The technique and results presented here are of practical and theoretical significance. The reconstituted genomic components of common hexaploid wheat may be of value in plant breeding. For example, the reconstituted AABB component of a commercial variety could be combined with varieties of *Aegilops squarrosa* to produce synthetic hexaploids. Differences noted between the synthetics and the commercial variety would be due to the newly added D genome of the particular *squarrosa* type used. Although preliminary evaluation of several such synthetic hexaploids indicates they are not of direct commercial value, as might be expected, desirable characteristics may be readily transferred to ordinary hexaploid varieties by routine breeding methods. Furthermore, if a synthetic were crossed with the common hexaploid strain from which the AABB had been extracted, segregation in the progeny would be for genes on the D chromosomes only. This would permit, therefore, a genetic analysis of the D genome.

By this technique it might be possible to separate or "dissect" hexaploid wheat into additional genomic components, either at the tetraploid (AADD and BBDD) or, less likely, at the diploid level (AA, BB, and DD). It might also prove useful in reconstituting the genomic components of other amphiploids in the *Triticum-Aegilops* complex and of similarly constructed polyploid types in other genera. The isolation of these components may provide a new approach to problems concerning the characteristics of the ancestral species of naturally occurring amphiploids, the genetic composition of the constituent genomes, and the genetic changes which presumably have taken place within them since incorporation into the polyploid form. It is obvious that genetic changes have occurred in the AABB component of common hexaploid wheat which adversely affect the growth and fertility of the reconstituted tetraploid. These deficiencies are not expressed at the hexaploid level because of the compensating effects of the D genome. This is substantiated by the normal growth, vigor, and high fertility of synthetic hexaploids produced from hybrids between the extracted AABB component of Canthatch and *A. squarrosa*.

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Joint Occurrence of a Lichen Depsidone and Its Probable Depside Precursor

Abstract. *A chemical race of the lichen* Cetraria ciliaris *Ach., known to produce the depside olivetoric acid, contains the corresponding depsidone, physodic acid, as well. Physodic acid may form by an intramolecular coupling of olivetoric acid.*

Lichens have been notoriously difficult subjects for physiological experimentation (*1*) and there is little information about the biosynthesis of their curious phenolic constituents. The routes of synthesis of some of these compounds have been proposed tentatively by analogy with known processes in other organisms and by the occurrence of chemically similar substances in certain closely related species or "strains." Conversions such as lecanoric acid to diploschistic acid by nuclear hydroxylation, alectoronic acid to α-collatolic acid by O-methylation, evernic acid to obtusatic acid by C-methylation, atranorin to chloratranorin by nuclear chlorination, and baeomycic acid to squamatic acid by alkyl side chain oxidation are suggested by the joint occurrence of these pairs of substances in the individual thalli of certain species of lichens.

Depsidones have a characteristic seven-membered ring joining two phenyl nuclei through ester and ether linkages, and are almost unique to lichens (*2*) (Fig 1). It has been proposed that depsidones are formed by dehydrogenative coupling of depsides, compounds containing the ester linkage preformed (*3*). This view is supported by the structural similarities between some depsides and depsidones. Also, a few examples of depside-producing lichens are known for which there is a morphologically indistinguishable segregate containing the corresponding depsidone (*4*). When a naturally occurring depsidone was synthesized in the laboratory, an oxidative coupling reaction was utilized, and the synthesis was cited as "good evidence in support of the suggestion that depsidones are formed *in vivo* from depsides" (*5*). The present report provides the first proof for the joint occurrence of a lichen depsidone and the corresponding depside.

During a microchemical survey of the lichen substances in the genus *Cetraria*, it became evident that specimens of *C. ciliaris*, producing olivetoric acid, contain another substance which interferes with analyses made by Asahina's microcrystallographic methods (*6*). Atranorin, a β-orcinol-type depside present in this lichen, was separated by its greater solubility in benzene and could not have interfered with the other tests. Chromatograms of extracts from fragments (approximately 25 mg) of 12 herbarium specimens were developed in n-butanol saturated with ammonium hydroxide, viewed with ultraviolet light (366 mμ), and sprayed with tetrazotized benzidine. Each sample showed spots for olivetoric acid and for another component, with a lower R_F value, tentatively identified as physodic acid by chromatographic comparisons with known lichen substances.

For confirmatory tests, a large sample of *Cetraria ciliaris* was collected from wooden fence rails at Laurel Springs, North Carolina. The lichen was air dried (179.2 g) and scanned with ultraviolet light (366 mμ). A few fluorescent plants (6.2 g, 3.5 percent of the sample) were segregated; they contained alectoronic acid and atranorin but were indistinguishable morphologically from the rest of the sample (*7*). A nonfluorescing, intact, fruiting plant (1.42 g) was extracted with boiling ethyl ether. The residue from evaporation of the extract was chromatographed on a column (50.0 × 4.0 cm) of silicic acid (Mallinckrodt, 100 mesh), and was eluted with benzene to which increasing concentrations of ethyl ether were added, up to 50 percent. The fractions (5 ml) of effluent were tested by paper chromatography (Whatman No. 1 paper developed with ammonium hydroxide-saturated n-butanol) and by Asahina's microcrystal tests (*8*).

Atranorin was identified in fractions

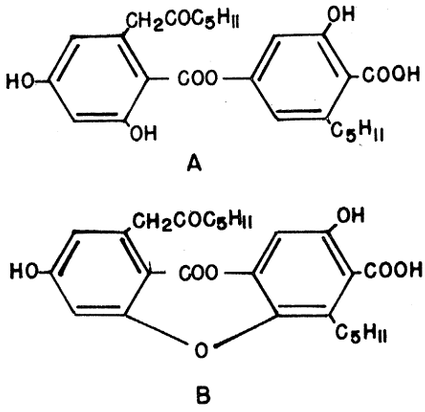

Fig. 1. Olivetoric acid, a depside (*A*), and physodic acid, a depsidone (*B*).

232 to 238 by comparison with an authentic sample from *Cladonia evansii* des Abb. On a paper chromatogram, the spot at R_F 0.52 fluoresces yellow in ultraviolet light (366 mμ) and colors yellow-brown with tetrazotized benzidine. Color reactions with alcoholic $FeCl_3$ (reddish brown) and dilute alkali (yellow), as well as microchemical tests in three reagents (*8*) were confirmatory. Chloratranorin mixed with atranorin would not have been distinguished by chromatography, color reactions, or microchemical tests, but the combined fractions gave a negative Beilstein test for halogen.

Fractions 391 to 407 contained olivetoric acid which gave the expected color reactions with alcoholic $FeCl_3$ (blue-red) and aqueous $Ca(OCl)_2$ (red). On the paper chromatogram, olivetoric acid appears as a double spot (R_F 0.61 and 0.73) due to base hydrolysis during development. It fluoresces deep blue in ultraviolet light (366 mμ) and turns red and then blue-red with tetrazotized benzidine. The results of microcrystal tests (*8*) in four reagents agreed with this identification (*9*). The infrared spectrum of olivetoric acid from *Cetraria ciliaris* confirms this identification and the ultraviolet spectrum is typical of an orcinol-type depside (*10*).

Fractions 408 to 412 contained a mixture of olivetoric acid and physodic acid (analysis by paper chromatography). Fractions 413 to 463, containing nearly pure physodic acid, were combined and again chromatographed to remove the last traces of olivetoric acid. The sample then gave the expected color reactions with alcoholic $FeCl_3$ (purple) and with aqueous $Ca(OCl)_2$ added to the sample in basic solution (red). Chromatographic comparison with physodic acid isolated from *Parmelia physodes* (L.) Ach. showed identical spots at R_F 0.41 which quenched ultraviolet light (366 mμ) and turned brown with tetrazotized benzidine. Characteristic crystals (*8*) were observed in two test solutions. The infrared spectrum (λ_{max} 3300, 1725, 1670, 1620, 1225, and 1145 cm^{-1}) confirmed the identification of this substance. The ultraviolet spectrum is typical of an orcinol-type depsidone (*10*).

Although lichen depsides and depsidones are structurally very similar, only one other pair of compounds, microphyllinic acid (a depside) and α-collatolic acid (a depsidone), differ at the site of the ether linkage alone. But there is some evidence that α-collatolic acid forms not from microphyllinic acid by dehydrogenation, but from the depsidone alectoronic acid by O-methylation. A depside which could give alectoronic acid directly by cyclization is unknown in nature. Erdtman and Wachtmeister and others have recognized that the secondary structural differences between known depsides and depsidones need not necessarily have occurred after cyclization (*3*). Future studies to reveal substances accompanying the major lichen metabolites are certain to give new clues to the biogenesis of these curious natural products.

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Photoelectric Ecosystem

Abstract. *A natural, self-maintaining photoelectric cell, composed of a blue-green algal mat and bacteria as a layered ecosystem, was isolated from a shallow marine bay in Texas near Port Aransas. In daytime the open-circuit potential across the ecological membrane was about 0.43 volt. The efficiency of conversion of light energy to organic potential energy before maintenance was 1.62 percent and to external electrical energy at optimum power loading was 0.016 percent, a flow analogous to a consumer population.*

This report concerns a living membrane in which the self-maintaining aspect of an ecological system (ecosystem), the electrochemical potentials of photosynthetic drive, and the dependency of organic and inorganic substances are combined.

The algal mat studied occurs in shallow marine bays of southern Texas. The vertical zonation, growth, and morphology of one group of such mats have been described by Sorensen and Conover (*1*). The sheaths of the filaments in the top layer had become stained with an iron complex which gave them a dark appearance; this top layer acted as a shield that reduced light intensity for lower layers. Maximum growth occurred below this top layer and the growth decreased with depth until the layers of sediment began a centimeter or less below the surface. In the area where mat and sediment meet, the filaments were decomposed.

The dominant species in the mat may differ. The mat which became stabilized in the laboratory experiments contained blue-green algae, such as *Microcoleus cthonoplastes* (Mert.) Zanard. and a few other sparsely represented species, *Schizothrix* and *Anacystis*. *Desulfovibrio, Beggiatoa,* and other bacteria occurred in the sediments. In the gross relation of the upper oxidized, photosynthetically active zone to the lower reduced and regenerative zones, the mat ecosystem is like some other aquatic systems with sharply defined epilimnetic and hypolimnetic zones, such as the Black Sea, except more compressed. Field measurements indicated a potential between top and bottom of the mat of 0.5 v.

Microcosms were set up by transferring small sections of the mat from outdoor culture ponds to finger bowls