

THE DISTRIBUTION OF ALKALOIDS IN NEW SOUTH WALES AND QUEENSLAND ORCHIDACEAE

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Abstract—205 orchids from New South Wales and Queensland have been screened for alkaloids. These results, together with those published from exotic species, are discussed from a taxonomic viewpoint.

INTRODUCTION AND RESULTS

DRAWING on the results from 1100 orchids, LÜNING has outlined the distribution of alkaloids throughout the family Orchidaceae.^{1,2} We are similarly interested in the possible use of alkaloid distribution as an aid to taxonomy and have undertaken a survey of the orchids from Eastern Australia and New Guinea.³ Although as many New South Wales and Queensland orchids have been tested as could be collected and identified, it was initially decided to examine those orchids which have been used in aboriginal folk-medicine. *Cymbidium madidum*, whose pseudobulbs were chewed for dysentery,⁴ and whose seeds have been used as an oral contraceptive,⁵ and *C. canaliculatum*, whose pseudobulbs have been used as a substitute for arrow-root,⁶ and also as a treatment for dysentery,⁵ appear to be the only two recorded examples. All testing in the field was carried out using the portable kit described by Culvenor.⁷ The reagents used for testing in the field were Mayer's reagent and Scheibler's reagent. For laboratory testing these two reagents were used together with Dragendorff's, Marmé's, Wagner's and ammonium reineckate reagents. These were all prepared according to Cromwell.* Where possible, all testing was done in the field on living plants and confirmed in the laboratory. When available, portions of root, leaf and stem or pseudobulb were included in the test sample. Precipitates were graded as follows: 4 (> 0.1 per cent), 3 (0.1 per cent), 2 (0.01 per cent), 1 (< 0.01 per cent), 0 (no alkaloid detectable); the alkaloid content in brackets being estimated by comparison with dendrobine from *Dendrobium nobile*. The figures can only be taken as an approximation of the alkaloid content because of the wide variation in sensitivity of the reagents to individual alkaloids.

¹ B. LÜNING, *Acta Chem. Scand.* **18**, 1507 (1964).

² B. LÜNING, *Phytochem.* **6**, 857 (1967).

³ L. J. LAWLER and M. SLAYTOR, to be published.

⁴ W. E. ROTH, *North Queensland Ethnography Bulletin* No. 5, Government Printer, Brisbane (1903).

⁵ L. J. WEBB, *Proc. Roy. Soc. Queensland* **71**, 103 (1959).

⁶ C. HEDLEY, *Proc. Roy. Soc. Queensland* **5**, 10 (1888).

⁷ C. C. J. CULVENOR and J. S. FITZGERALD, *J. Pharm. Sci.* **52**, 303 (1963).

⁸ B. T. CROMWELL, in *Modern Methods of Plant Analysis* (edited by K. PAECH and M. V. TRACEY), Vol. IV, Springer-Verlag, Berlin (1955).

TABLE 1. RESULTS OF ALKALOID TESTING

Subfamily Monandreae: Division Acrotonae: Tribe Polychondreae: Subtribe Pterostylideae: *Pterostylis acuminata* 0; *P. baptistii* 0; *P. concinna* 0; *P. curta* 1; *P. cynocephala* 2; *P. falcata* 1; *P. longifolia* 0; *P. mutica* 0; *P. nutans* 0; *P. obtusa* 0; *P. pedunculata* 0; *P. pusilla* v. *prominens* 3. Subtribe Thelymitreae: *Calochilus campestris* 2; *C. paludosus* 3; *C. robertsonii* 2; *Thelymitra carnea* 0; *T. ixioides* 1; *T. nuda* 0. Subtribe Prasophylleae: *Microtis parviflora* 0; *M. umfolia* 1; *Prasophyllum archeri* 0; *P. australe* 2; *P. brevifolium* 0; *P. elatum* 1; *P. viride* 0. Subtribe Drakaeae: *Caleana major* 0; *C. minor* 0; *Chiloglottis gunnii* 1; *C. reflexa* 1; *Spiculaea irritabilis* 0. Subtribe Caladenieae: *Caladenia alba* 0, v. *picta* 0; *C. carnea* 1; *Glossodia major* 0; *G. minor* 0; *Lyperanthus suaveolens* 3. Subtribe Aciantheae: *Acianthus caudatus* 1; *A. fornicatus* 2. Subtribe Corybadeae: *Corybas abellianus* 0; *C. aconitiflorus* 0. Subtribe Cryptostylideae: *Cryptostylis erecta* 4. Subtribe Vanilleae: *Galeola cassythoides* 2; *G. foliata* 2. Subtribe Nervillieae: *Nercilia discolor* 2; *N. holochila* 3. Subtribe Physureae: *Anoetochilus yatesae* 1; *Cheirostylis ovata* 0; *Ketaeria oblongifolia* 0; *H. polygonoides* (F. Muell) Dockr. 2; *Zeuxine oblonga* 0. Subtribe Tropidieae: *Corymborkis veratrifolia* 2. Subtribe Spirantheae: *Spiranthes sinensis* 1. Subtribe Diurideae: *Diuris aurea* 0; *D. sulphurea* 0. Subtribe Gastrodieae: *Gastrodia sesamoides* 3.

Tribe Kerosphaerae: Series Acranthae: Subtribe Liparideae: *Liparis coelogynoides* 4; *L. fleckeri* 3; *L. habenarina* 4; *L. nugentiae* 4; *L. reflexa* 3; *Malaxis latifolia* 4; *Oberonia attenuata* 0; *O. muelleriana* 2; *O. palmicola* 3. Subtribe Coelogynae: *Pholidotapallida* 2. Subtribe Dendrobieae: *Cadetia hispida* 0; *C. taylori* 0; *Dendrobium*—Section 1 (*Rhizobium*): *D. cucumerinum* 2; *D. linguiforme* v. *linguiforme*, 1, v. *nugentiae* 1; Section 2: *D. lichenastrum* v. *lichenastrum* 0, v. *prenticei* forma *prenticei* 0, forma *aurantiaco-purpureum* 0; *D. toressae* 0; Section 3 (*Monophyllaea*): *D. carriei* 0; *D. monophyllum* 1; *D. schneiderae* 1; Section 4: *D. agrostophyllum* 0; Section 5 (*Eleutheroglossum*): *D. canaliculatum* v. *canaliculatum* 0, v. *nigrescens* 0; Section 6 (*Latourea*): *D. bairdianum* 0; *D. bifalce* 0; Section 7 (*Dendrocoryne*): *D. adae* 1; *D. aemulum* 0; *D. x delicatum* 2; *D. falcrostrum* 1; *D. jleckeri* 1; *D. gracilicaule* v. *gracilicaule* 2, v. *howeanum* 0; *D. x gracillimutn* 0; *D. x kestevenii* 1; *D. kingianum* 0; *D. moorei* 1; *D. ruppianum* v. *ruppianum* forma *ruppianum* 0, forma *magnificum* 0; *D. speciosum* v. *speciosum* 0, v. *hillii* 0; *D. x suffusum* 0; *D. tetragonum* v. *tetragonum* 1, v. *hayesiammt* 0; Section 8 (*Ceratobium*): *D. antennatum* 1; *D. discolor* 0; *D. johannis* 0; *D. toffitii* 0; *D. wilkianum* 0; Section 9 (*Phalaenanthus*): *D. bigibbum* v. *bigibbum* 0, v. *superbum* subv. *superbum* 0, subv. *compactum* 0; *D. dicuphum* F. Muell 1; Section 9 x Section 8: *D. x superbiens* 2; Section 11 (*Pedilonum*): *D. ophioglossum* 0; *D. smilliae* 0; Section 12 (*Grastidium*): *D. baileyi* 1; *D. cancroides* 2; *D. luteociliatum* 1; Section 13: *D. beckeri* 0; *D. mortii* 1; *D. pugioniforme* 2; *D. racemosum* 0; *D. rigidum* 0; *D. striolatum* 1; *D. tenuissimum* 1; *D. teretifolium* v. *teretifolium* 0, v. *fairfaxii* forma *fairfaxii* 1, forma *aureum* 1, v. *fasciculatum* 0; Section 14 (*Monanthos*): *D. malbrownii* Dockr. 0; Cultivars: *D. cv. 'Bardot Rose'* 0; *D. cv. 'Ellen'* 0; *Diplocaulobium glabrum* 1; *Ephemerantha convexa* 1; *Eria eriaeoides* 1; *E. fitzalanii* 0; *E. inornata* 1; *E. intermedia* 0; *E. irukandjiana* 0; *E. queenslandica* 0. Subtribe Podochileae: *Polochilus australiensis* 0.

Tribe Kerosphaerae: Series Pleuranthae: Subseries Sympodiales: Subtribe Phajaeae: *Calanthe triplicata* 1; *Phaius australis* 2; *P. pictus* 0; *P. tankervilleae* 1; *Spathoglottis paulinae* 0. Subtribe Bulbophylleae: *Bulbophyllum*—Section 1: *B. bracteatum* 4; *B. exiguum* 0; *B. lageniforme* 2; *B. lilianae* 0; *B. newportii* 0; Section 2: *B. evasum* 0; Section 4 (*Sestochilus*): *B. baileyi* 0; Section 5 (*Micromonanthus*): *B. bowkettiae* 0; *B. johnsonii* 0; Section 6 (*Nematorhiza*): *B. nematopodium* 0; Section 7 (*Polyblepharon*): *B. macphersonii* 0; Section 8 (*Sphaeracron*): *B. aurantiacum* 0; *B. crassulifolium* 0; *B. gadgarrense* 0; *B. wadsworthii* 0; Section 9 (*Fruticicola*): *B. radicans* 0; Section 10: *B. globuliforme* 0; *B. minutissimum* 0; Section 11: *B. weinthalii* 0; Section 12: *B. elisae* 1. Subtribe Cyrtopodieae: *Geodorum pictum* 0. Subtribe Cymbidieae: *Cymbidium canaliculatum* 0; *C. canaliculatum* forma *aureolum* 0; *C. madidum* 0; *C. suave* 0; *Dipodium ensifolium* 0; *D. punctatum* 2. Subtribe Thelasiaceae: *Phreatia baileyana* 0; *P. crassiuscula* 0; *P. robusta* 0. Subtribe Thecosieleae: *Acriopsis javanicav. nelsoniana* 1; Subseries Monopodiales: Subtribe Sarcantheae: *Camarotis keffordii* 2; *Chiloschista phyllorhiza* 1; *Luisia teretifolia* 1; *Mobilabium hamatum* 0; *Parasarcocochilus spathulatus* 0; *P. weinthalii* 0; *Peristeranthus hillii* 1; *Phalaenopsis amabilis* v. *rosentromii* 4; *Pomatocalpa macphersonii* 0; *Rhinerrhiza divitiflora* 4; *Robiquetia tierneyana* 1; *R. wassellii* 0; *Saccolabiopsis armitii* 0; *Sarcocochilus australis* 1; *S. ceciliae* 2; *S. dilatatus* 0; *S. falcatus* 0; *S. fitzgeraldii* 2; *S. hartmannii* 1; *S. hillii* 2; *S. moorei* 1; *S. olivaceus* 0; *S. tricallatus* 0; *Schistostylis purpuratus* 1; *Schoenorchis densiflora* v. *densiflora* 1; *Taeniophyllum flavum* 0; *T. muelleri* 0; *T. wilkianum* 3; *Plectorrhiza tridentata* 0; *Vanda whiteana* 1.

The classification of the Orchidaceae in this paper follows that of Schlechter as summarized by Withner⁹ while the names of genera and species are from Rupp¹⁰ and Dockrill.¹¹ The classification of *Dendrobium* and *Bulbophyllum* into sections follows Dockrill with the unnamed sections numbered.¹² Authors are given for those species not listed by Rupp or Dockrill.

DISCUSSION

The Australian species under discussion fall entirely into the subfamily Monandreae, division Acrotonae. There are two tribes in this division, Polychondreae and Kerosphaereae; the latter being divided into Acranthae and Pleuranthe. Finally, Pleuranthe is divided into Sympodiales and Monopodiales.

The tribe Polychondreae contains eighteen Australian subtribes of which fifteen were tested. Throughout the subtribes alkaloids are consistently found in well-defined genera. For example, in the subtribe Thelymitreae the botanical differences between the genera *Thelymitra* and *Calochilus* are reinforced by the screening results. The series Acranthae of the tribe

TABLE 2. ALKALOID DISTRIBUTION ACCORDING TO SUBTRIBES

Tribe Polychondreae	Number of genera	Alkaloid- positive species	Tribe Kerosphaereae	Number of genera	Alkaloid- positive species
Pterostylideae	1	2/12	Liparideae	3	8/9
Thelymitreae	2	3/6	Coelogyneae	1	1/1
Prasophylleae	2	1/7	Dendrobieae	5	10/68
Drakaeae	3	0/5	Podochileae	1	0/1
Calandenieae	3	1/6	Phajaeae	3	2/5
Aciantheae	1	1/2	Bulbophylleae	1	2/20
Corybadeae	1	0/2	Cyrtopodieae	1	0/1
Cryptostylideae	1	1/1	Cymbidieae	2	1/6
Vanilleae	1	2/2	Thelasiaeae	1	0/3
Nervillieae	1	2/2	Thecosteleae	1	0/1
Physureae	4	1/5	Sarcantheae	17	7/30
Tropidieae	1	1/1			
Diurideae	1	0/2			
Gastrodieae	1	1/1			
Spirantheae	1	0/1			
Total	24	16/55		36	31/145

Kerosphaereae contains six Australian subtribes, four of which were tested. Of the nine species of the subtribe Liparideae, eight are strongly positive and *Oberonia attenuata* is negative.

The results from these 205 Australian orchids, contained in Table 1 and summarized in Table 2, become more significant when they are integrated with the results from 1100 largely non-Australian species by Lüning,^{1,2} and 300 New Guinean species by Lawler and Slaytor.³ Liming uses Pfitzer's system of classification,¹³ in contrast to that of Schlechter used here.⁹ When the two systems are compared they are practically identical in the groupings of the genera into subtribes. Further, with two exceptions, Sobralieae and Dendrobieae, the same subtribes are grouped together into higher taxa. Thus it is possible to make a direct comparison between the two systems.

⁹ C. WITHNER, *The Orchids: A Scientific Survey*, The Ronald Press Company, New York (1959).

¹⁰ H. M. R. RUPP, *The Orchids of New South Wales*, 2nd edition, N.S.W. Government Printer, Sydney (1969).

¹¹ A. W. DOCKRILL, *A Checklist of the Orchidaceous Plants of North Queensland*, North Queensland Naturalists Club, Cairns (1966); *Australasian Sarcanthinae*, The Australasian Native Orchid Society, Sydney (1967).

¹² A. W. DOCKRILL, personal communication (1968).

¹³ E. H. PFITZER, in *Die Natürlichen Pflanzenfamilien* (edited by A. ENGLER and K. PRANTL), 2 (6), 62, Leipzig (1888).

All the results now published on species from Diandreae are consistent and show only a few alkaloid-rich species scattered through the subfamily. In the Basitonae we have found one species of interest, *Habenariapapuana*.³ Exhaustive screening of this taxa will probably reveal the pattern of random distribution of alkaloid-rich species which is emerging from the other major taxa. It is in the division Acrotonae that the greatest number of alkaloid-rich species are found. Seventeen genera of the tribe Polychondreae (Pfitzer's Neottiinae) have now been tested. We have tested fourteen, eight of which consist largely of Australian species. The combined results show random distribution of alkaloids throughout the tribe at generic level. Series Acranthae of tribe Kerosphaereae contains the subtribe Liparideae, the most uniformly positive of any subtribe tested. Almost all species from the seven genera tested are strongly positive. Several species from *Liparis* and *Malaxis*, including the Australian *L. reflexa*,¹⁴ produce glycosidic alkaloids of very closely related structure. Lüning's assumption that Coelogyneae is almost completely alkaloid free¹⁵ must be modified, as our results show frequent low-level occurrence. Our sampling of Glomereae from New Guinea has considerably supplemented Lüning's results. There are some genera, *Agrostophyllum*, *Mediocalcar* and *Glossorhyncha*, with moderate alkaloid concentrations. All the results from Dendrobieae are in agreement. It is interesting that *Dendrobizcm*, which contains some of the most alkaloid-rich orchids, is classified by Schlechter in Acranthae together with Liparideae, while in Pfitzer's system it is grouped with less positive subtribes. The overall pattern in subseries Sympodiales of series Pleuranthe is now one of random distribution at generic level. For example, further testing of the subtribe Phajeae leads to the conclusion that this subtribe contains only a few alkaloid-rich species, including the New Guinean genus *Plocoglottis*.³ A similar conclusion can now be drawn for the subtribes Thelasieae and Bulbophylleae. In subseries Monopodiales, the subtribe Sarcantheae is well represented in Australia and all the results are in agreement.

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¹⁴ J. MOHANDAS and M. SLAYTOR, unpublished results.

¹⁵ B. LÜNING, *Proc. Fifth World Orchid Conf.* 211 (1966).