International
Lichenological Newsletter

Vol. 1 No. 3 December 1967

Editor: Vernon Ahmadjian
Clark University
Worcester, Mass. 01610
U.S.A.

Co-Editor: Irwin M. Brodo
National Museum of Canada
Ottawa 4, Ontario
Canada

Editorial

Chemotaxonomy in the Lichens

The International Lichenological Newsletter constitutes an excellent forum for an exchange of views on a number of interesting problems in the biology and taxonomy of lichens. One such problem of great importance is that of the chemical constituents.

During the last few decades significant advances have been made in the study of lichen compounds, both as regards molecular structure and methods of practical recognition (crystal tests, thin layer chromatography), but considerable diversity of opinion still exists as to how they should be evaluated in taxonomy. Do chemical differences automatically constitute distinct taxa, or are they best recorded as "strains" outside of the framework of formal taxonomy?

Chemotaxonomy in the higher plants has not yet reached the stage at which it is common practice to base species on chemical criteria alone, and in any case the fundamental situation there is different from that in the lichens, on account of the latter being dual, symbiotic associations which cannot be characterized as a unit either taxonomically or physiologically, no matter how closely integrated and interdependent their components (fungus and alga) may be.

Lichen substances appear, in most cases at least, to be a joint product of both components, neither of them being usually capable of their elaboration when grown separately from the other. It would seem probable, as suggested by ASAHINA (1967), that the production of different chemical substances may be due to the nature of the alga (phycobiont) with which the same fungus happens to be associated. AHMADJIAN (1967, and elsewhere) has demonstrated great clonal variability, both morphological and physiological, in the phycobionts of individuals of the same lichen species. If it is eventually shown that divergent metabolic pathways, and corresponding different lichen compounds, are originated by the phycobiont, can we justifiably use this character as a taxonomic attribute of the fungus (mycobiont), which is what we are actually classifying? The situation would then be similar to that of a fungus elaborating different chemical substances when grown on culture media of different composition. Only the final success of artificial synthesis experiments combining the same lichen fungus with different phycobionts can ultimately prove or disprove the validity of this hypothesis and its taxonomic implications.

Leaving aside for the moment the question of the origin of lichen substances in the thallus, we are confronted with some further difficulties when we attempt to use the chemical characters as taxonomic criteria. When these characters are clearly correlated with others, either morphological or distributional, their use as complementary taxonomic criteria seems logical and desirable. HALE (1966) has recently published an illuminating discussion on cases of proved correlation between lichen compounds and certain morphological characters, pointing out the significant fact that O-methylated depsides and depsidones are most common in structurally advanced genera or subgenera and are rare or lacking in structurally less advanced groups. The real problem arises when chemical differences are found in otherwise completely indistinguishable lichens. (It should be noted, however, that chemical characters are sometimes correlated with minor morphological differences which may easily escape observation or be mistaken for mere environmental modifications; this has been shown for instance by AHTI (1966) in the *Cladonia chlorophaea* complex.) But there do remain cases where it can be rather confidently asserted that no correlation of this kind exists. At first sight these

would seem no reason for not treating the chemical differences taxonomically in exactly the same way as other (morphological) characters, as constituting distinct species or infraspecific taxa. However, the situation is not quite as simple as that, for the reason that chemical and morphological characters combine independently in a sort of "crossing over" procedure. Let us illustrate this by a theoretical case (I prefer not to use actual names in the present illustration, although I know of several species in which such a state of affairs exists). Suppose that we have Species X, with three morphological varieties x, y and z, and occuring in two distinct chemical "strains," say with Acid A and Acid B. We might then well have the following situation:

XxA - the typical species
XxB - no name available
XyA - a varietal name available
XyB - no name available
XzA - a species name available for new combination
XzB - no name available

Are we justified in fabricating new varietal names for XxB, XyB and XzB, which are morphologically indistinguishable from XxA, XyA and XzA respectively within the same species? It seems to me that to embark definitively on such a course as this, with the consequent proliferation of taxonomic epithets thereby involved, we would have to be pretty sure in the first place of the fundamental validity of such chemical differences in the light of the considerations outlined above as regards their metabolic origin. And the same holds good of course if we were to regard the chemical characters as criteria at the species level.

Furthermore, there is the problem of accessory lichen substances to be considered. Some lichen compounds, such as atranorin, are rather constantly present in many genera as a clearly accessory constituent. Sometimes, however, it is the accessory constituent which gives rise to a visible character which seems at first sight to be of considerable taxonomic importance, e.g. in the case of medullary color in *Usnea baileyi* discussed by ASAHINA (1967).

Although it has been shown (HALE, 1963, and elsewhere) that neither climate nor substratum influence the nature of the chemical compounds formed, it has been equally clearly demonstrated (LAMB, 1964) that their relative concentration (from abundant to lacking or practically lacking) can be thus influenced. In other

words, mere presence or absence of a given lichen substance, whether primary or accessory, is a very dubious taxonomic criterion at the best. SUOMINEN and AHTI (1966), for instance, have shown that *Cladonia nemoxyna*, with homosekikaic acid as the regular or primary constituent, may occur with or without fumarprotocetraric acid as accessory constituent, without any morphological or distributional character-correlations. In such cases as this, it would seem more appropriate to speak of "chemical phases" of the species rather than of "strains." Close ecological study of such phases may well bring to light microenvironmental factors responsible for the presence or absence of the chemical compound in question, as was shown on a broader environmental basis for some of the Antarctic *Usnea* (*Neuropogon*) species (LAMB, supra cit.).

I hope that the above remarks, sketchy and fragmentary though they are, will stimulate a presentation of various points of view in forthcoming numbers of the Newsletter, leading to (let us hope) a clarification, if not a unification, of current ideas on the subject.

I. M. LAMB

REFERENCES

AHMADJIAN, V. 1967. The Lichen Symbiosis. Blaisdell Pub. Co. Waltham/Toronto/London.

AHTI, T. 1966. Correlation of the chemical and morphological characters in *Cladonia chlorophaea* and allied lichens. *Ann. Bot. Fenn.* 3:380-390.

ASAHINA, Y. 1967. Lichenologische Notizen (203). *Journ. Jap. Bot.* 42:1-9.

HALE, M. E. 1963. Populations of chemical strains in the lichen *Cetraria ciliaris*. *Brittonia* 15:126-133.

HALE, M. E. 1966. Chemistry and evolution in lichens. *Israel Journ. Bot.* 15:150-157.

LAMB, I. M. 1964. Antarctic lichens I. The genera *Usnea, Ramalina, Himantormia, Alectoria, Cornicularia*. *Brit. Antarct. Survey Sci. Rept.* no. 38.

SUOMINEN, J. and AHTI, T. 1966. The occurrence of the lichens *Cladonia nemoxyna, C. glauca* and *C. polycarpoides* in Finland. *Ann. Bot. Fenn.* 3:418-423.

News

AWASTHI, D. D. (India)—Work on the monographic revision of *Dirinaria* is nearing completion. This genus is comprised of uniform species several of which show relationships to *Pyxine* and *Physcia*. Recently completed a collecting trip to the Eastern Himalayas in the district of Darjeeling at altitudes of 8,000 to 10,000 ft.

BACHMANN, O. (Germany)—Studying chemical species of *Parmelia* and doing chemical investigations of *Umbilicaria*. During the fall of 1967 collected in the Nordschwarzwald in West Germany and Vogesen in France. In summer of 1968 plan to collect in Scandinavia. Interested in exchanging specimens of *Umbilicaria* and *Parmelia*.

CHERNOHORSKY, Z. (Czechoslovakia)—Studying the yellow *Rhizocarpon* species, particularly their ecology and distribution in Czechoslovakia. Currently, president of the Czech. Bot. Soc.

CLAUZADE, G. (France)—Ecologie des Lichens de la Region mediterrainienne francaise. Connaissance de la flore lichenique de la France meridionale.

DEGELIUS, G. (Sweden)—Monograph of extra-European species of *Collema*. Biological studies of epiphytes of twigs.

DES ABBAYES, H. (France)—Continuation de l'etude des Lichens de Madagascar, Ile de la Reunion, Afrique intertropicale et des *Cladonia* du monde entier. Monsieur Louis Masse (Maitre-Assistant a mon Laboratoire) s'occupe actuellement de l'ecologie des Lichens ornithocoprophiles et de leur teneur en azote.

GALLOWAY, D. J. (New Zealand)—Enzymology of polyhydric alcohol metabolism in plants, with special reference to lichens. Investigation of the lichens of Stewart Island, N.Z., and ecology of alpine lichens in New Zealand.

GALUN, M. (Israel)—Lichen flora of Israel; directing the following research theses: Monograph of the genus *Caloplaca* in Israel (in progress); lichens of Har Meron (Upper Galilee) and their chemical constituents (completed); ultrastructure of the lichen thallus (in progress). Plan trip to Farlow Herbarium and Smithsonian Institution in December 1967 for herbarium and chemotaxonomy studies.

HENSSEN, A. (Germany)—Ontogenetic studies of various groups. Revisions or monographic treatments of *Placynthium, Lichina, Lempholemma,* and *Zahlbrucknerella.* Request specimens of *Zahlbrucknerella* (most species occur in N. and S. America, some in S. Africa, only one in Europe; no material seen from Asia, except one specimen from China and Australia), *Lempholemma* spp. on stone, and *Lichina* spp. except *L. confinis* and *L. pygmaea.*

HUNECK, S. (Germany)—My colleagues, FOLLMANN and J. SANTESSON, and I have isolated and elucidated the structure of a new depside from *Ramalina subdecipiens* Stein. (an endemic species from the Canaries). This new lichen substance is 4-O-desmethyl barbatinic acid and is the depside analog of hypoprotocetraric acid reported from *Ramalina siliquosa* Smith and *R. tumidula* Hun. & Follm. I request 100-1000 g of *Roccella fuciformis* DC. for chemical studies. For a list of lichen substances in my collection which are available to other lichen chemists, see separate list.

JAMES, P. (England)—With Miss DUNCAN completing a new book on the identification of British lichens. Studies continuing on *Psoroma* and *Menegazzia* as well as New Zealand, Tasmania, and temperate South America.

JANEX, M.-C. (France)—Development of the ascocarps of some pyrenolichens, particularly *Pyrenula.* I would like specimens of any of the following genera: *Sarcopyrenia, Endocarpon, Staurothele, Leptorhaphis, Thelidium,* or tropical Graphidaceae.

KARENLAMPI, L. (Finland)—Ordination of the rocky shore lichen stands in the Finnish Archipelago. Includes also the land uplift caused succession. Biosystematic studies on the Unciales group of the genus *Cladonia.*

KERSHAW, K. A. (England)—Studying the N2-fixation by cephalodial algae of *Peltigera aphthosa* (there is fixation) and subsequent movement of the fixed N. Environmental control of lichen zonation on birch and oak in southwest England. Taxonomic features of *Lecanora* sect. *Aspicilia.*

KOFLER, L. (France)—Germination of spores, growth of *in vitro* cultures of the fungal component in response to external factors; relation with ecology Effect of pollutants on germination and growth. The resistance to pollutants *in vitro* seems well in accord with the species distribution around factories and towns. Request well-determined *Psora* from southern hemisphere. Completed a 2-year stay in South Africa and plan a 3-month stay in Ottawa and 2 months in S. Africa.

LAUNDON, J. R. (England)—Distribution of *Lecanora conizaeoides* in relation to atmospheric pollution. The taxonomy and nomenclature of sorediate crustaceous lichens in the British Isles.

LEBLANC, F. (Canada)—Influence of air pollution, especially SO2, on lichens. Ecology and phytosociology of epiphytic lichens and bryophytes.

OZENDA, P. (France)—Flore des lichens de France par G. CLAUZADE et P. OZENDA (date probable de parution: 1968). Decrit 1900 especes; 600 photographies environ. Partie systematique par CLAUZADE; partie generale et illustrations par OZENDA. Desire des echanges de specimens; propose d'envoyer des lichens des Alps.

MATTICK, F. (Germany)—Geschichte und Literatur der Lichenologie 1870-1970. Morphologie und Soziologie der Flechten. Der Untergang der nordwestdeutschen Flechtenheiden. Im Druck befindliche Arbeiten: Bemerkungen zu M. SATO; *Gyrophora esculenta* (Nova Hedwigia). 1967-Gedenk-und Jubilaumsjahr der Lichenologie (Ber. d. Bot. Ges.). Trip to Japan during July-November 1966.

RICHARDSON, D. H. S. (England)—Carbohydrate physiology of lichens, particularly *Roccella fuciformis* and *Baeomyces rufus.*

RUDOLPH, E. D. (U.S.A.)—Ecology of Antarctic lichens, latest studies in Marie Byrd Land. Continue work on the monograph of N. A. Teloschistaceae (*sensu lato*). Preliminary results of a study of lichen dissemination in Antarctica show by sticky-slide trapping that soredia are more frequently recovered than are ascospores. Does anyone have information from other regions about airborne propagules?

SCHOFIELD, E. (U.S.A.)—Preparations underway for a study of the influence of nutritional and other environmental factors on the distribution of Antarctic lichens. Work will involve two field seasons for making observations and two years for laboratory work. Evaluation of data obtained on a previous project suggests

a possible physiological basis for the type of lichen distribution called "nitrophilous." The present project is designed to test the conclusions reached from the first project.

SHIBATA, S. (Japan)—Structure of iso-usnic acid and triterpenoids in *Lobaria* and *Peltigera* species. Have found the presence of skyrin and rugulosin in *Acroscyphus sphaerophoroides* Lev.

SIERK, H. A. (U.S.A.)—Systematics of *Leptogium* in Mexico and the American tropics. There appear to be about 30 species of *Leptogium* in Mexico of which about a third do not occur in N. America north of Mexico. In addition to species common to Eastern N. America and Asia, there are some species in common with Europe. I would be interested in cooperating with others interested in Latin America and would appreciate receiving specimens of *Leptogium* from Latin America, Asia, Africa, Australia, and the South Pacific.

STEINER, M. (Germany)—Anthraquinones in lichens; Lichen flora of the Wipptal (Tyrol).

TUCKER, S. (U.S.A.)—Have compiled a checklist of the lichens of California based on literature reports and cited references for each species. About 1020 species have been reported to date, in about 150 publications. A card-file of ecological information from these references is being maintained at the mycological herbarium at the Univ. of Calif., Berkeley. In spite of the relatively large number of publications concerning Calif. specimens, the state has been neglected by lichenologists since the collecting days of Herre. It is suggested that monographers make full use of all lichen herbaria in California, some of which are occasionally overlooked. Sizable collections of lichens exist at the Univ. of Calif., Berkeley (I. TAVARES, Curator); Stanford Univ. (J. H THOMAS, Curator); San Francisco State College (H. THIERS, Curator); Los Angeles County Museum (B. TEMPLETON, Curator).

WERNER, R. G. (France)—Ecology and phytogeography of lichens; culture of lichen symbionts; air pollution by lichens.

Views

WEBER, W. A. (U.S.A.)—(Currently at the Australian National Univ., Canberra) *Chondropsis semiviridis* (F. Muell. ex Nyl.) apud Crombie is an unattached lichen of grasslands and deserts of Australia. It has been listed variously as *Parmeliopsis* and *Parmelia*. *Chondropsis* consists of a flat yellow to yellow-green thallus without rhizinae or hapteres of any kind. It is almost always sterile. Its branching pattern is one of the most regular types I have seen. The branches are of the same width throughout, 1.5-2.0 mm, and ultimately are truncate or retuse. The branches diverge at 45° angles from the previous one, forming new dichotomies with 90° angles. When wet, the thallus spreads out horizontally, but when dry the thallus curls up into a ball.

The lack of rhizinae or other attachment organs implies that the species is rolled about and distributed by the wind. Actually, our field observations found that quite the reverse is the case. The lichen is restricted to discrete patches of grassland, and only rarely does one find scattered individuals well away from the main mass. Colonies are often so dense that one can scoop up handfuls from the ground. The colonies, furthermore, do not tend to accumulate in protected areas. Visiting some colonies near Cooma. in New South Wales, we found that in a strong wind there seems to be no tendency for the thalli to roll.

The explanation for this appears to be in the morphology of the thallus in its rolled condition. When dry, the lichen's dichotomous pattern, rolled up into a ball, forms a spherical object perforated with perfect round holes. If these roll a slight distance, they are almost certain to encounter grass blades or straws, upon which they are impaled. Possibly the transition from the unrolled to the rolled condition, from wet to dry conditions, automatically insures the chance encounter with a grass blade. We tested this hypothesis in the field and found that almost all specimens were hindered from rolling.

Thus, it appears that *Chondropsis* is adapted *for* a reasonable amount of wind dispersal, but *against* continuous movement. Perhaps this is a general feature in unattached foliose forms of lichens.

AHMADJIAN, V. (U.S.A.)—C. CULBERSON's recent discovery of a depside in *Herpothallon sanguineum* (Bryologist, 1966) has caused her to doubt the positioning of this lichen in the Basidiomycetes since lichen depsides have been found only in ascomycetous lichens. As the only evidence of *H. sanguineum* being a Basidiomycete is TOBLER's observation of hyphal clamp connections, we are faced with a peculiar dilemma of almost having to choose between TOBLER's cytological observations and CULBERSON's chemical findings. My recent cytological studies of this lichen as well as its isolated mycobiont support TOBLER's observations of clamp connections. The mycobiont in culture forms a colony which is typical of those of ascomycetous mycobionts. A red pigment is present in the fungal colony but no known lichenized substances are produced. The phycobiont is *Trentepohlia*. *Herpothallon*, if it is indeed a true Basidiomycete, illustrates how similar adaptive modifications have occurred in two different classes of fungi as a result of association with algae.

Hale & Son, Printers
Arlington, Virginia

Lichen substances available to other lichen chemists from S. Huneck, Institute of Plant Chemistry, Dresden, Germany:

Atranorin
7β-Acetoxy-22-hydroxyhopane
D-Arabitol
Aspicilin
4-O-Desmethyl barbatinic acid
Calycin
β-Carotene
Chloratranorin
Confluentinic acid
15β,22-Dihydroxyhopane
Diploicin
Diploschistesic acid
Epanorin
Ergosterol
Erythrin
Evernic acid
Friedelin
3a-Friedelanol
3e-Friedelanol
Fuciformic acid
Fumarprotocetraric acid
Glomelliferic acid
Gyrophoric acid
(-)-16α-Hydroxykaurane
Hypoprotocetraric acid
Lecanoric acid
Leprapinic acid
Lichexanthone
Lobaric acid
D-Mannitol
meso-Erythritol
Norstictinic acid
Pannarin
Parietin
Physodic acid
Pinastrinic acid
Planaic acid
(+)-Protolichesterinic acid
Psoromic acid
Pulvinic acid lactone
Rhizocarpic acid
Roccellaric acid
Roccellic acid
Salazinic acid
Schizopeltic acid
Sekikaic acid
Squamatic acid
Stictinic acid
Strepsilin
Tetrahydroxy fatty acids
Thamnolic acid
Thiophanic acid
Tumidulin
Umbilicaric acid
(+)-Usninic acid
(-)-Usninic acid
Vulpinic acid

BEST WISHES TO ALL FOR A HAPPY AND PRODUCTIVE NEW YEAR -
THE EDITORS