Usnic acid, one of about 90 "lichen substances" which are produced by lichenized fungi, has been reported to cause allergic contact dermatitis (1, 2). In view of a resemblance between the molecular structure of usnic acid (dibenzo-furan) Fig. 1(a) and that of psoralen (furocoumaran) Fig. 1(d), which is a photosensitizer of human skin, usnic acid and some lichens and lichen substances were tested for phototoxic activity. The procedure used was that described by Daniels (3).

Candida albicans was inoculated onto plates of Sabouraud's agar. Pieces of lichens and lichen substances were placed on the surface of the medium. The plates were exposed to long-wave ultraviolet light in a dark room at 90°F. Other plates prepared in the same way were kept in the dark at the same temperature. The plates were examined at 16 and 24 hours.

To confirm the efficacy of the method and materials, tests were made with Zetar®, 8-methoxy-psoralen, Fig. 1(d) parsley, parsnip, marigold, Skimmio japonica and other chemicals and plants.

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† Racemic usnic acid was obtained from Nutritional Biochemicals Corporation, Cleveland 28, Ohio. d- and l-usnic acid were obtained from Koch-Light Laboratories, Colnbrook, Bucks., England.

Samples of vulpinic acid and parietin were given by Professor G. H. N. Towers, University of British Columbia.

Samples of vernic acid, divaricatic, perlatolic, phystidalic and hypoprotocetraric acids were given by Dr. Chicata F. Culberson, Department of Botany, Duke University, Durham, North Carolina.

Samples of protolichesteric, aldeotronic, protocetraric, fumarprotocetraric, psoromic, gyrophoric, evernic, divaricatic, lobatic, lecanoric and stictic acids, atranorine and zeorine were given by Professor S. Shibata, Faculty of Pharmaceutical Sciences, University of Tokyo. 8-methoxy-psoralen was obtained from Paul B. Elder Co., Bryan, Ohio. Angelica root was found to exhibit phototoxic activity. This plant contains angelicin Fig. 1(e) which is chemically related to psoralen and to usnic acid. Rotenone, Fig 1(f) did not exhibit phototoxic activity.

Usnic acid was tested by placing crystals on the surface of the medium; usnic acid dissolved in acetone, furfural and dimethylsulphoxide was also used. Discs of No. 2 Whatman's filter paper, 6 mm diam., were soaked in the solutions, dried in the air and placed on the surface of the medium. The following lichen substances were tested: a triterpenoid zeorine: a pulvic acid derivative, vulpinic acid: depsides (Fig. 1(c)), atranorine, divaricatic acid, evernic acid, gyrophoric acid, lecanoric acid, perlatolic acid: depsidones (Fig. 1(b)); aldeotronic acid, fumarprotocetraric acid, hypoprotectaric acid, lobatic acid, protocetraric acid, psoromic acid, stictic acid: and the quinone, parietin. The colored apothecia of many lichens contain rhodocladonic acid. Specimens of the following lichens and some colored apothecia were tested:—Parmelia caperata, Cetraria, Alectoria, Cladonia, Rhizocarpon, Usnea, Letharia species. Pieces of the thallus and colored apothecia of Cladonia bacillaris, which contains the dibenzofuran didymic acid, were also tested. No difference was noted between plates kept under the light and in the dark. "Usno"® is a compound of usnic acid which has been reported to show antibiotic activity against yeasts (4). Tests with "Usno" powder® consistently showed clearing of zones of equal size in light and dark, indicating an antibiotic rather than a phototoxic effect. Crystalline usnic acid showed no antibiotic effect against Candida.

Many lichens exhibit fluorescence when exposed to Wood's light, e.g. Rhizocarpon (red), Cetraria (white). The following lichen substances were found to exhibit fluorescence: parietin (orange), lobatic acid (pale white), aldeotronic acid (brilliant white). Tests were also carried out on plates exposed to Wood's light (Burton Model 1910) instead of Westinghouse black light as used by Daniels. The three lichen substances exhibited fluorescence when placed on the surface of the medium and continued to do so after the glass covers had been placed on the plates, indicating that the glass per-
mitted passage of the light. These substances did not, however, inhibit the growth of Candida when exposed to Wood's light.

These results indicate that usnic acid (a dibenzofuran chemically related to psoralen and to angelicin), some species of lichens, and some lichen substances derived from lichens do not exhibit phototoxicity of the psoralen type.

Tenchio described allergic contact dermatitis resulting from exposure to the lichen Parmelia caperata (5). This species of lichen contains usnic acid. He observed that dermatitis first appeared or flared on sunny days, and he discussed the roles of sunlight and sweating in pathogenesis of the disease. The findings reported here indicate that a phytophototoxic effect from usnic acid is unlikely to be significant in allergic contact dermatitis from lichens.

REFERENCES