Opuscula Philolichenum, **1**: 21-24. 2004.

A Preliminary Study of *Acarospora smaragdula* var. *lesdainii* in California

KERRY KNUDSEN[1]

ABSTRACT. – The current state of *Acarospora* studies is discussed. *Acarospora hassei* Herre and *Acarospora particularis* H. Magnusson are placed in synonymy with *Acarospora smaragdula* var. *lesdainii* (Harmand *in* A.L. Smith) H. Magnusson. A lectotype is selected for *A. hassei* Herre.

INTRODUCTION

Acarospora is a successful global genus including many species with intercontinental distributions. This success is attributable to two major characteristics. The first is extreme genetic variability. A single species may show variation in almost all of its characteristics allowing *Acarosporas* to respond to selective pressures and establish populations in harsh microhabitats such as western exposures or on felsenmeers (the chaotic pile of rocks on a summit). The second is phenotypic plasticity in response to environmental pressures. The identification of *Acarospora* species demands knowing the lichen's gestalt as well as finding the few characteristics that are relatively unvarying. The ontogeny of the thallus must be taken into consideration as well as the ecological dimension. This is generally true of many genera, however, like *Caloplaca*, *Acarospora* has a very simple *bauplan* honed by evolution which makes the genus equally difficult.

The history of the study of *Acarospora* in North America in the 20th century is dominated by the two eminent lichenologists H. Magnusson and W. Weber.

Magnusson studied nearly every available specimen from North America during the 1920's while writing his world monograph on the genus (Magnusson, 1929). He continued to publish on *Acarospora* from North America throughout the rest of his career and named many new species in numerous papers and two supplements to his monograph.

Magnusson's species concept predated the Modern Synthesis. He lacked an understanding of genetic variability and its relation to speciation in the evolutionary process. He is also considered a "splitter" by many lichenologists. Magnusson was meticulous in the measurement of *Acarospora* morphology. His formation of taxa was mathematical. His species concept generally did not allow for a flexible and natural range of variation caused either by genetic variability or environmental modification. His propensity to name species from single and even meager collections only served to reinforce this phenetic formalism.

Magnusson's systematic perspective led to the description of approximately fifty-eight new taxa from North America. Any revision of the genus needs to critically examine the holotypes of his taxa and in many cases the only record of these species is the holotype. Unfortunately, specimens determined by American lichenologists using his descriptions are often incorrect when compared to the types.

In response to Magnusson's treatments William Weber attempted to revise the genus. To his credit he had an understanding of the environmental factors influencing lichen phenotypes. In his major publication, "A taxonomic revision of *Acarospora*, subgenus *Xanthothallia*" (Weber, 1968), he attributed all diversity in the genus *primarily* to environmental modification. Applying this principle to *Acarospora* subgenus *Xanthothallia* he reduced 64 species of yellow *Acarospora* into synonymy with *A. scheicheri* A. Massalongo. Poelt immediately led an offensive against Weber's reductionism and was joined by Culberson (among others) in the United States (W. Weber, pers. comm.). While his revision was not accepted in continental Europe, American lichenologists in general accepted his revision, feeling an exhilarating freedom from the difficulties of Magnusson's approach. Nonetheless, the opposition against Weber prevailed and convinced (or prevented) him from publishing his revision of *Acarospora* subgenus *Phaeothallia* which would have led to the reduction of an equally large number of species into synonymy with *A. smaragdula* and *A. fuscata* (anonymous, pers.

[1]Kerry Knudsen: University of Riverside Herbarium, Department of Botany, University of California at Riverside, Riverside, California 92595 USA. – e-mail: kk999@msn.com

comm.) Undaunted at the time and recognized in the lichenological community after Magnusson's death as a world expert on *Acarospora*, Weber continued to annotate thousands of specimens, most as *A. fuscata, A. schelicheri*, and *A. smaragdula*. Many older taxa are thus difficult to find in herbaria because they have been re-filed under these three names.

The fundamental error of Weber's treatment was to base his taxonomy on the principle that environmental modification is the primary cause of *Acarospora* diversity. The effect of this *a priori* principle is to reduce the complexity of biodiversity, the phylogenetic tree of the genus, to a diversity of forms and *not* of genotypes and lineages. Thus biodiversity becomes only an appearance hiding an *essential* unity. This treatment had the effect of emptying the taxa *A. fuscata, A. schelicheri,* and *A. smaragdula* of any biological reality and turning them into metaphysical entities of an idealistic monism. Weber was correct in stating his approach was philosophical (Weber, 1970). It is easy to recognize in the 21st century, however, that his philosophy is implicitly anti-evolutionary. The real effect of Weber's approach was to polarize the study of *Acarospora*. In his reaction to Magnusson's excesses as a "splitter" he became the archetypal "lumper." Between these two extremes the study of *Acarospora* has been plunged into chaos and confusion.

J.W. Thomson, in his annotations and his revision of the genus in his Arctic flora (Thomson, 1997), stands out as an example showing that the correct approach to the taxonomy of the genus is one of taxonomic decisions based on rationality grounded in observation of the organism. Attempting to follow Thomson's example, I have begun a revision of *Acarospora* in California and am working on *Acarosporsa* subgenus *Phaeothallia* for the Sonoran Flora. The following study came out of an attempt to revise *Acarospora smaragdula* as well as *A. hassei* and *A. particularis.* It is the third of a series of studies of *Acarospora* taxa. (Knudsen, 2003; Lendemer, in press)

TAXONOMIC TREATMENT

Acarospora smaragula var. ***lesdainii*** (Harmand *in* A.L. Smith) H. Magnusson

Acarospora lesdainii Harmand *in* A.L. Smith, Monogr. Brit. Lich., ed. 2, 1: 344-345. TYPE: no type designated in protologue.

Acarospora smaragdula var. *lesdainii* (Harmand *in* A.L. Smith) H. Magnusson, Kungl. Sv. Vet. Akademiens Handlingar, ser. 3, 7(4): 144-145, 1929.

Acarospora hassei Herre, Proc. Washingt. Acad. Sci., 12: 128. 1910. TYPE: On sandstone at 3000 ft., Castle Rock, Santa Cruz Mountains, California, USA. *A. Herre 757* (FH! (packet labeled by Herre), lectotype (**designated here!**); FH!, isolectotype; FH! paralectotypes[2]).

Syn. nov. *Acarosopora particularis* H. Magnusson, Kungl. Sv. Vet. Akademiens Handlingar, 7(4):178, 1929. TYPE: San Bernardino Mountains, California, USA at 270 meters. *H.E. Hasse s.n.* (W!, holotype).

Magnusson (1929) made *Acarospora lesdainii* Harmand *in* A.L. Smith a variety of *Acarospora smaragdula* (Wahlenberg) Th. Fries. The taxon intergrades with European specimens of *A. smaragdula* and occurs within the circumpolar range of *A. smaragdula. A. smaragdula* var. *lesdainii* differs from many European specimens of *A. smaragdula* in having an uneven cortex, rough disc, and generally KOH- reaction. It does not, however, differ in cortical or hymenial detail, fitting easily into the range of variation. It is reported in Europe as often growing in "sheltered places under over hanging rocks" (Magnusson, 1929) thus it appears to have different microhabitat requirements than *A. smaragdula* var. *smaragdula* (which prefers open situations in temperate climates), but this needs further investigation.

It is also possible that its distribution pattern may not be co-extensive with *A. smaragdula* var. *smaragdula* but rather nested within it. Populations in California south of San Francisco occur within the hypermarine zone and are chasomolithic with large crystals of the substrate becoming embedded in the thallus. Purvis et al. (1992) and Thomson (1997) treated var. *lesdainii* as synonymous with var. *smaragdula,* however, until there is a modern revision of *A. smaragdula*, I believe that the varietal status proposed by Magnusson (1929) should be retained.

In his description of *A. hassei*, Herre (1910) wrote that it was "quite different from any *Acarospora* I have been able to examine." Those who have not seen European or Arctic specimens of *A. smaragdula* or *A. smaragdula* var. *lesdainii* would be surprised by how much they differ from the many specimens one can find in packets marked *A. smaragdula* in American herbaria. When compared to Magnusson's specimens of var. *lesdainii* from Sweden, there is no significant difference. Magnusson (1929) already placed *A. hassei* in

[2] *A. Herre 750* – Two packets in FH collected at the type locality on the same date as the type, but given a different collection number by Herre.

synonymy with *A. smaragdula* var. *lesdainii,* but some confusion about this taxon within the United States remains. Fink (1935) and Esslinger (1997) maintained *A. hassei* as a valid species as does the Catalog of California Lichens (Tucker and Jordan, 1978). The synonymy proposed by Magnusson (1929) is confirmed here and the name should be considered a synonym of *A. smaragdula* var. *lesdainii*.

As with many taxa, Magnusson (1929) named *A. particularis* from a single collection made by H. E. Hasse in the San Bernardino Mountains of Southern California at 270 meters. The verruca or squamules of the type of *A. particularis* are small, less than 0.5mm on an average, dirty brown with blackish apothecia, and growing on sandstone or crumbling granite (the crystals in the substrate easily separate). Magnusson justified naming this species on two grounds: its blackish apothecia and its thin cortex that is one to three cells thick.

The cortex of the type does appear thin, merely one to three layers of rounded cells ca.(2-)3(-6)µm in diameter that are heavily pigmented. The vertical hyphae which form the cortex rise through a poorly-developed algal layer, but can be seen at 1000x (Magnusson used 400x in general (Magnusson, 1929)). In the type specimen the lower cortical cells are not developed or are poorly developed within the hyphae below the top one or three cells. The actual cortical layer is closer to 30µm in the most developed areas and below the top layer is opaque prosoplectenchyma. This opaqueness is not unusual in Acarosporas that usually have lower layers with distinct cortical cells.

The apothecia do appear black to the naked eye and at 10x. However, at higher magnification (40x) with bright light the apothecia are reddish-brown, rough, and immediately recognizable as *A. smaragdula* var. *lesdainii.* The hymenium is the same as *A. smaragdula* var. *lesdainii* with paraphyses ca. 1.7µ. thick and with the upper part of the paraphyses short segmented. The hymenial height, asci, and ascospores do not differ either. *A. smaragdula* var. *smaragdula* and *A. smaragdula* var. *lesdainii* generally have hyphal bundles penetrating the algal layer. This feature is lacking in the type of *A. particularis* and the algal layer (as well as the medulla) is poorly developed. The squamules are less than the normal 1-2 mm. range of var. *smaragdula* and var. *lesdainii.*

The poor development of the algal layer and medulla is due to environmental causes. The substrate of the type of *A. particularis* is extremely weak, crumbly, and is eroding faster than the *Acarospora* could have grown. This effect is often seen in chasmolithic lichens such as the common Sonoran lichen *Buellia sequax* (Nylander) Zahlbruckner, which appears to have a solid white thallus when growing between the crystals and particles of stable, flat substrates. But, for instance, when growing on a decaying pegmatite dike the thallus of *B. sequax* is reduced to small white clumps and black apothecia. Also, Hasse collected the type specimen from a relictual population stranded approximately seventy miles inland from the sea at a low and very arid elevation in the chaparral belt. Such relictual populations of lichens are common in Southern California which has been growing steadily more arid over the last ten thousand years during the current interglacial period (Axelrod, 1966; Pielou, 1991). I have seen thalli of *Letharia columbiana* (Nuttall) J.W. Thomson at the same elevation in arid Southern California and they are always less than two centimeters tall. *Usnea hirta* (L.) Wigg is also found dwarfed at same elevation. The aridity of this inland elevation in Southern California equally limits crusts that usually thrive in the hypermarine belt or at higher elevations.

A. particularis is a synonym of *Acarospora smaragdula* var. *lesdainii. Acarospora smaragdula* var. *lesdainii* is rare in California and I have so far seen no other collections of the species except those cited as types above and those cited below.

Selected specimens examined: SWEDEN. Bohuslän: Par. Ödsmål, Starrkär. Under overhanging loose rocks with *Lecanora tristcolor*, *A.H. Magnusson s.n. = Lichenes selecti scandinavici exsiccati, No. 132*, 9.September.1930 (H); Stenkyrka, Djupvick. Rock on shore. *A.H. Magnusson 505170,* 29.June.1923 (ASU). USA: California: Castro Crest, Los Angeles Co., Santa Monica Mountains. Sandstone outcrop in sun, Lat. 34° 04.840'N Long. 118° 45.136'W, elev. 655 m., *K. Knudsen #707 & T. Sagar* (herb. Knudsen); north side of sandstone outcrop, same location as *Knudsen 707, K. Knudsen #709 & T. Sagar* (herb. Lendemer, FH, H, SBBG, UCR).

CONCLUSION

As can be seen in this modest revision, the study of *Acarospora* must transcend the limitations of Magnusson and Weber. Magnusson's careful observation of specimens, freed from the typological and formalistic tendencies of his age, coupled with a keen awareness of genetic variability is still a fruitful approach. Weber's awareness of environmental modification, freed from his philosophical framework, is likewise indispensable to understanding the genus. This cannot be accomplished without including as much field observations as are possible in one's investigations. As can be seen by the problems of naming *A. hassei* and *A. particularis* from single collections progress in the reformation of the study of *Acarosporas* in North America includes both bringing reality back to taxa like *A. smaragdula* and *A. fuscata* as well as critically

reviewing all *Acarospora* taxa using type specimens. Type specimens cannot, however, be relied upon alone and as many specimens as can be observed must be included in the process of revision. Eventually as our understanding of *Acarospora* becomes clearer molecular studies can be integrated into the study of the genus to increase our understanding of *Acarospora*'s evolutionary history.

ACKNOWLEDGEMENTS

For their help I thank Tom Nash, Frank Bungartz and Florke Ziemmeck for their assistance during my visits to ASU, Scott LaGreca at FH, Orvo Vitikainen at H, Andy Sanders at UCR, and Othmar Breuss at W. I thank Carrie Kiel and James Lendemer for their help with editing the manuscript. I also thank Rick Riefner Jr. for initiating my interest in the problem of *A. particularis.*

LITERATURE CITED

Axelrod, D.I. 1966. The Pleistocene Soboba Flora of Southern California. University of California Publications in Geological Sciences. Berkeley, California. 79 pp., 14 plates.

Esslinger, T. L. 1997. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. North Dakota State University: http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.htm (First Posted 1 December 1997, Most Recent Update July 17, 2002), Fargo, North Dakota.

Fink, B. 1935. The Lichen Flora of the United States. Completed for Publication by Joyce Hedrick. University of Michigan Press, Ann Arbor. xii + 426 pp.

Herre, A.W.T.C. 1910. The Lichen Flora of the Santa Cruz Mountains. Proceedings of the Washington Academy of Sciences, Vol. XII(2): 27-269.

Knudsen, Kerry. 2003. Type Specimens: Investigations and Observations. Bulletin of the California Lichen Society, 10:.2:36-38.

Lendemer, James. in press. Changes and additions to the checklist of North American lichens. I. Mycotaxon.

Magnusson, A.H. 1929. A monograph of the genus *Acarospora*. Kungliga Svenska Vetenskapsakademiens Handlingar, ser. 3, 7(4): 1-400.

Pielou, E.C. After the Ice Age. 1991. University of Chicago Press, Chicago and London. 366 pp.

Purvis, O.W., Coppins, B.J., Hawksworth, D.L., James, P.W., & Moore, D.M. The Lichen Flora of Great Britain and Ireland. 1992 Natural History Museum Publications, Great Britain. 710 pp.

Thomson, J.W. 1997. American Arctic Lichens. 2. The Microlichens. The University of Wisconsin Press, Madison. 675 pp.

Tucker, S.C. & Jordon, W.P. 1978. A Catalog of California Lichens. The Waseman Journal of Biology, 36 (1 and 2): 1-105.

Weber, W.A. 1968. A Revision of *Acarospora*, subgenus *Xanthothallia.* The Lichenologist, 4:16-31.