TRANSACTIONS
OF THE
ROYAL SOCIETY OF NEW ZEALAND
GENERAL

VOL. 1 No. 20 18 MAY 1966

A New Zealand Phytochemical Register—Part II.

By S. G. BROOKER, R. C. CAMBIE, and MARGARET A. JAMES

[*Received by the Editor, 8 July 1965.*]

Abstract

A phytochemical register of New Zealand species of the order Coniferales is compiled and compounds obtained from each source are cross-indexed according to chemical types. Selected references to the chemistry of some diterpenes and diterpenoids which are common in New Zealand species are also given.

INTRODUCTION

IN Part I (Brooker, Cain, and Cambie, 1963) a phytochemical register of species endemic to New Zealand was compiled, which covered all native plants except the Gymnosperms and Lichens. Part II is concerned with the former group. The format of this Part follows that of the earlier one in which the order of species, the botanical authority, and the aims of compiling this register were detailed. Again, no attempt has been made to review the chemistry or to draw relationships between the botanical classification and the type of compound found.

A few modifications require comment. Wherever possible, references to preliminary communications have been omitted, except where all the information reported therein is not repeated in a later or main paper. Reference to the detection only of compounds or classes of compounds have been omitted, but attention is drawn to the paper of Cain, Scannell, and Cambie (1961) in which is reported the occurrence and identification of leucoanthocyanins in all the endemic gymnosperms mentioned here.

The New Zealand species of the gymnosperms are characterised by the occurrence of diterpenes and diterpenoid compounds and indeed it is mainly for this reason that these species have attracted considerable attention from chemists concerned with natural products. In view of this interest, where considerable work has been reported on the elucidation of the structure and stereochemistry of a diterpene or diterpenoid, its reactions, synthesis, occurrence in other species, or its utilisation for chemical purposes, a separate list of selected references is included on pages 220–231. These lists are not exhaustive but include the majority of major papers concerned with a particular compound. In general the patent

Published by the Royal Society of New Zealand, c/o Victoria University of Wellington, P.O. Box 196, Wellington.

literature has not been included in the survey. Where only a few papers have been published on a particular diterpenoid these are included under the references to the species where it is first mentioned. For some diterpenoids of well-established structure (e.g., abietic acid) which also occur in many exotic plants no additional references are given. In addition to the references given in the lists the reviews or texts by Arya and Erdtman (1962), Barton (1949, 1953), Barltrop and Rogers (1961), De Mayo (1956), Dutta and Narang (1961), Haagen-Smit (1955), Rogers and Barltrop (1962), Simonsen and Barton (1952), and Tsutsui and Tsutsui (1959) should also be consulted.

In Section I of this Part the non-endemic species *Araucaria excelsa* R.Br., the Norfolk Island Pine, is included. This is because it is a common tree in New Zealand and its chemistry follows closely that of the New Zealand gymnosperms.

REFERENCES TO THE INTRODUCTION

ARYA, V. P., ERDTMAN, H., 1962. In *Recent Progress in the Chemistry of Natural and Synthetic Colouring Matters,* Academic Press, London, p. 359.

BARLTROP, J. A., ROGERS, N. A. J., 1961. In *Progress in Organic Chemistry,* Butterworths Scientific Publns., London, Vol. V, p. 96.

BARTON, D. H. R., 1949. *Quart. Revs., 3*: 36.

——— 1953. In *Chemistry of Carbon Compounds,* Elsevier Publishing Co., Amsterdam, Vol. IIB, p. 696.

BROOKER, S. G., CAIN, B. F., CAMBIE, R. C., 1963. *Trans. Roy. Soc. N.Z., General, 1*: 61.

CAIN, B. F., SCANNELL, S., CAMBIE, R. C., 1961. *N.Z. J. Sci., 4*: 3.

DE MAYO, P., 1956. *The Chemistry of Natural Products,* Vol. III, *The Higher Terpenoids,* Interscience Publishers, New York.

DUTTA, P. C., NARANG, S. A., 1961. *J. Ind. Chem. Soc., 38*: 576.

HAAGEN-SMIT, A. J., 1955. In *Progress in the Chemistry of Organic Natural Products,* Springer-Verlag, Vienna, Vol. II, p. 1.

ROGERS, N. A. J., BARLTROP, J. A., 1962. *Quart. Revs., 16*: 117.

SIMONSEN, J., BARTON, D. H. R., 1952. *The Terpenes,* Vol. III, Cambridge University Press. See also Simonsen, J., Ross, W. C. J., 1957. *The Terpenes,* Vol. V.

TSUTSUI, M., TSUTSUI, E. A., 1959. *Chem. Rev., 59*: 1031.

ERRATA (to Part I)

P. 75—The reference under *Brachyglottis repanda* J. R. et G. Forst. ("Rangiora") should read: Skey, W., 1881. *Trans. N.Z. Inst., 14*: 400.

P. 87—Under "Alkaloids, unidentified" delete "*Coriaria* sp."

We are grateful to Dr E. P. White for pointing out these errors.

Section I

A REGISTER OF SPECIES AND COMPOUNDS ISOLATED FROM THEM

CONIFERALES

PODOCARPACEAE

Podocarpus dacrydioides A. Rich. ("Kahikatea").

ESSENTIAL OIL: α-Pinene, β-pinene, unidentified acids, alcohols, phenols, aldehydes, terpenes, sesquiterpenes, and sesquiterpene alcohols, a cadinene, possibly caryophyllene, phyllocladene, isophyllocladene, cupressene (≡ hibaene).—

Aitken, H. A. A., 1929. *J. Soc. chem. Ind. Lond., 48*: 344T.

Hunter, G. J. E., 1932. *J. Soc. chem. Ind. Lond., 51*: 394T.

Briggs, L. H., 1937. *Aust. N.Z. Assoc. Adv. Sci., 23*: 45.

Briggs, L. H., 1959. *J. N.Z. Inst. Chem. 23*: 92.

Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205. (See also under phyllocladene and cupressene.)

HEARTSHAKES: Podocarpic acid.

Easterfield, T. H., 1910. *Trans. N.Z. Inst., 42*: 53.

Sherwood, I. R., Short, W. F., 1938. *J. chem. Soc.*: 1006. (See also under podocarpic acid.)

HEARTWOOD: Ferruginol, Δ^6-dehydroferruginol, sugiol, xanthoperol, podocarpic acid, methyl podocarpate, pododacric acid, unidentified keto-acid, n-heptacosane.—

Briggs, L. H., Cambie, R. C., Seelye, R. N., Warth, A. D., 1959. *Tetrahedron, 7*: 270.

Cashmore, A. R., 1963. *Thesis, Univ. Auckland.* (See also under ferruginol, sugiol, xanthoperol, podocarpic acid.)

Podocarpus spicatus R.Br. ex Mirbel ("Matai").

ESSENTIAL OIL: (+)-α-Pinene, β-pinene, myrcene, α-terpinene, γ-terpinene, (+)-β-phellandrene, dipentene, p-cymene, α-terpineol, aromadendrene, a selinene, (±)-cadinene, an unidentified terpene, unidentified oxygenated sesquiterpenes, heerabolene (?), (+)-kaurene, (+)-isokaurene, phyllocladene (N.Is.), cupressene.—

Butler, J. M., Holloway, J. T., 1939. *J. Soc. chem. Ind. Lond., 58*: 223.

Briggs, L. H., Loe, J. A., 1950. *J. chem. Soc.*: 958.

McGimpsey, J. R., Murray, J., 1960. *J. appl. Chem., 10*: 340.

Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205. (See also under phyllocladene, kaurene, cupressene.)

HEARTSHAKES: Matairesinol, conidendrin, podospicatin, quercetin, caproic acid.

Easterfield, T. H., 1910. *Trans. N.Z. Inst., 43*: 55.

Easterfield, T. H., Bee, T., 1910. *J. chem. Soc., 97*: 1028.

Easterfield T. H., McDowall, J. C., 1915. *Trans. N.Z. Inst., 48*: 518.

Haworth, R. D., Richardson, T., 1935. *J. chem. Soc.*: 633.

Briggs, L. H., Peak, D. A., Woolloxall, J. L. D., 1935. *Proc. roy. Soc. N.S.W., 69*: 61.

Haworth, R. D., Richardson, T., Sheldrich, G., 1935. *J. chem. Soc.*: 1576.

Briggs, L. H., Peak, D. A., 1936. *J. chem. Soc.*: 724, and references to conidendrin therein.

Haworth, R. D., Kelly, W., Richardson, T., 1936. *J. chem. Soc.*: 725.

Keimatsu, S., Ishiguro, T., 1936. *J. Pharm. Soc. Japan, 56*: 399.

Haworth, R. D., Atkinson, J. R., 1938. *J. chem. Soc.*: 797.

Briggs, L. H., Cain, B. F., 1959. *Tetrahedron, 6*: 143.

HEARTWOOD: Matairesinol, conidendrin, seco-isolariciresinol, quercetin, kaempferol, taxifolin, aromadendrin, genistein, podospicatin, sequoyitol.—

Brewerton, H. V., 1958. *N.Z. J. Sci., 1*: 220.
Briggs, L. H., Cebalo, T. P., 1959. *Tetrahedron, 6*: 145.
Briggs, L. H., Cambie, R. C., Hoare, J. L., 1959. *Tetrahedron, 7*: 262.
Freudenberg, K., Weinges, K., 1959. *Tetrahedron Letters,* No. 17: 19.
Freudenberg, K., Sidhu, G. S., 1961. *Chem. Ber., 94*: 851.
Weinges, K., 1961. *Chem. Ber., 94*: 2522.
Weinges, K., 1961. *Chem. Ber., 94*: 3032.
Briggs, L. H., Cebalo, T., 1963. *Tetrahedron, 19*: 2301.
Farkas, L., Várady, J., 1963. *Acta Chim. Acad. Sci. Hung., 38*: 283.
Farkas, L., Várady, J., 1963. *Magyar Kem. Folyoirat., 69*: 458.
Várady, J., 1963. *Periodica Polytech., 7*: 241.

Podocarpus ferrugineus G. Benn. ex D. Don. ("Miro").

ESSENTIAL OIL: (+)-α-Pinene, (+)-limonene, dipentene, cineole, (+)-cadinene, phyllocladene, isophyllocladene, kaurene, rimuene, cupressene.—

Hosking, J. R., Short, W. F., 1928. *Rec. trav. chim., 47*: 834.
Hosking, J. R., 1930. *Rec. trav. chim., 49*: 1036.
Briggs, L. H., Cawley, R. W., Loe, J. A., Taylor, W. I., 1950. *J. chem. Soc.*: 955.
Briggs, L. H., Cain, B. F., Cambie, R. C., Davis, B. R., Rutledge, P. S., 1962. *J. chem. Soc.*: 1850.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem. 2*: 205.
Briggs, L. H., Cambie, R. C., Rutledge, P. S., Stanton, D. W., 1964. *Tetrahedron Letters,* No. 32: 2223.

(See also under phyllocladene, kaurene, rimuene, and cupressene.)

BLED RESIN: (+)-α-Pinene, β-pinene, ferruginol, Δ^6-dehydroferruginol, sugiol, isopimaric acid.—

Easterfield, T. H., 1910. *Trans. N.Z. Inst., 43*: 53.
Brandt, C. W, Neubauer, L. G., 1939. *J. chem. Soc.*: 1031.
Brandt, C. W., Neubauer, L. G., 1940. *J. chem. Soc.*: 683.
Campbell, W. P., Todd, D., 1940. *J. Amer. chem. Soc., 62*: 1287.
Campbell, W. P., Todd, D., 1942. *J. Amer. chem. Soc., 64*: 928.
Brossi, A., Jeger, O., 1950. *Helv. Chim. Acta, 33*: 722.
Bredenberg, J-B., 1957. *Acta Chem. Scand., 11*: 932.
Briggs, L. H., Cambie, R. C., 1960. *Tetrahedron, 8*: 356.
(See also under ferruginol, sugiol, and isopimaric acid.)

BARK: Tannins.—

Aston, B. C., 1918. *N.Z. J. Agric., 16*: 358.

Podocarpus nivalis Hook. ("Mountain totara").

ESSENTIAL OIL: (—)-α-Pinene (?), myrcene, unidentified sesquiterpene, phyllocladene, isophyllocladene, kaurene, cupressene.—

Murray, J., 1960. *J. appl. Chem.*, 10: 366.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.

HEARTWOOD: Totarol, podototarin, podototarin mono-acetate, podocarpic acid, methyl podocarpate, β-sitosterol, alkanes C_{13}, C_{14}, and C_{21}–C_{31} inclusive.

Bennett, C. R., 1965. *Thesis, Univ. Auckland.*

(See also under totarol and podocarpic acid.)

Podocarpus totara G. Benn. ex D. Don ("Totara").

ESSENTIAL OIL: α-Pinene, β-pinene, unidentified terpene and sesquiterpene alcohols and sesquiterpenes, a cadinene, phyllocladene, kaurene, isokaurene, rimuene.—

Aitken, H. A. A., 1929. *J. Soc. chem. Ind. Lond., 48*: 344T.
Beath, G. B., 1933. *J. Soc. chem. Ind. Lond., 52*: 338T.
Murray, J., 1960. *J. appl. Chem., 10*: 366.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.
Aplin, R. T., Cambie, R. C., 1964. *N.Z. J. Sci. 7*: 258.

HEARTWOOD: Totarol, 16-hydroxytotarol, podototarin, sugiol, podocarpic acid, methyl podocarpate, pododacric acid, β-sitosterol, unidentified compound $C_{15}H_{14}O_8$, m.p. 245–246°.—

Easterfield, T. H., 1910. *Trans. N.Z. Inst., 43*: 53.
Easterfield, T. H., McDowell, J. C., 1915. *Trans. N.Z. Inst., 48*: 518.
Short, W. F., Stromberg, H., 1937. *J. chem. Soc.*: 516.
Short, W. F., Wang, H., 1950. *J. chem. Soc.*: 991.
Short, W. F., Wang, H., 1951. *J. chem. Soc.*: 2979.
Brandt, C. W., Thomas, B. R., 1951. *N.Z. J. Sci. Tech., 33B*: 30.
Barltrop, J. A., Rogers, N. A. J., 1958. *J. chem. Soc.*: 2566.
Wenkert, E., Beak, P., 1961. *Tetrahedron Letters*, No. 11, 358.
Cambie, R. C., Mander, L. N., 1962. *Tetrahedron, 18*: 465.
Chow, Y-L., Erdtman, H., 1962. *Acta Chem. Scand., 16*: 1305.
Cambie, R. C., Simpson, W. R. J., Colebrook, L. D., 1963. *Tetrahedron, 19*: 209.
(See also under totarol, sugiol, and podocarpic acid.)

Podocarpus hallii Kirk ("Fuchsia-barked totara").

ESSENTIAL OIL: Phyllocladene, isophyllocladene, isokaurene, rimuene.—
Briggs, L. H., 1940. *Trans. roy. Soc. N.Z., 70*: 173.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.
(See also under the respective diterpenes.)

HEARTWOOD: Totarol, 16-hydroxytotarol, 16-oxototarol, 16-carboxytotarol (?), sugiol, podcarpic acid, unidentified compounds, m.p.s. 204° and 298–299°.
Cambie, R. C., Simpson, W. R. J., Colebrook, L. D., 1963. *Tetrahedron, 19*: 209.
(See also under totarol, sugiol, and podocarpic acid.)

Podocarpus acutifolius Kirk ("Sharp leaved totara").

ESSENTIAL OIL: Isokaurene, rimuene.—

Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.
(See also under kaurene and rimuene.)

Dacrydium kirkii F. Muell. ex Parl. ("Monoao").

ESSENTIAL OIL: (+)-α-Pinene, myrcene, (+)-limonene, unidentified terpene(s), (—)-cadinene, unidentified sesquiterpene, b.p. 118–125°/10mm, three unidentified sesquiterpene alcohols, b.p.s. 125–134°/5mm, 135°/5mm, and

100–112°/0.01mm, (+)-bornyl acetate, carvone, sobrerol (?), phyllocladene, isophyllocladene, kaurene, rimuene, cupressene.—

Briggs, L. H., 1941. *J. Soc. chem. Ind., 60*: 222T.
Briggs, L. H., Taylor, W. I., 1947. *J. org. Chem., 12*: 551.
Aplin, R. T., Cambie, R. C., 1964. *N.Z. J. Sci., 7*: 258.
(See also under respective diterpenes.)

HEARTWOOD: Manool, isopimaric acid.—

Hosking, J. R., 1937. *N.Z. J. Sci. Tech., 19B*: 208.
Brossi, A., Jeger, O., 1950. *Helv. Chim. Acta, 33*: 722.
(See also under manool and isopimaric acid.)

Dacrydium biforme Pilger ("Yellow pine").

LEAVES AND ESSENTIAL OIL: Myrcene, β-terpinene, three unidentified oxygenated terpenes, unidentified tricyclic sesquiterpene, b.p. 80°/4mm, (+)-longifolene, (+)-aromadendrene, (—)-metrosiderene, (+)-γ-cadinene, (+)-δ-cadinene, unidentified sesquiterpene alcohol, b.p. 104°/2.5mm, torreyol (?), α-camphorene, phyllocladene, isophyllocladene.—

Goudie, B. H., 1923. *J. Soc. chem. Ind. Lond., 42*: 357T.
Aitken, P. W., 1928. *J. Soc. chem. Ind. Lond., 47*: 223T.
Briggs, L. H., 1937. *J. chem. Soc.*: 79.
Briggs, L. H., 1937. *Aust. N.Z. Assoc. Adv. Sci., 23*: 45.
Corbett, R. E., Wong, L. C-K., 1955. *J. Sci. Food Agric., 6*: 739.
Cambie, R. C., Mander, L. N., 1964. *N.Z. J. Sci., 7*: 188.
Aplin, R. T., Cambie, R. C., 1964. *N.Z. J. Sci., 7*: 258.
(See also under phyllocladene.)

HEARTWOOD: Biformene, isopimara-7,15-diene, manool, manoyl oxide, 2-oxomanoyl oxide, torulosol, torulosal, isopimarinol, isopimarinal, isopimaric acid, juniperol (≡ macrocarpol), β-sitosterol.—

Hosking, J. R., Brandt, C. W., 1935. *Chem. Ber., 68B*: 1311.
Hosking, J. R., 1936. *Chem. Ber., 69B*: 780.
Hosking, J. R., Brandt, C. W., 1936. *N.Z. J. Sci. Tech., 17*: 750.
Brandt, C. W., Neubauer, L. G., 1940. *J. chem. Soc.*: 683.
Brossi, A., Jeger, O., 1950. *Helv. Chim. Acta, 33*: 722.
Ohloff, G., 1958. *Helv. Chim. Acta, 41*: 845.
Akiyoshi, S., Erdtman, H., Kubota, T., 1960. *Tetrahedron, 9*: 237.
Carman, R. M., Grant, P. K., 1961. *J. chem. Soc.*: 2187.
Enzell, C., 1961. *Acta Chem. Scand., 15*: 1303.
Barreto, H. S., Enzell, C., 1961. *Acta Chem. Scand., 15*: 1313.
Cambie, R. C., Mander, L. N., 1964. *N.Z. J. Sci., 7*: 188.
Enzell, C. R., Thomas, B. R., 1964. *Tetrahedron Letters*, No. 8: 391.
(See also under manool, manoyl oxide, 2-oxomanoyl oxide, and isopimaric acid.)

BARK: Manool, β-sitosterol, leucodelphinidin.—

Cambie, R. C., Mander, L. N., 1964. *N.Z. J. Sci., 7*: 188.
(See also under manool.)

Dacrydium bidwillii Hook. f. ex Kirk ("Mountain pine").

ESSENTIAL OIL: Phyllocladene, isophyllocladene.—
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem.*, 2: 205.
(See also under phyllocladene.)

HEARTWOOD: Manool.—
Brandt, C. W., 1951. *N.Z. J. Sci. Tech., 33B*: 141.
(See also under manool.)

Dacrydium laxifolium Hook. f. ("Pigmy pine").

ESSENTIAL OIL: α-Pinene, phyllocladene, kaurene, isokaurene, rimuene, cupressene.—
Murray, J., 1960. *J. appl. Chem., 10*: 366.
Aplin, R. C., Cambie, R. C., 1964. *N.Z. J. Sci., 7*: 258.
(See also under respective diterpenes.)

Dacrydium. (Putative hybrid between *D. laxifolium* and *D. intermedium.*)
(The name "*farnellii*" used in the reference below has not been validly published in accordance with the International Code of Botanical Nomenclature, and should not be used.)

ESSENTIAL OIL: Phyllocladene, isophyllocladene, rimuene, cupressene.—
Aplin, R. T., Cambie, R. C., 1964. *N.Z. J. Sci., 7*: 258.
(See also under respective diterpenes.)

Dacrydium cupressinum Lamb. ("Rimu").

ESSENTIAL OIL: α-Pinene, unidentified sesquiterpene, b.p. 132–135°/20mm, phyllocladene, isophyllocladene, rimuene.—
McDowall, F. H., Finlay, H. J., 1925. *J. Soc. chem. Ind. Lond., 44*: 42T.
Carrie, M. S., 1932. *J. Soc. chem. Ind. Lond., 51*: 367T.
Briggs, L. H., 1937. *J. chem. Soc.*: 79.
Briggs, L. H., 1937. *Aust. N.Z. Assoc. Adv. Sci., 23*: 45.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.

HEARTSHAKES: Podocarpic acid.—
Easterfield, T. H., Aston, B. C., 1903. *Trans. N.Z. Inst., 36*: 483.
Easterfield, T. H., 1910. *Trans. N.Z. Inst., 43*: 53.
Sherwood, I. R., Short, W. F., 1938. *J. chem. Soc.*: 1006.
(See also under podocarpic acid.)

HEARTWOOD: Ferruginol, Δ^6-dehydroferruginol, sugiol, podocarpic acid, totarol, juniperol, β-sitosterol, crystalline wax, m.p. 63–64°.—
Brandt, C. W., Thomas, B. R., 1951. *N.Z. J. Sci. Tech., 33B*: 30.
Bredenberg, J-B., 1957. *Acta Chem. Scand., 11*: 932.
Cambie, R. C., Cain, B. F., 1960. *N.Z. J. Sci., 3*: 121.
(See also under ferruginol, sugiol, podocarpic acid, and totarol.)

BARK: Tannins, sequoyitol, totarol, β-sitosterol, leucocyanidin.—
Aston, B. C., 1918. *N.Z. J. Agric., 16*: 358.
Cambie, R. C., Cain, B. F., 1960. *N.Z. J. Sci., 3*: 121.
(See also under totarol.)

Dacrydium intermedium Kirk ("Yellow silver pine").

ESSENTIAL OIL: Kaurene, isokaurene, rimuene, cupressene.—
Aplin, R. T., Cambie, R. C., 1964. *N.Z. J. Sci., 7*: 258.
(See also under respective diterpenes.)

HEARTWOOD: Unidentified acids.—
Hosking, J. R., 1937. *N.Z. J. Sci. Tech., 33B*: 206.

Dacrydium colensoi Hook. ("Silver pine").

ESSENTIAL OIL: (—)-α-Pinene, myrcene, (—)-limonene, terpinolene, unidentified tricylic sesquiterpenes, b.p.s 89°/4.5mm, 93°/4.5mm, (+)-longifolene, unidentified tricyclic sesquiterpene, b.p. 91°/2.5mm, unidentified dicyclic sesquiterpene, b.p. 94°/2mm, muurolene (?), (+)-β-cadinene, (+)-juniperol (macrocarpol), phyllocladene, isophyllocladene, rimuene.—
Blackie, W. J., 1929. *J. Soc. chem. Ind. Lond., 48*: 357T.
Blackie, W. J., 1930. *J. Soc. chem. Ind. Lond., 49*: 26T.
Briggs, L. H., 1937. *J. chem. Soc.*: 79.
Briasco, J. D., Murray, J., 1952. *J. appl. Chem., 2*: 187.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem. 2*: 205.
(See also under phyllocladene and rimuene.)

HEARTWOOD: Manoyl oxide, 2-oxomanoyl oxide, colensenone, dacrydol.—
Hosking, J. R., Brandt, C. W., 1934. *Chem. Ber., 67B*: 1173.
Hosking, J. R., Brandt, C. W., 1935. *Chem. Ber., 68B*: 37.
Hosking, J. R., Brandt, C. W., 1935. *Chem. Ber., 68B*: 286.
Hosking, J. R., Brandt, C. W., 1936. *N.Z. J. Sci. Tech., 17*: 750.
Grant, P. K., 1959. *J. N.Z. Inst. Chem., 23*: 121.
Wenkert, E., Beak, P., Grant, P. K., 1961. *Chem. and Ind.*: 1574.
Grant, P. K., Carman, R. M., 1962. *J. chem. Soc.*: 3740.
Grant, P. K., Hill, N. R., 1964. *Aust. J. Chem., 17*: 66.
(See also under manoyl oxide and 2-oxomanoyl oxide.)

Phyllocladus alpinus Hook. f. ("Alpine toatoa").

ESSENTIAL OIL: Phyllocladene, isophyllocladene.—
Briggs, L. H., 1937. *J. chem. Soc.*: 79.
Briggs, L. H., 1937. *J. Soc. chem. Ind. Lond., 56*: 137T.
Brandt, C. W., 1938. *N.Z. J. Sci. Tech., 20*: 8B.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.
(See also under phyllocladene.)

Phyllocladus glaucus Carr. ("Toatoa").

ESSENTIAL OIL: Phyllocladene, isophyllocladene, rimuene.—
Brooker, E. G., 1959. *N.Z. J. Sci., 2*: 212.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.
(See also under phyllocladene and rimuene.)

BARK: Tannins, acetic acid ester of a bimolecular compound of lignoceryl and ceryl alcohols, ferulic acid ester of a bimolecular compound of lignoceryl and ceryl alcohols.—

Aston, B. C., 1918. *N.Z. J. Agric., 16*: 358.
Brooker, E. G., 1959. *N.Z. J. Sci., 2*: 212.

Phyllocladus trichomanoides D. Don (" Tanekaha ").

ESSENTIAL OIL: (+)-α-Pinene, myrcene, dipentene, γ-terpinene, copaene, (—)-cadinene, a cadinol, b.p. 134–137°/5mm, unidentified tricyclic sesquiterpene, b.p. 110–114°/10mm, unidentified sesquiterpene, b.p. 124–127°/10mm (possibly calamene or cadinene), phyllocladene, isophyllocladene, kaurene, rimuene.—

Briggs, L. H., Taylor, W. I., 1947. *J. chem. Soc.*: 1338.
Briggs, L. H., Sutherland, M. D., 1948. *J. org. Chem., 13*: 1.
Vonasek, F., Herout, V., Sorm, F., 1960. *Coll. Czech. chem. Comm., 25*: 919.
Büchi, G., Feairheller, S. H., De Mayo, P., Williams, R. E., 1963. *Proc. chem. Soc.*: 214.
Kapadia, V. H., Nagasampagi, B. A., Naik, V. G., Dev, S., 1963. *Tetrahedron Letters,* No. 28: 1933.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.
(See also under respective diterpenes.)

HEARTWOOD: Sequoyitol, pinitol, myoinositol, (+)-inositol, 1-0-methylmuco-inositol, arabinose.—

Adhikari, S. K., Bell, R. A., Harvey, W. E., 1962. *J. chem. Soc.*: 2829.

BARK: Tannins.—

Aston, B. C., 1918. *N.Z. J. Agric., 16*: 358.
White, P., 1930. *Bull. Imp. Inst., 28*: 450.

CUPRESSACEAE

Libocedrus plumosa Sargent (" Kawaka ").

ESSENTIAL OIL: Phyllocladene, isophyllocladene, kaurene, isokaurene, rimuene.—

Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.
(See also under respective diterpenes.)

Libocedrus bidwillii Hook. f. (" Pahautea ").

ESSENTIAL OIL: (—)-α-Pinene, (±)-α-pinene, β-pinene (?), (+)-sabinene, myrcene, a ketone, $C_{10}H_{16}O$, b.p. 56.2°/10mm, (+)-limonene, dipentene, p-cymene, terpinolene, terpinen-4-ol, unidentified tricyclic sesquiterpene, b.p. 85°/3 mm, unidentified sesquiterpene, b.p. 88°/3mm, α-caryophyllene, (+)-γ-curcumene, (+)-cadinene, unidentified alkane, m.p. 56–56.5, isophyllocladene, diterpene (?), m.p. 53–55°.—

Goudie, B. H., 1923. *J. Soc. chem. Ind. Lond., 42*: 350T.
Birrell, K. S., 1932. *J. Soc. chem. Ind. Lond., 51*: 397T.
Batt, R. D., Hassall, C. H., 1949. *J. Soc. chem. Ind. Lond., 68*: 359.
Batt, R. D., Slater, S. N., 1949. *J. chem. Soc.*: 838.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.
(See also under phyllocladene.)

HEARTWOOD:

Corbett, R. E., Wright, D. E., 1953. *Chem. and Ind.*, 1258.

ARAUCARIACEAE

Agathis australis Salisb. ("Kauri").

ESSENTIAL OIL: (+)-α-Pinene, (+)-camphene, (+)-limonene, dipentene, cineole, citronellal, (+)-borneol, bornyl acetate, (—)-cadinene, unidentified sesquiterpene, b.p. 158–163°/2mm, unidentified acids and phenols, (—)-kaurene, (—)-isokaurene, cupressene.—

Hosking, J. R., 1928. *Rec. trav. chim., 47*: 578.
Hosking, J. R., 1930. *Rec. trav. chim., 49*: 1036.
Briggs, L. H., Cawley, R. W., 1948. *J. chem. Soc.*: 1888.
Briggs, L. H., Taylor, W. I., 1950. *J. chem. Soc.*: 407.
Briggs, L. H., Cain, B. F., Cambie, R. C., Davis, B. R., Rutledge, P. S., Wilmshurst, J. K., 1963. *J. chem. Soc.*: 1345.
(See also under kaurene and cupressene.)

RESIN: (+)-α-Pinene, (+)-limonene, dipentene, fenchyl alcohol, glucose, galactose, arabinose (—)-leucomaclurin glycol ether, agathic acid, abietic acid, sandaracopimaric acid, communic acid-communol copolymer (?), mixture of diterpenoid oxides (resenes).—

Tschirch, A., Niederstadt, B., 1901. *Arch. Pharm., 239*: 145.
Hosking, J. R., 1929. *Rec. trav. chim., 48*: 622.
Ruzicka, L., Hosking, J. R., 1929. *Ann., 469*: 147.
Ruzicka, L., Hosking, J. R., 1930. *Helv. Chim. Acta, 13*: 1402.
Ruzicka, L., Hosking, J. R., 1931. *Helv. Chim. Acta, 14*: 203.
Hosking, J. R., 1935. *N.Z. J. Sci. Tech., 17*: 369.
Ruzicka, L., Jacobs, H., 1938. *Rec. trav. chim., 57*: 509.
Hosking, J. R., 1939. *Varnish Making, Oils and Colour Chem. Assoc.*: 138.
Brandt, C. W., 1939. *N.Z. J. Sci. Tech., 20*: 306B.
Ruzicka, L., Bernold, E., Tallichet, A., 1941. *Helv. Chim. Acta, 24*: 223.
Ruzicka, L., Bernold, E., 1941. *Helv. Chim. Acta, 24*: 931.
Ruzicka, L., Bernold, E., 1941. *Helv. Chim. Acta, 24*: 1167.
Ruzicka, L., Rey, E., 1943. *Helv. Chim. Acta, 26*: 2136.
Nierenstein, M., 1944. *Pharm. J., 153*: 5. *Chem. Abs., 38*: 5686.
Ruzicka, L., Zwicky, R., Jeger, O., 1948, *Helv. Chim. Acta, 31*: 2143.
Gough, L. J., 1964. *Chem. and Ind.*: 2059.
(See also under agathic, sandaracopimaric, and communic acids.)

HEARTWOOD: Pentosans, araucarolone (isopimar-7-ene-2,15-dione-3,16-diol), araucarone, araucarol, araucarenolone, unidentified alkaloid, β-sitosterol.—

Worley, F. P., Brooker, S. G., 1937. *J. Soc. chem. Ind. Lond., 56*: 74T.
Cain, B. F., Scannell, S., Cambie, R. C., 1960. *N.Z. J. Sci., 4*: 3.
Enzell, C. R., Thomas, B. R., 1964. *Tetrahedron Letters*, No. 8: 391.
Enzell, C. R., Thomas, B. R., 1956. *Tetrahedron Letters*, No. 4: 225.
Cambie, R. C., Person. Comm.

Araucaria excelsa B. Br. ("Norfolk Island pine").

ESSENTIAL OIL: (+)-α-Pinene, unidentified sesquiterpene, b.p. 122–124°/10 mm, camphene, (+)-limonene, p-cymene, caryophyllene, unidentified monoterpene, humulene (?), phyllocladene, isophyllocladene.—

Briggs, L. H., 1941. *J. Soc. chem. Ind. Lond., 60*: 222.
Briggs, L. H., Taylor, W. I., 1947. *J. Soc. chem. Ind. Lond., 66*: 186.
Southward, C. R., 1962. *Thesis, Univ. Auckland.*

Section II

A REGISTER OF COMPOUNDS CLASSIFIED ACCORDING TO CHEMICAL TYPE

HYDROCARBONS

Tridecane:	*Podocarpus nivalis*
Tetradecane:	*Podocarpus nivalis*
Alkanes, C_{21}–C_{31}:	*Podocarpus nivalis*
Heptacosane:	*Podocarpus dacrydioides*
Alkane, m.p. 56–56.5°:	*Libocedrus bidwillii*
Crystalline wax, m.p. 63–64°:	*Dacrydium cupressinum*
Myrcene:	*Podocarpus spicatus, P. nivalis, Dacrydium kirkii, D. biforme, D. colensoi, Phyllocladus trichomanoides*
	Libocedrus bidwillii
p-Cymene:	*Podocarpus spicatus*
	Libocedrus bidwillii
	Araucaria excelsa
α-Terpinene:	*Podocarpus spicatus*
γ-Terpinene:	*Podocarpus spicatus, Phyllocladus trichomanoides*
β-Phellandrene:	*Podocarpus spicatus*
β-Terpinene:	*Dacrydium biforme*
Terpinolene:	*Dacrydium colensoi*
	Libocedrus bidwillii
Limonene:	*Podocarpus ferrugineus, Dacrydium kirkii, D. colensoi*
	Libocedrus bidwillii
	Agathis australis, Araucaria excelsa
Dipentene:	*Podocarpus spicatus, P. ferrugineus, Phyllocladus trichomanoides*
	Libocedrus bidwillii
	Agathis australis
Sabinene:	*Libocedrus bidwillii*
α-Pinene:	*Podocarpus dacrydioides, P. spicatus, P. ferrugineus, P. nivalis*(?), *P. totara, Dacrydium kirkii, D. laxifolium, D. cupressinum, D. colensoi, Phyllocladus trichomanoides*
	Libocedrus bidwillii
	Agathis australis, Araucaria excelsa
β-Pinene:	*Podocarpus dacrydioides, P. spicatus, P. ferrugineus, P. totara*
	Libocedrus bidwillii
Camphene:	*Agathis australis, Araucaria excelsa*

ALCOHOLS AND PHENOLS

Lignoceryl and ceryl alcohol complex (as acetic acid ester):	*Phyllocladus trichomanoides*
Lignoceryl and ceryl alcohol complex (as ferulic acid ester):	*Phyllocladus trichomanoides*
Myoinositol:	*Phyllocladus trichomanoides*
Sequoyitol:	*Podocarpus spicatus, Dacrydium cupressinum, Phyllocladus trichomanoides*

1-0-Methylmucoinositol:	*Phyllocladus trichomanoides*
Pinitol:	*Phyllocladus trichomanoides*
(+)-Inositol:	*Phyllocladus trichomanoides*
Terpinen-4-ol:	*Libocedrus bidwillii*
α-Terpineol:	*Podocarpus spicatus*
Fenchyl alcohol:	*Agathis australis*
Borneol:	*Agathis australis*
Borneol (as acetic ester):	*Dacrydium kirkii*
	Agathis australis
Sobrerol:	*Dacrydium kirkii*
Alcohols, unidentified:	*Podocarpus dacrydioides*
Phenols, unidentified:	*Podocarpus dacrydioides*
	Agathis australis

ALDEHYDES

Citronellal:	*Agathis australis*
Aldehydes, unidentified:	*Podocarpus dacrydioides*

KETONES AND OXIDES

Leucomaclurin glycol ether:	*Agathis australis*
Ketone, $C_{10}H_{16}O$, b.p. 56.2°/10 mm:	*Libocedrus bidwillii*
Carvone:	*Dacrydium kirkii*
1:8-Cineole:	*Podocarpus ferrugineus*
	Agathis australis

CARBOHYDRATES

Arabinose:	*Phyllocladus trichomanoides*
	Agathis australis
Glucose:	*Agathis australis*
Galactose:	*Agathis australis*
Pentosans:	*Agathis australis*

CARBOXYLIC ACIDS

Caproic acid:	*Podocarpus spicatus*
Keto-acid, unidentified:	*Podocarpus dacrydioides*
Acids, unidentified:	*Podocarpus dacrydioides, Dacrydium intermedium*
	Agathis australis

LIGNANS

Matairesinol:	*Podocarpus spicatus*
Conidendrin:	*Podocarpus spicatus*
seco-Isolariciresinol:	*Podocarpus spicatus*

γ-PYRONE DERIVATIVES

Kaempferol:	*Podocarpus spicatus*
Quercetin:	*Podocarpus spicatus*
Aromadendrin:	*Podocarpus spicatus*
Taxifolin:	*Podocarpus spicatus*
Genistein:	*Podocarpus spicatus*
Podospicatin:	*Podocarpus spicatus*

PYRAN DERIVATIVES

Leucodelphinidin:	*Dacrydium biforme*
Leucocyanidin:	*Dacrydium cupressinum*

TERPENES, UNIDENTIFIED (See also hydrocarbons and alcohols.)

Terpenes, unidentified:	*Podocarpus dacrydioides, P. spicatus, Dacrydium kirkii*
	Araucaria excelsa
Terpene alcohols, unidentified:	*Podocarpus totara*
Oxygenated terpenes, unidentified:	*Dacrydium biforme*

SESQUITERPENES

(+)-γ-Curcumene:	*Libocedrus bidwillii*
(+)-β-Cadinene:	*Dacrydium colensoi*
(+)-γ-Cadinene:	*Dacrydium biforme*
(+)-δ-Gadinene:	*Dacrydium biforme*
(+)-Cadinene:	*Podocarpus ferrugineus*
	Libocedrus bidwillii
(—)-Cadinene:	*Dacrydium kirkii, Phyllocladus trichomanoides*
	Agathis australis
Cadinene:	*Podocarpus dacrydioides, P. spicatus, P. totara*
A cadinol, b.p. 134–137°/5mm:	*Phyllocladus trichomanoides*
(—)-Metrosiderene:	*Dacrydium biforme*
Torreyol:	*Dacrydium biforme*
Selinene:	*Podocarpus spicatus*
Copaene:	*Phyllocladus trichomanoides*
Aromadendrene:	*Podocarpus spicatus, Dacrydium biforme*
Caryophyllene:	*Podocarpus dacrydioides*
	Libocedrus bidwillii
	Araucaria excelsa
Humulene:	*Araucaria excelsa*
Longifolene:	*Dacrydium biforme, D. colensoi*
Juniperol:	*Dacrydium biforme, D. cupressinum, D. colensoi*
Muurolene:	*Dacrydium colensoi*
Heerabolene:	*Podocarpus spicatus*
Sesquiterpene, b.p. 118-125°/10 mm:	*Dacrydium kirkii*
Sesquiterpene, b.p. 132–135°/ 20mm:	*Dacrydium cupressinum*
Sesquiterpene, b.p. 124–127°/ 10mm:	*Phyllocladus trichomanoides*
Sesquiterpene, b.p. 88°/3mm:	*Libocedrus bidwillii*
Sesquiterpene, b.p. 158–163°/ 2mm:	*Agathis australis*
Sesquiterpene, b.p. 122–124°/ 10mm:	*Araucaria excelsa*
Sesquiterpene, dicyclic, b.p. 94°/ 2mm:	*Dacrydium colensoi*
Sesquiterpene, tricyclic, b.p. 80°/ 4mm:	*Dacrydium biforme*

Sesquiterpene, tricyclic, b.p. 89°/4.5mm:	*Dacrydium colensoi*
Sesquiterpene, tricyclic, b.p. 93°/4.5mm:	*Dacrydium colensoi*
Sesquiterpene, tricyclic, b.p. 91°/2.5mm:	*Dacrydium colensoi*
Sesquiterpene, tricyclic, b.p. 110–114°/10mm:	*Phyllocladus trichomanoides*
Sesquiterpene, tricyclic, b.p. 85°/3mm:	*Libocedrus bidwillii*
Sesquiterpenes, unidentified:	*Podocarpus dacrydioides, P. nivalis, P. totara*
Sesquiterpene alcohol, b.p. 125–134°/5mm:	*Dacrydium kirkii*
Sesquiterpene alcohol, b.p. 135°/5mm:	*Dacrydium kirkii*
Sesquiterpene alcohol, b.p. 100–112°/0.01mm:	*Dacrydium kirkii*
Sesquiterpene alcohol, b.p. 104°/2.5mm:	*Dacrydium biforme*
Sesquiterpene alcohols, unidentified:	*Podocarpus dacrydioides, P. totara*
Oxygenated sesquiterpenes, unidentified:	*Podocarpus ferrugineus*

DITERPENES AND DITERPENOIDS

α-Camphorene:	*Dacrydium biforme*
Biformene:	*Dacrydium biforme*
Manool:	*Dacrydium kirkii, D. biforme, D. bidwillii*
Manoyl oxide:	*Dacrydum biforme, D. colensoi*
2-Oxomanoyl oxide:	*Dacrydum biforme, D. colensoi*
Colensenone:	*Dacrydium colensoi*
Dacrydol:	*Dacrydium colensoi*
Torulosol:	*Dacrydium biforme*
Torulosal:	*Dacrydium biforme*
Communic acid - communol copolymer:	*Agathis australis*
Agathic acid:	*Agathis australis*
Isopimara-7, 15-diene:	*Dacrydium biforme*
Rimuene:	*Podocarpus ferrugineus, P. totara, P. hallii, P. acutifolius, Dacrydium kirkii, D. laxifolium, D. laxifolium* x *intermedium, D. cupressinum, D. intermedium, D. colensoi, Phyllocladus glaucus, P. trichomanoides*
	Libocedrus plumosa
Ferruginol:	*Podocarpus dacrydioides, P. ferrugineus, Dacrydium cupressinum*
Δ^6-Dehydroferruginol:	*Podocarpus dacrydioides, P. ferrugineus, Dacrydium cupressinum*
Totarol:	*Podocarpus nivalis, P. totara, P. hallii, Dacrydium cupressinum*
16-Hydroxytotarol:	*Podocarpus totara, P. hallii*
16-Oxototarol:	*Podocarpus hallii*
16-Carboxytotarol:	*Podocarpus hallii*
Podototarin:	*Podocarpus nivalis, P. totara*

Podototarin mono-acetate:	*Podocarpus nivalis*
Sugiol:	*Podocarpus dacrydioides, P. ferrugineus, P. totara, P. hallii, Dacrydium cupressinum*
Xanthoperol:	*Podocarpus dacrydioides*
Isopimarinol:	*Dacrydium biforme*
Isopimarinal:	*Dacrydium biforme*
Isopimaric acid:	*Podocarpus ferrugineus, Dacrydium kirkii, D. biforme*
Sandaracopimaric acid:	*Agathis australis*
Abietic acid:	*Agathis australis*
Araucarolone:	*Agathis australis*
Araucarone:	*Agathis australis*
Araucarol:	*Agathis australis*
Araucarenolone:	*Agathis australis*
Podocarpic acid:	*Podocarpus dacrydioides, P. nivalis, P. totara, P. hallii, Dacrydium cupressinum*
Methyl podocarpate:	*Podocarpus dacrydioides, P. nivalis, P. totara*
Pododacric acid:	*Podocarpus dacrydioides, P. totara*
Diterpene oxides:	*Agathis australis*
Phyllocladene:	*Podocarpus dacrydioides, P. spicatus, P. ferrugineus, P. nivalis, P. totara, P. hallii, Dacrydium kirkii, D. biforme, D. bidwillii, D. laxifolium, D. cupressinum, D. colensoi, D. laxifolium* x *intermedium, Phyllocladus alpinus, P. glaucus, P. trichomanoides, Libocedrus plumosa* *Araucaria excelsa*
Isophyllocladene:	*Podocarpus dacrydioides, P. ferrugineus, P. nivalis, P. hallii* *Dacrydium kirkii, D. biforme, D. bidwillii, D. cupressinum, D. colensoi, D. laxifolium* x *intermedium, Phyllocladus alpinus, P. glaucus, P. trichomanoides, Libocedrus plumosa, L. bidwillii* *Araucaria excelsa*
(+)-Kaurene:	*Podocarpus spicatus, P. ferrugineus, P. nivalis, P. totara, Dacrydium kirkii, D. laxifolium, D. intermedium, Phyllocladus trichomanoides* *Libocedrus plumosa*
(—)-Kaurene:	*Agathis australis*
(+)-Isokaurene:	*Podocarpus spicatus, P. totara, P. hallii, P. acutifolius, Dacrydium laxifolium, D. intermedium, Libocedrus plumosa*
(—)-Isokaurene:	*Agathis australis*
Cupressene (hibaene):	*Podocarpus dacrydioides, P. spicatus, P. ferrugineus, P. nivalis, Dacrydium kirkii, D. laxifolium, D. intermedium, D. laxifolium* x *intermedium, Agathis australis*
Diterpene(?), m.p. 53–55°:	*Libocedrus bidwillii*

STEROLS

β-Sitosterol:	*Podocarpus nivalis, P. totara, Dacrydium biforme, D. cupressinum* *Agathis australis*

Tannins:	*Podocarpus ferrugineus, Dacrydium cupressinum, Phyllocladus glaucus, P. trichomanoides*
Unidentified compounds:	
Compound $C_{15}H_{14}O_8$, m.p. 245–246°:	*Podocarpus totara*
Compound, m.p. 204°	*Podocarpus hallii*
Compound, m.p. 298–299°:	*Podocarpus hallii*
Alkaloid, unidentified:	*Agathis australis*

Section III

SELECTED REFERENCES TO THE CHEMISTRY OF DITERPENES AND DITERPENOIDS

Manool. $C_{20}H_{34}O$.

Hosking, J. R., Brandt, C. W., 1935. *Chem. Ber., 68B*: 1311.

Hosking, J. R., 1936. *Chem. Ber. 69B*: 780.

Hosking, J. R., Brandt, C. W., 1936. *N.Z. J. Sci. Tech., 17*: 750.

Jeger, O., Dürst, O., Büchi, G., 1947. *Helv. Chim. Acta, 30*: 1853.

Ruzicka, L., Gutmann, H., Jeger, O., Lederer, E., 1948. *Helv. Chim. Acta, 31*: 1746.

Ruzicka, L., Zwicky, R., Jeger, O., 1948. *Helv. Chim. Acta, 31*: 2143.

Schenk, H. R., Gutmann, H., Jeger, O., Ruzicka, L., 1952. *Helv. Chim. Acta, 35*: 817.

Brandt, C. W., Thomas, B. R., 1952. *Nature, 170*: 1018.

Kyburz, E., Riniker, B., Schenk, H. R., Heusser, H., Jeger, O., 1953. *Helv. Chim. Acta, 36*: 1891.

Schenk, H. R., Gutmann, H., Jeger, O., Ruzicka, L., 1954. *Helv. Chim. Acta, 37*: 543.

Enzell, C., Erdtman, H., 1957. *Acta Chem. Scand., 11*: 902.

Büchi, G., Biemann, K., 1957. *Croat. Chem. Acta, 29*: 163.

Ohloff, G., 1958. *Helv. Chim. Acta, 41*: 845.

Ohloff, G., 1958. *Ann., 617*: 134.

Grant, P. K., 1959. *J. chem. Soc.*: 860.

Barltrop, J. A., Bigley, D. B., 1959. *Chem. and Ind.*: 1378.

Bigley, D. B., Rogers, N. A. J., Barltrop, J. A., 1960. *J. chem. Soc.*: 4613.

Grant, P. K., Hodges, R., 1960. *J. chem. Soc.*: 5274.

Bory, S., Asselineau, C., 1961. *Bull. Soc. Chim. France*: 1355.

Barreto, H. S., Enzell, C., 1961. *Acta Chem. Scand., 15*: 1313.

Bigley, D. B., Rogers, N. A. J., Barltrop, J. A., 1962. *Chem. and Ind.*: 1570.

Carman, R. M., 1962. *Tetrahedron, 18*: 285.

Sheidegger, U., Schaffner, K., Jeger, O., 1962. *Helv. Chim. Acta, 42*: 400.

Mousseron-Canet, M., Millot, J., Mani, J-C., 1963. *Israel J. Chem., 1*: 468; *Chem. Abs., 60*: 15919.

Carman, R. M., 1963. *Aust. J. Chem., 16*: 225.

Demole, E., 1964. *Experientia, 20*: 609.

Mousseron-Canet, M., Mani, J-C., 1965. *Bull. Soc. Chim. France*: 481.

Manoyl oxide. $C_{20}H_{34}O$.

Hosking, J. R., Brandt, C. W., 1934. *Chem. Ber., 67B*: 1173.
Hosking, J. R., Brandt, C. W., 1935. *Chem. Ber., 68B*: 37.
Hosking, J. R., Brandt, C. W., 1935. *Chem. Ber., 68B*: 286.
Hosking, J. R., Brandt, C. W., 1936. *N.Z. J. Sci. Tech., 17*: 750.
Ohloff, G., 1958. *Ann., 617*: 134.
Barltrop, J. A., Bingley, D. B., 1959. *Chem. and Ind.*: 1378.
Grant, P. K., 1959. *J. chem. Soc.*: 860.
Hodges, R., Reed, R. I., 1960. *Tetrahedron, 10*: 71.
Carman, R. M., 1962. *Tetrahedron, 18*: 285.
Giles, J. A., Schumacher, J. N., Mims, S. S., Bernasek, E., 1962. *Tetrahedron, 18*: 169.
Laidlaw, R. A., Morgan, J. W. W., 1963. *J. chem. Soc.*: 644.
Belardini, M., Sauderi, G., Mangoni, L., 1964. *Gazz. chim. Ital., 94*: 829.
Audier, H., Bory, S., Fétizon, M., 1964. *Bull. Soc. Chim. France*: 1381.
Bory, S., Fétizon, M., 1965. *Bull. Soc. Chim. France*: 148.

2-Oxomanoyl oxide. $C_{20}H_{32}O_2$

Hosking, J. R., Brandt, C. W., 1934. *Chem. Ber., 67B*: 1173.
Hosking, J. R., Brandt, C. W., 1935. *Chem. Ber., 68B*: 286.
Hosking, J. R., Brandt, C. W., 1936. *N.Z. J. Sci. Tech., 17*: 750.
Grant, P. K., 1959. *J. chem. Soc.*: 860.
Grant, P. K., Hodges, R., 1960. *Chem. and Ind.*: 1300.
Enzell, C., 1960. *Acta Chem. Scand., 14*: 2053.
Hodges, R., 1961. *Tetrahedron, 12*: 215.
Wenkert, E., Beak, P., Grant, P. K., 1961. *Chem. and Ind.*: 1574.
Carman, R. M., 1962. *Tetrahedron, 18*: 285.
Grant, P. K., Hill, N. R., 1964. *Aust. J. Chem., 17*: 66.

Communic acid. $C_{20}H_{30}O_2$.

Arya, V. P., Enzell, C., Erdtman, H., Kubota, T., 1961. *Acta Chem. Scand., 15*: 225.
Arya, V. P., Erdtman, H., Kubota, T., 1961. *Tetrahedron, 16*: 255.
Narasimhachari, N., von Rudloff, E., 1961. *Canad. J. Chem., 39*: 2572.
Arya, V. P., 1962. *J. Sci. Ind. Res. India, 21B*: 201.
Sommer, P. F., Pascual, C., Arya, V. P., Simon, W., 1963. *Helv. Chim. Acta, 46*: 1734.
Carman, R. M., Dennis, N., 1964. *Aust. J. Chem., 17*: 390.
Carman, R. M., Dennis, N., 1964. *Aust. J. Chem., 17*: 395.
Ahond, A., Carnero, P., Gastambide, B., 1964. *Bull. Soc. Chim. France*: 348.
Mangoni, L., Belardini, M., 1964. *Gazz. Chim. Ital., 94*: 1108.
Miyasaka, T., 1964. *Chem. Pharm. Bull. Japan, 12*: 744; *Chem. Abs., 61*: 12042.
Joye, N. M., Roberts, E. M., Lawrence, R. V., Gough, L. J., Soffer, M. D., Karman, O., 1965. *J. org. Chem., 30*: 429.

Agathic acid. $C_{20}H_{30}O_4$.

Büchi, G., Pappas, J. J., 1954. *J. Amer. chem. Soc., 76*: 2963.
Kitahonoki, K., 1958. *Chem. Pharm. Bull. Japan, 6*: 472; *Chem. Abs., 53*: 11365.
Cole, A. R. H., Michell, A. J., 1959. *J. chem. Soc.*: 2005.
Asselineau, C., Bory, S., Fétizon, M., Laszlo, P., 1961. *Bull. Soc. Chim. France*: 1429.
Arya, V. P., Erdtman, H., Kubota, T., 1961. *Tetrahedron, 16*: 255.
Sommer, P. F., Pascual, C., Arya, V. P., Simon, W., 1963. *Helv. Chim. Acta,* 46: 1734.
Bory, S., Fétizon, M., Laszlo, P., 1963. *Bull. Soc. Chim. France*: 2310.
Tahara, A., Hoshino, O., Hamazaki, Y., 1963. *Chem. Pharm. Bull. Tokyo, 11*: 1328; *Chem. Abs., 60*: 4195.
Carman, R. M., 1964. *Aust. J. Chem., 17*: 393.

Rimuene. $C_{20}H_{32}$.

McDowall, F. H., Finlay, H. J., 1925. *J. Soc. chem. Ind. Lond., 44*: 42T.
Carrie, M. S., 1932. *J. Soc. chem. Ind. Lond., 51*: 367T.
Beath, G. B., 1933. *J. Soc. chem. Ind. Lond., 52*: 338T.
Brandt, C. W., 1938. *N.Z. J. Sci. Tech., 20*: 8B.
Wenkert, E., 1955. *Chem. and Ind.*: 282.
Briggs, L. H., Cain, B. F., Wilmshurst, J. K., 1958. *Chem. and Ind.*: 599.
Briggs, L. H., Cain, B. F., Davis, B. R., Wilmshurst, J. K., 1959. *Tetrahedron Letters,* No. 8: 13.
Briggs, L. H., Cain, B. F., Cambie, R. C., 1959. *Tetrahedron Letters,* No. 8: 17.
Galik, V., Kuthan, J., Petru, F., 1960. *Chem. and Ind.*: 722.
Ireland, R. E., Schiess, P. W., 1960. *Tetrahedron Letters,* No. 25: 37.
Wenkert, E., Beak, P., 1961. *J. Amer. chem. Soc., 83*: 998.
Church, R. F., Ireland, R. E., 1961. *Tetrahedron Letters,* No. 14: 493.
Whalley, W. B., 1962. *Tetrahedron, 18*: 43.
Carman, R. M., 1963. *Aust. J. Chem., 16*: 225.
Carman, R. M., 1963. *Aust. J. Chem., 16*: 1104.
Church, R. F., Ireland, R. E., 1963. *J. org. Chem., 28*: 17.
Corbett, R. E., Wyllie, S. G., 1964. *Tetrahedron Letters,* No. 29: 1903.
Connolly, J. D., McCrindle, R., Murray, R. D. H., Overton, K. H., 1964. *Tetrahedron Letters,* No. 29: 1983.
Ireland, R. E., Mander, L. N., 1964. *Tetrahedron Letters,* No. 46: 3453.
Scott, A. I., McCapra, F., Comer, F., Sutherland, S. A., Young, D. W., 1964. *Tetrahedron,* 20: 1339.
Wenkert, E., Alfonso, A., Beak, P., Carney, W. J., Jeffs, P. W., McChesney, J. D., 1965. *J. org. Chem., 30*: 713.

Ferruginol. $C_{20}H_{30}O$.

Brandt, C. W., Neubauer, L. G., 1939. *J. chem. Soc.*: 1031.
Campbell, W. P., Todd, D., 1940. *J. Amer. chem. Soc., 62*: 1287.
Campbell, W. P., Todd, D., 1942. *J. Amer. Chem. Soc., 64*: 928.

Brandt, C. W., Thomas, B. R., 1951. *N.Z. J. Sci. Tech., 33B*: 30.
Gibson, M. S., 1951. *Experientia, 7*: 176.
Brandt, C. W., Thomas, B. R., 1952. *J. chem. Soc.*: 2442.
Brandt, C. W., 1952. *N.Z. J. Sci. Tech., 34B*: 65.
Brandt, C. W., Thomas, B. R., 1952. *Nature, 170*: 1018.
King, F. E., King, T. J., Topliss, J. G., 1954. *Chem. and Ind.*: 108.
Bredenberg, J. B-S., Gripenberg, J., 1956. *Acta Chem. Scand., 10*: 1511.
Bredenberg, J. B-S., 1957. *Acta Chem. Scand., 11*: 932.
King, F. E., King, T. J., Topliss, J. G., 1957. *J. chem. Soc.*: 573.
Rao, P. N., Raman, K., 1958. *Tetrahedron, 4*: 294.
Kondo, T., Imamura, H., Suda, M., 1959. *Yakugaku Zasshi, 79*: 1298; *Chem. Abs., 54*: 4524.
Kondo, T., Imamura, H., Suda, M., 1959. *Bull. Agric. Chem. Soc. Japan, 23*: 233; *Chem. Abs., 54*: 887.
Barreto, H. S., Enzell, C., 1961. *Acta Chem. Scand., 15*: 1313.
Edwards, O. E., Feniak, G., Los, M., 1962. *Canad. J. Chem., 40*: 1540.
Falshaw, C. P., Johnson, A. W., King, T. J., 1963. *J. chem. Soc.*: 2422.

Totarol. $C_{20}H_{30}O$.

Easterfield, T. H., 1910. *Trans. N.Z. Inst., 43*: 53.
Easterfield, T. H., McDowell, J. C., 1915. *Trans. N.Z. Inst., 48*: 518.
Short, W. F., Stromberg, H., 1937. *J. chem. Soc.*: 516.
Short, W. F., Wang, H., 1950. *J. chem. Soc.*: 991.
Short, W. F., Wang, H., 1951. *J. chem. Soc.*: 2979.
Brandt, C. W., Thomas, B. R., 1951. *N.Z. J. Sci. Tech., 33B*: 30.
Brandt, C. W., Thomas, B. R., 1952. *Nature, 170*: 1018.
Brandt, C. W., 1952. *N.Z. J. Sci. Tech., 34B*: 65.
Nasipuri, D., Chaudhuri, A. C., 1957. *Sci. and Cult., 23*: 319; *Chem. Abs., 53*: 310.
Barltrop, J. A., Rogers, N. A. J., 1958. *J. chem. Soc.*: 2566.
Cambie, R. C., Cain, B. F., 1960. *N.Z. J. Sci., 3*: 121.
Hodges, R., 1961. *J. chem. Soc.*: 4247.
Wenkert, E., Beak, P., 1961. *Tetrahedron Letters*, No. 11: 358.
Johnson, A. W., King, T. J., Martin, R. J., 1961. *J. chem. Soc.*: 4420.
Elmore, N. F., King., T. J., 1961. *J. chem. Soc.*: 4425.
Taylor, D. A. H., 1961. *Chem. and Ind.*: 1712.
Arya, V. P., 1962. *J. Sci. Ind. Res. India, 21B*: 236.
Cambie, R. C., Mander, L. N., 1962. *Tetrahedron, 18*: 465.
Chow, Y-L., Erdtman, H., 1962. *Acta Chem. Scand., 16*: 1291.
Chow, Y-L., Erdtman, H., 1962. *Acta Chem. Scand., 16*: 1305.
Cambie, R. C., Simpson, W. R. J., Colebrook, L. D., 1963. *Tetrahedron, 19*: 209.
Taylor, D. A. H., 1963. *J. chem. Soc.*: 1553.
Bevan, C. W. L., Taylor, D. A. H., 1963. *J. chem. Soc.*: 6050.
Falshaw, C. P., Johnson, A. W., King, T. J., 1963. *J. chem. Soc.*: 2422.
Bocks, S. M., Cambie, R. C., 1963. *Proc. chem. Soc.*: 143.
Bocks, S. M., Cambie, R. C., Takahashi, T., 1963. *Tetrahedron, 19*: 1109.

Pyne, G., 1963. *J. Ind. Chem. Soc., 40*: 905.
Day, A. C., 1964. *J. chem. Soc.*: 3001.
Adegoke, E. A., Ojechi, P., Taylor, D. A. H., 1965. *J. chem. Soc.*: 415.

Sugiol. $C_{20}H_{28}O_2$.

Keimatsu, S., Ishiguro, T., Fukuri, G., 1937. *J. Pharm. Soc. Japan, 57*: 69.
Huzii, G., Tikamori, T., 1939. *J. Pharm. Soc. Japan, 59*: 124.
Brandt, C. W., Thomas, B. R., 1951. *N.Z. J. Sci. Tech. 33B*:30.
Brandt, C. W., Thomas, B. R., 1952. *J. chem. Soc.*: 2442.
Bredenberg, J. B-S., Gripenberg, J., 1954. *Acta Chem. Scand. 8*: 1728.
Bredenberg, J. B-S., Gripenberg, J., 1956. *Acta Chem. Scand., 10*: 1511.
Kondo, T., Imamura, H., Suda, M., 1959. *Yakugaku Zasshi, 79*: 1298; *Chem. Abs., 54*: 4524.
Kondo, T., Imamura, H., Suda, M., 1959. *Bull. Agric. Chem. Soc. Japan, 23*: 233; *Chem. Abs., 54*: 887.
Briggs, L. H., Cambie, R. C., Seelye, R. N., Warth, A. D., 1959. *Tetrahedron, 7*: 270.
Briggs, L. H., Cambie, R. C., 1960. *Tetrahedron, 8*: 356.
Sengupta, P., Choudhuri, S. N., Khastgir, H. N., 1960. *Tetrahedron, 10*: 45.
Sogo, M., Hata, K., 1961. *Nippon Nogei Kagaku Kaishi, 35*: 724; *Chem.* Abs., *60*: 4460.
Cambie, R. C., Mander, L. N., 1962. *Tetrahedron, 18*: 465.
Nasipuri, D., Guha, M., 1962. *J. chem. Soc.*: 4248.
Hata, K., Sogo, M., Kamemura, Y., 1962. *Nippon Mokuzai Gakkaishi, 8*: 167; *Chem. Abs., 58*: 2564.
Cambie, R. C., Simpson, W. R. J., Colebrook, L. D., 1963. *Tetrahedron, 19*: 209.
Gupta, B. K., Paul, V., Handa, K. L., 1963. *Ind. J. Chem., 1*: 188.
Cambie, R. C., Mander, L. N., Bose, A. K., Manhas, M. S., 1964. *Tetrahedron, 20*: 409.

Xanthoperol. $C_{20}H_{26}O_3$.

Bredenberg, J. B-S., Gripenberg, J., 1956. *Acta Chem. Scand., 10*: 1511.
Bredenberg, J. B-S., 1957. *Acta Chem. Scand., 11*: 927.
Wenkert, E., Chamberlin, J. W., 1959. *J. Amer. chem. Soc., 81*: 688.
Kondo, T., Imamura, H., Suda, M., 1959. *Yakugaku Zasshi, 79*: 1298; *Chem. Abs., 54*: 4524.
Kondo, T., Imamura, H., Suda, M., 1959. *Bull. Agric. Chem. Soc. Japan, 23*: 233; *Chem. Abs., 54*: 887.
Briggs, L. H., Cambie, R. C., Seelye, R. N., Warth, A. D., 1959. *Tetrahedron, 7*: 270.
Bredenberg, J. B., 1960. *Acta Chem. Scand. 14*: 385.
Bredenberg, J. B., Shoolery, J. N., 1960. *Acta Chem. Scand., 14*: 557.
Sogo, M., Hata, K., 1961. *Nippon Nogei Kagaku Kaishi, 35*: 724; *Chem. Abs., 60*: 4460.
Nasipuri, D., Guha, M., 1962. *J. chem. Soc.*: 4248.
Hata, K., Sogo, M., Kamemura, Y., 1962. *Nippon Mokuzai Gakkaishi, 8*: 167; *Chem. Abs., 58*: 2564.

Kondo, Y., Ikeuoue, T., Takemoto, T., 1963. *Chem. Pharm. Bull. Japan, 11*: 678.

Isopimaric acid. $C_{20}H_{30}O_2$.

Harris, G. C., Sanderson, T. F., 1948. *J. Amer. chem. Soc., 70*: 2079.
Harris, G. C., Sanderson, T. F., 1948. *J. Amer. chem. Soc., 70*: 2081.
Harris, G. C., 1948. *J. Amer. chem. Soc., 70*: 3671.
Brossi, A., Jeger, O., 1950. *Helv. Chim. Acta, 33*: 722.
Bruun, H., 1952. *Acta Chem. Scand., 6*: 494.
Bruun, H., 1952. *Acta Chem. Scand., 6*: 798.
Bruun, H., 1952. *Acta Chem. Scand., 6*: 953.
Ukita, C., Tsumita, T., 1952. *J. Pharm. Soc. Japan, 72*: 1324.
Tsutsui, M., 1953. *J. Chem. Soc. Japan, 74*: 542.
Lombard, R., Rotovic, B., 1954. *Compt. rend., 238*: 1670.
Jalava, P. O., 1954. *Paperi ja Puu, 36*: 69; *Chem. Abs., 48*: 11250.
Bruun, H. H., 1955. *Acta Chem. Scand., 9*: 342.
Bruun, H. H., 1955. *Acta Chem. Scand., 9*: 712.
Bruun, H. H., 1955. *Arkiv Kemi., 8*: 411.
Ukita, C., Tsumita, T., Utsugi, N., 1955. *Pharm. Bull. Japan, 3*: 441; *Chem. Abs., 50*: 14651.
Roberts, E. McC., Lawrence, R. V., 1956. *J. Amer. chem. Soc., 78*: 4087.
Bruun, H. H., 1956. *Paperi ja Puu, 38*: 577; *Chem. Abs., 51*: 15276.
Yasue, M., 1958. *Mokuzai Gakkaishi, 4*: 22; *Chem. Abs., 52*: 12419.
Arbuzov, B. A., Khismatullina, A. G., 1958. *Izvest. Akad. Nauk S.S.S.R., Otel. Khim. Nauk*: 166; *Chem. Abs., 52*: 12823.
Baldwin, D. E., Loeblich, V. M., Lawrence, R. V., 1958. *J. org. Chem., 23*: 25.
Bardyshev, I. I., Cherches, Kh. A., 1958. *Doklady Akad. Nauk S.S.S.R., 120*: 1025; *Chem. Abs., 52*: 20229.
Green, B., Harris, A., Whalley, W. B., 1958. *J. chem. Soc.*: 4715.
Van-Thoi, L., 1958. *Compt. rend., 247*: 1343.
Bruun, H. H., Ryhage, R., Stenhagen, E., 1958. *Acta Chem. Scand., 12*: 789.
Edwards, O. E., Howe, R., 1959. *Canad. J. Chem., 37*: 760.
Wenkert, E., Chamberlin, J. W., 1959. *J. Amer. chem. Soc., 81*: 688.
Kondo, T., Imamura, H., Suda, M., 1959. *Bull. Agric. Chem. Soc. Japan, 23*: 233; *Chem. Abs., 54*: 887.
Genge, C. A., 1959. *Anal. Chem., 31*: 1750.
Hudy, J. A., 1959. *Anal. Chem., 31*: 1754.
Bruun, H. H., Fischmeister, I., Stenhagen, E., 1959. *Acta Chem. Scand., 13*: 379.
Bruun, H. H., Gasland, S., 1959. *Acta Chem. Scand., 13*: 598.
Bruun, H. H., Stenhagen, E., 1959. *Acta Chem. Scand., 13*: 832.
Bose, A. K., Struck, W. A., 1959. *Chem. and Ind.*: 1628.
Bardyshev, I. I., Ukhova, L. I., 1959. *Sbornik Nauch. Rabot. Akad, Nauk Beloruss. S.S.S.R., Inst. Fiz-Org. Khim,* No. 7: 89; *Chem. Abs., 54*: 25803.
Edwards, O. E., Howe, R., 1959. *Chem. and Ind.*: 537.
Briggs, L. H., Cambie, R. C., 1960. *Tetrahedron, 8*: 356.

Bardyshev, I. I., Cherches, Kh. A., Kortunenko, Z. Y., Kokhanskaya, Zh. F., 1960. *Doklady Akad. Nauk Beloruss. S.S.S.R., 4*: 421; *Chem. Abs., 55*: 9866.

Chien, J. C. W., 1960. *J. Amer. chem. Soc., 82*: 4762.

Bose, A. K., 1960. *Chem. and Ind.*: 1104.

Bruun, H. H., Gasland, S., 1960. *Acta Acad. Aboensis, Math. et Phys., 22*: 122; *Chem. Abs., 55*: 11837.

Van-Thoi, L., 1960. *Ann. fac. sci. Univ. Saigon*: 89; *Chem. Abs., 55*: 26017.

Cherches, Kh. A., Bardyshev, I. I., Kokhanskaya, Zh. F., 1961. *Zhur. Priklad. Khim., 34*: 938; *Chem. Abs., 55*: 19272.

Bardyshev, I. I., Cherches, Kh. A., Kokhanskaya, Zh. F., 1961. *Zhur. Priklad. Khim., 34*: 1147; *Chem. Abs., 55*: 21586.

ApSimon, J. W., Green, B., Whalley, W. B., 1961. *J. chem. Soc.*: 752.

Yasue, M., Hashi, M., Miyazaki, M., 1961. *Nippon Mokuzai Gakkaishi, 7*: 96; *Chem. Abs., 56*: 2615.

Sogo, M., Hata, K., 1961. *Nippon Nogei Kagaku Kaishi, 35*: 724; *Chem. Abs., 60*: 4460.

Milne, G. W. A., Smith, H., 1961. *Chem. and Ind.*: 1307.

Arya, V. P., Enzell, C., Erdtman, H., Ryhage, R., 1961. *Acta Chem. Scand., 15*: 682.

Church, R. F., Ireland, R. E., 1961. *Tetrahedron Letters,* No. 14: 493.

Antkowiak, W., ApSimon, J. W., Edwards, O. E., 1962. *J. org. Chem., 27*: 1930.

Prima, A. M., Makarevich, N. I., Bardyshev, I. I., Cherches, Kh. A., 1962. *Zh. Fiz. Khim., 36*: 620; *Chem. Abs., 57*: 1759.

Khashtanova, N. K., Pontegova, V. A., 1962. *Izv. Sibirsk. Otd. Akad. Nauk S.S.S.R.*, No. 3: 121; *Chem. Abs., 57*: 8884.

Lawrence, R. V., 1962. *Tappi, 45*: 654; *Chem. Abs., 57*: 12768.

Daniels, P., Enzell, C., 1962. *Acta Chem. Scand., 16*: 1530.

Prima, A. M., Makarevich, N. I., Cherches, Kh. A., Bardyshev, I. I., 1962. *Izv. Akad. Nauk S.S.S.R., Ser. Fiz., 26*: 1313; *Chem. Abs., 58*: 7517.

Tahara, A., Hoshino, O., Ikekawa, N., 1962. *Chem. Pharm. Bull. Japan, 10*: 995.

Bose, A. K., Harrison, S., 1963. *Chem. and Ind.*: 254.

Ireland, R. E., Newbould, J., 1963. *J. org. Chem., 28*: 23.

Sommer, P. F., Pascual, C., Arya, V. P., Simon, W., 1963. *Helv. Chim. Acta, 46*: 1734.

von Rudloff, E., Sato, A., 1963. *Canad. J. Chem., 41*: 2165.

Tahara, A., Hoshino, O., 1963. *Sci. Papers Inst. Phys. Chem. Res. Tokyo, 57*: 19; *Chem. Abs., 59*: 13095.

Sato, A., von Rudloff, E., 1964. *Canad. J. Chem., 42*: 635.

Zinkel, F., Rowe, J. W., 1964. *J. Chromat., 13*: 74.

Podocarpic acid. $C_{17}H_{22}O_3$.

Radcliffe, C. B., Sherwood, I. R., Short, W. F., 1931. *J. chem. Soc.*: 2293.

Sherwood, I. R., Short, W. F., 1938. *J. chem. Soc.*: 1006.

Campbell, W. P., Todd, D., 1940. *J. Amer. chem. Soc., 62*: 1287.

Campbell, W. P., Todd, D., 1942. *J. Amer. chem. Soc., 64*: 928.

Briggs, L. H., De Ath, G. C., Ellis, S. R., 1942. *J. chem. Soc.*: 61.

Bhattacharyya, B. K., 1945. *J. Indian Chem. Soc., 22*: 165.

Haworth, R. D., Moore, B. P., 1946. *J. chem. Soc.*: 633.
Zeiss, H. H., Slimowicz, C. E., 1948. *J. Amer, chem. Soc., 70*: 1981.
Brandt, C. W., Ross, D. J., 1948. *Nature, 161*: 892.
Picha, G. M., 1949. U.S. Pat. 2,478,987; *Chem. Abs., 44*: 1141.
Brandt, C. W., 1952. *N.Z. J. Sci. Tech., 34B*: 65.
King, F. E., King, T. J., 1953. *J. chem. Soc.*: 4158.
Bible, R. H., Hoehn, N. M., 1955. U.S. Pat. 2,705,725; *Chem. Abs., 50*: 5034.
King, F. E., King, T. J., Topliss, J. G., 1956. *Chem. and Ind.*: 113.
Bible, R. H., 1956. U.S. Pat. 2,750,373; *Chem. Abs., 51*: 4436.
Bible, R. H., 1956. U.S. Pat. 2,753,357; *Chem. Abs., 51*: 2869.
Picha, G. M., 1956. U.S. Pat. 2,767,162; *Chem. Abs., 51*: 5122.
Bible, R. H., 1956. U.S. Pat. 2,759,014; *Chem. Abs., 51*: 5838.
Bible, R. H., 1957. U.S. Pat. 2,796,431; *Chem. Abs., 52*: 9214.
Bruun, H. H., 1957. *Paperi ja Puu, 39*: 221; *Chem. Abs., 51*: 15276.
Bruun, H. H., 1957. *Paperi ja Puu, 39*: 341; *Chem. Abs., 51*: 16105.
Bible, R. H., 1958. U.S. Pat. 2,851,485; *Chem. Abs., 53*: 8097.
Bible, R. H., 1958. U.S. Pat. 2,854,474; *Chem. Abs., 53*: 8096.
Wenkert, E., Jackson, B. G., 1958. *J. Amer. chem. Soc., 80*: 217.
Bible, R. H., Hoehn, W. M., 1959. U.S. Pat. 2,889,371; *Chem. Abs., 53*: 17991.
Cole, A. R. H., Michell, A. J., 1959. *J. chem. Soc.*: 2005.
Ghatak, U. R., Datta, D. K., Ray, S. C., 1960. *J. Amer. chem. Soc.*: 1728.
Hodges, R., Raphael, R. A., 1960. *J. chem. Soc.*: 50.
Bible, R. H., 1960 (?). U.S. Pat. 2,971,008; *Chem. Abs., 55*: 16506.
Bible, R. H., 1960. *Tetrahedron, 11*: 22.
Wenkert, E., Tahara, A., 1960. *J. Amer. chem. Soc., 82*: 3229.
Grove, J. F., Riley, B. J., 1961. *J. chem. Soc.*: 1105.
Bible, R. H., Burtner, R. R., 1961. *J. org. Chem., 26*: 1174.
Hill, J. A., Johnson, A. W., King, T. J., 1961. *J. chem. Soc.*: 4430.
Wenkert, E., Stenberg, V. I., Beak, P., 1961. *J. Amer. chem. Soc., 83*: 2320.
ApSimon, J. W., Edwards, O. E., 1962. *Canad. J. Chem., 40*: 896.
Sommer, P. F., Pascual, C., Arya, V. P., Simon, W., 1963. *Helv. Chim. Acta, 46*: 1734.
Wenkert, E., Beak, P., Carney, R. W. J., Chamberlin, J. W., Johnston, D. B. R., Roth, C. D., Tahara, A., 1963. *Canad. J. Chem., 41*: 1924.
Othman, A. A., Rogers, N. A. J., 1963. *Tetrahedron Letters,* No. 20: 1339.
Meyer, W. L., Maheshwari, K. K., 1964. *Tetrahedron Letters,* No. 32: 2175.
Crowshaw, K., Newstead, R. C., Rogers, N. A. J., 1964. *Tetrahedron Letters,* No. 33: 2307.
Girota, N. N., Zalkow, L. H., 1965. *Tetrahedron, 21*: 101.
Wenkert, E., Afonso, A., Beak, P., Carney, R. W. J., Jeffs, P. W., McChesney, J. P., 1965. *J. org. Chem., 30*: 713.
Hill, J. A., Johnson, A. W., King, T. J., Natori, S., Tam, S. W., 1965. *J. chem. Soc.*: 361.

Sandaracopimaric acid. $C_{20}H_{30}O_2$.

Henry, T. A., 1901. *J. chem. Soc., 79*: 1144.
Tschirch, A., Wolff, M., 1906. *Arch. Pharm., 244*: 684.

Rollett, A., Tabakoff, P., Feimer, S., 1928. *Monatsh., 50*: 1.
Balas, F., Brzák, J., 1929. *Coll. Czech. Chem. Comm., 1*: 306.
Novácek, R., 1930. *Z. Krist., 72*: 419; *Chem. Abs., 24*: 2025.
Petru, F., Galik, V., 1953. *Coll. Czech. Chem. Comm., 18*: 717.
Galik, V., Petru, F., Kuthan, J., 1959. *Tetrahadron, 7*: 223.
Galik, V., Kuthan, J., Petru, F., 1960. *Chem. and Ind.*: 722.
Edwards, O. E., Nicolson, A., Rodger, M. N., 1960. *Canad. J. Chem., 38*: 663.
Bose, A. K., 1960. *Chem. and Ind.*: 1104.
Ireland, R. E., Schiess, P. W., 1960. *Tetrahedron Letters,* No. 25: 37.
Van-Thoi, L., 1960. *Ann. fac. sci. Univ. Saigon*: 89; *Chem. Abs. 55*: 26017.
ApSimon, J. W., Green, B., Whalley, W. B., 1961. *J. chem. Soc.*: 752.
Arya, V. P., Enzell, C., Erdtman, H., Ryhage, R., 1961. *Acta Chem. Scand., 15*: 682.
ApSimon, J. W., Edwards, O. E., 1961. *Canad. J. Chem., 39*: 2543.
Daniels, P., Enzell, C., 1962. *Acta Chem. Scand., 16*: 1530.
Sommer, P. F., Pascual, C., Arya, V. P., Simon, W., 1963. *Helv. Chim. Acta, 46*: 1734.
Laidlaw, R. A., Morgan, J. W. W., 1963. *J. chem. Soc.*: 644.
Ireland, R. E., Schiess, P. W., 1963. *J. org. Chem., 28*: 6.
Bose, A. K., Harrison, S., 1963. *Chem. and Ind.*: 254.
Fétizon, M., Golfier, M., 1963. *Bull. Soc. Chem. France*: 167.
Sato, A., von Rudloff, E., 1964. *Canad. J. Chem., 42*: 635.

Cupressene (≡ Hibaene ≡ Stachene). $C_{20}H_{32}$.

Briggs, L. H., Sutherland, M. D., 1942. *J. org. Chem., 7*: 397.
Briggs, L. H., Cain, B. F., Davis, B. R., Wilmshurst, J. K., 1959. *Tetrahedron Letters,* No. 8: 8.
Briggs, L. H., Cain, B. F., Davis, B. R., Wilmshurst, J. K., 1959. *Tetrahedron Letters,* No. 8: 13.
Gupta, R. C., Muthana, M. S., 1954. *J. Indian Inst. Sci., 36A*: 76.
Gupta, R. C., Muthana, M. S., 1954. *J. Indian Inst. Sci., 36A*: 122.
Briggs, L. H., Cain, B. F., Cambie, R. C., 1959. *Tetrahedron Letters,* No. 8: 17.
Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochemistry, 2*: 205.
Kitahara, Y., Yoshikoshi, A., 1964. *Tetrahedron Letters,* No. 26: 1771.
Kitahara, Y., Yoshikoshi, A., 1964. *Bull. Chem. Soc. Japan, 37*: 890.
Murray, R. D. H., McCrindle, R., 1964. *Chem. and Ind.*: 500.
Wenkert, E., Jeffs, P. W., Mahajan, J. R., 1964. *J. Amer. chem. Soc., 86*: 2218.
Briggs, L. H., Cambie, R. C., Rutledge, P. S., Stanton, D. W., 1964. *Tetrahedron Letters,* No. 32: 2223.
Kapadi, A. H., Dev, S., 1964. *Tetrahedron Letters,* No. 19: 1181.
Kapadi, A. H., Dev, S., 1964. *Tetrahedron Letters,* No. 38: 2751.

Kaurene and Isokaurene. $C_{20}H_{32}$.

Hosking, J. R., 1928. *Rec. trav. chim., 47*: 578.
Hosking, J. R., 1930. *Rec. trav. chim., 49*: 1036.
Nishida, K., Uota, H., 1931. *J. Agric. Chem. Soc. Japan, 7*: 157; *Chem. Abs.,* **25: 4547.**

Nishida, K., Uota, H., 1931. *J. Agric. Chem. Soc. Japan, 7*: 957.

Kawamura, J., 1931. *Bull. Imp. Forestry Exp. Stat. Tokyo,* No. 31: 93; *Chem. Abs., 26*: 4679.

Brandt, C. W., 1938. *N.Z. J. Sci. Tech., 20*: 8B.

Butler, J. M., Holloway, J. T., 1939. *J. Soc. chem. Ind. Lond., 58*: 223.

Briggs, L. H., Cawley, R. W., 1948. *J. chem. Soc.*: 1888.

Briggs, L. H., Taylor, W. I., 1950. *J. chem. Soc.*: 407.

Briggs, L. H., Cawley, R. W., Loe, J. A., Taylor, W. I., 1950. *J. chem. Soc.*: 955.

Nakatsuka, T., Hirose, Y., Matsuda, M., 1957. *Mokuzai Gakkaishi, 3*: 206; *Chem. Abs., 52*: 11362.

McGimpsey, J. R., Murray, J., 1960. *J. appl. Chem., 10*: 340.

Djerassi, C., Quitt, P., Mosettig, E., Cambie, R. C., Rutledge, P. S., Briggs, L. H., 1961. *J. Amer. chem. Soc., 83*: 3720.

Briggs, L. H., Cain, B. F., Cambie, R. C., Davis, B. R., Rutledge, P. S., 1962. *J. chem. Soc.*: 1850.

Vorbrueggen, H., Djerassi, C., 1962. *J. Amer. chem. Soc., 84*: 2990.

Bell, R. A., Ireland, R. E., Partyka, R. A., 1962. *J. org. Chem., 27*: 3741.

Briggs, L. H., Cain, B. F., Cambie, R. C., Davis, B. R., Rutledge, P. S., Wilmshurst, J. K., 1963. *J. chem. Soc.*: 1345.

Cross, B. E., Galt, R. H. B., Hanson, J. R., Curtis, P. J., Grove, J. F., Morrison, A., 1963. *J. chem. Soc.*: 2937.

Cross, B. E., Galt, R. H. B., Hanson, J. R., Briggs, L. H., Cambie, R. C., Rutledge, P. S., 1963. *Proc. chem. Soc. Lond.*: 17.

Hanson, J. R., 1963. *J. chem. Soc.*: 5061.

Mosettig, E., Beglinger, U., Dolder, F., Lichti, H., Quitt, P., Waters, J. A., 1963. *J. Amer. chem. Soc., 85*: 2305.

Nagahama, S., 1963. *Bull. Chem. Soc. Japan, 36*: 753.

Briggs, L. H., Cambie, R. C., Rutledge, P. S., 1963. *J. chem. Soc.*: 5374.

Bell, R. A., Ireland, R. E., 1963. *Tetrahedron Letters,* No. 4: 269.

Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.

Hugel, G., Lods, L., Mellor, J. M., Theobald, D. W., Ourisson, G., 1963. *Bull. Soc. chim. France*: 1974.

Masamune, S., 1964. *J. Amer. chem. Soc., 86*: 288.

Masamune, S., 1964. *J. Amer. chem. Soc., 86*: 289.

Cross, B. E., Galt, R. H. B., Hanson, J. R., 1964. *J. chem. Soc.*: 295.

Phyllocladene and Isophyllocladene. $C_{20}H_{32}$.

Baker, R. T., Smith, H. G., 1910. *Pines of Australia,* Technological Museum, Sydney, p. 419.

Goudie, B. H., 1923. *J. Soc. chem. Ind. Lond., 42*: 357T.

Aitken, P. W., 1928. *J. Soc. chem. Ind. Lond., 47*: 223T.

Blackie, W. J., 1929. *J. Soc. chem. Ind. Lond., 48*: 357T.

Blackie, W. J., 1930. *J. Soc. chem. Ind. Lond., 49*: 26T.

Kawamura, J., 1931. *Bull. Imp. Forest. Exp. Sta. Japan, 31*: 77.

Nishida, K., Uota, H., 1935. *Bull. Agric. Chem. Soc. Japan, 11*: 489.

Nishida, K., Uota, H., 1936. *Bull. Agric. Chem. Soc. Japan, 12*: 308.

Uota, H., 1937. *J. Dept. Agric. Kyushu Imp. Univ., 5*: 117; *Chem. Abs., 31*: 7416.

Briggs, L. H., 1937. *J. chem. Soc.*: 79.

Briggs, L. H., 1937. *J. Soc. chem. Ind. Lond., 56*: 137T.

Briggs, L. H., 1937. *Aust. N.Z. Assoc. Adv. Sci., 23*: 45.

Briggs, L. H., 1937. *J. chem. Soc.*: 1035.

Holloway, J. T., 1938. *N.Z. J. Sci. Tech., 20*: 16B.

Brandt, C. W., 1938. *N.Z. J. Sci. Tech., 20*: 8B.

Briggs, L. H., 1940. *Trans. Roy. Soc. N.Z., 70*: 173.

Briggs, L. H., 1941. *J. Soc. chem. Ind. Lond., 60*: 222.

Orcutt, R. M., Bogert, M. T., 1941. *J. Amer. chem. Soc., 63*: 127.

Briggs, L. H., Sutherland, M. D., 1942. *J. org. Chem., 7*: 397.

Briggs, L. H., Taylor, W. I., 1947. *J. Soc. chem. Ind. Lond., 66*: 186.

Briggs, L. H., Taylor, W. I., 1947. *J. org. Chem., 12*: 551.

Briggs, L. H., Sutherland, M. D., 1948. *J. org. Chem., 13*: 1.

Briggs, L. H., Cawley, R. W., Loe, J. A., Taylor, W. I., 1950. *J. chem. Soc.*: 955.

Briggs, L. H., Loe, J. A., 1950. *J. chem. Soc.*: 958.

Briasco, J. D., Murray, J., 1952. *J. appl. Chem., 2*: 187.

Brandt, C. W., 1952. *N.Z. J. Sci. Tech., 34B*: 46.

Bottomley, W., Cole, A. R. H., White, D. E., 1955. *J. chem. Soc.*: 2624.

Corbett, R. E., Wong, L. C-K., 1955. *J. Sci. Food Agric., 6*: 739.

Djerassi, C., Riniker, R., Riniker, B., 1956. *J. Amer. chem. Soc., 78*: 6362.

Briggs, L. H., Cain, B. F., Cambie, R. C., 1959. *Tetrahedron Letters,* No. 8, 13.

Baslas, K. K., 1959. *Perfumery Essent. Oil Record, 50*: 823; *Chem. Abs., 54*: 7980.

Brooker, E. G., 1959. *N.Z. J. Sci., 2*: 212.

Djerassi, C., Cais, M., Mitscher, L. A., 1959. *J. Amer. chem. Soc., 81*: 2386.

Grant, P. K., Hodges, R., 1960. *Tetrahedron, 8*: 261.

Briggs, L. H., Cain, B. F., Cambie, R. C., Davis, B. R., 1960. *Tetrahedron Letters,* No. 24, 18.

Murray, J., 1960. *J. appl. Chem.,* 10: 366.

Turner, R. B., Shaw, P. E., 1960. *Tetrahedron Letters,* No. 18: 24.

Henderson, R. H., Hodges, R., 1960. *Tetrahedron, 11*: 226.

Church, R. F., Ireland, R. E., Marshall, J. A., 1960. *Tetrahedron Letters,* No. 17: 1.

Turner, R. B., Gänshirst, K. H., 1961. *Tetrahedron Letters,* No. 7: 231.

Mosettig, E., Quitt, P., Beglinger, U., Vorbrueggen, H., Djerassi, C., 1961. *J. Amer. chem. Soc., 83*: 3163.

Briggs, L. H., Cain, B. F., Cambie, R. C., Davis, B. R., 1962. *J. chem. Soc.*: 1840.

Briggs, L. H., Cain, B. F., Cambie, R. C., Davis, B. R., Rutledge, P. S., 1962. *J. chem. Soc.*: 1850.

Vorbrueggen, H., Djerassi, C., 1962. *J. Amer. chem. Soc., 84*: 2990.

Cross, B. E., Hanson, J. R., Briggs, L. H., Cambie, R. C., Rutledge, P. S., 1963. *Proc. chem. Soc.*: 17.

Mori, K., Matsui, M., 1963. *Agr. Biol. Chem. Tokyo, 27*: 31; *Chem. Abs., 59*: 9929.

Briggs, L. H., Cambie, R. C., Rutledge, P. S., 1963. *J. chem. Soc.*: 5374.

Aplin, R. T., Cambie, R. C., Rutledge, P. S., 1963. *Phytochem., 2*: 205.

Birch, A. J., Winter, J., 1963. *J. chem. Soc.*: 5547.

S. G. BROOKER, M.Sc., Abels Ltd., Box 9012, Auckland, S.E.1.

R. C. CAMBIE, D.Sc., D.Phil., University of Auckland, Auckland, C.1.

MARGARET A. JAMES, B.Sc., University of Auckland, Auckland, C.1.