) as the lectotype of *Parmelia subconspersa*. Other syntypes are New Zealand (nos. 34708 and 34718) = *P. linkolae* Gyelnik (= X. *scabrosa* (Taylor) Hale); Ins. Bourbon s.c. (no. 34702b) (= *X. leonora* (Massalongo) Hale). The material from Brasilia and Gallia was not seen.

Parmelia subconspersa var. *benguellensis* Vainio, 1904b:401.
TYPE COLLECTION.—Mt. Morro de Lopollo, Huilla, Benguela, Angola, *Welwitsch* 31 p.p. (TUR, lectotype; BM, isolectotype). This is *Flavoparmelia amplexa* (Stirton) Hale (Hale, 1986c).

Parmelia subconspersa var. *submonophylla* Asahina, 1952:63.
TYPE COLLECTION.—No type is cited.

Parmelia subtinctina Werner, 1950:20.
TYPE COLLECTION.—Mt. Tibesti, Tousside, Chad, *Monod* 8226. The type specimen was requested from IFAN but has not yet been located and studied.

Parmelia xanthotropa Stirton, 1878:202.
TYPE COLLECTION.—Somerset East, Cape Province, South Africa, *MacOwan* s.n. (BM, lectotype). The type specimen is fragmentary and its identity remains in doubt. It may be a *Flavoparmelia*.

Parmelia xanthotropa f. *squamicola* [*squamaecola*] (Gyelnik) Gyelnik, 1938b:44.
See entry under *P. papillosa* f. *squamaecola*.

Parmelia xanthotropa f. *exornata* (Gyelnik) Gyelnik, 1938b:44.
See entry under *P. papillosa* var. *exornata*.

Parmelia zenkeri Dodge, 1959:74.
TYPE COLLECTION.—Bipinde, Cameroon, *Zenker* 4053 (BM, lectotype; FH-Dodge, isolectotype). This is a synonym of *Pseudoparmelia sphaerospora* (Nylander) Hale (Hale, 1976a).

Squamaria interrupta (Stizenberger) Gyelnik, 1935:36.
See entry under *Parmelia interrupta*.

Umbilicaria lecanorocarpa Krempelhuber, 1877:440.
TYPE COLLECTION.—Cape of Good Hope, Bains-Kloof, South Africa, *Wawra* [88] (M, lectotype). This is a synonym of *Xanthomaculina hottentotta* (Acharius) Hale (Hale, 1985b).

Xanthoparmelia adhaerens (Nylander) Hale, 1974b:486.
See entry under *Parmelia adhaerens*.

Xanthoparmelia centrifuga (L.) Hale, 1974b:486.
See entry under *Lichen centrifugus*.

Xanthoparmelia chlorea (Stizenberger) Hale, 1974b:486.
See entry under *Parmelia chlorea*.

Xanthoparmelia distincta (Nylander) Hale, 1974b:487.
See entry under *Parmelia distincta*.

Xanthoparmelia encrustans (Hale) Hale, 1974b:487.
See entry under *Parmelia encrustans*.

Xanthoparmelia exornata (Zahlbruckner) Brusse and Knox in Knox and Brusse, 1983:150.
See entry under *Parmelia conturbata* var. *exornata*.

Xanthoparmelia flavobrunnea (Müller Argoviensis) Hale, 1974b:487.
See entry under *Parmelia flavobrunnea*.

Xanthoparmelia gerlachei (Zahlbruckner) Hale, 1974b:486.
This is *Flavoparmelia gerlachei* (Zahlbruckner) Hale (Hale, 1986c).

Xanthoparmelia incurva (Persson) Hale, 1974b:488.
See entry under *Parmelia incurva*.

Xanthoparmelia interrupta (Stizenberger) Krog and Swinscow, 1987:427.
See entry under *Parmelia interrupta*.

Xanthoparmelia lividica Hale, 1986b:584.
TYPE COLLECTION.—Olifantsbaai, Cape of Good Hope Nature Reserve, Cape Province, South Africa, Grid 3418 AD, *Hale* 74092 (US, holotype; PRE, isotype). This is a *Paraparmelia*, there being no usnic acid in the cortex.

Xanthoparmelia papillosa (Lynge) Hale, 1974b:488.
See entry under *Parmelia papillosa*.

Xanthoparmelia neopropagulifera (Gyelnik) Hale, 1987b:324.
See entry under *Parmelia propagulifera*.

Xanthoparmelia separata (T. Fries) Hale, 1974b:489.
See entry under *Parmelia separata*.

Xanthoparmelia stenophylloides (Müller Argoviensis) Hale, 1987b:330.
See entry under *Parmelia adpressa* var. *stenophylloides*.

Xanthoparmelia subcentrifuga (Oxner) Hale, 1974b:489.
See entry under *Parmelia subcentrifuga*.

Xanthoparmelia subconspersa (Nylander) Hale, 1974b:489.
See entry under *Parmelia subconspersa*.

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(Synonyms in italics)