Hybrids Between *Duboisia myoporoides* and *D. leichhardtii*

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SUMMARY

A brief account is given of the crossing of the Australian alkaloid bearing species, D. myoporoides *and* D. leichhardtii, *in which acetylene was used to induce flowering. Some morphological characters and the main alkaloids of the first generation hybrids are described and the possible relationship of the latter to certain naturally occurring forms intermediate between the parent species is indicated.*

INTRODUCTION.

In the course of field surveys of species of *Duboisia* made in connection with an investigation of the alkaloid content of members of the genus, a number of trees was found in a restricted area at Yarraman, in south-eastern Queensland, which appeared to be intermediate in some characters between *D. leichhardtii,* the species normally found in the area, and *D. myoporoides.* These intermediate forms might be the descendants of a natural cross, as, though *D. myoporoides* has not been identified, it is possible that both species occur there. A controlled cross between the species would be useful in testing this theory, and at the same time provide breeding material from which commercially useful genotypes might be selected. The present paper describes the making of such a cross and gives a brief account of some of the morphological and physiological characters of the F1.

PROCEDURE

Flower Induction.

The plants which were available for crossing at the Nambour Field Station of the Queensland Department of Agriculture and Stock comprised 15-months-old trees of *D. leichhardtii* and *D. myoporoides* raised from seed collected at Yarraman and Imbil (also in south-eastern Queensland), respectively. These trees were not expected to flower until the following year, and in order to expedite the project an attempt was made to induce flowering by chemical means. In pineapple culture it is a practice to bring about flowering by pouring an aqueous solution of acetylene on to the apical meristem of the plant, and it was thought that a modification of this treatment might be effective with *Duboisia.* Accordingly, in May, 1944, one tree of each species was treated by immersing the cut ends of twigs in an aqueous solution of acetylene, the treatment being applied to one branch of each tree. Absorption was fairly

rapid with both species. In the following spring, flowering was general on treated and untreated trees of *D. leichhardtii,* but on the *D. myoporoides* tree only the treated branch flowered, producing two flower panicles. Subsequent experience has shown that the treatment is usually successful, provided the acetylene is applied several months before the plant might be expected to flower. The technique should be useful in accelerating subsequent breeding operations by the induction of flowering at an earlier age.

Technique of Crossing.

The flower opens progressively over a period of days. The anthers first recede from the style, and approach the stigma again shortly before they dehisce. With this indication of maturity it was convenient to emasculate and pollinate just prior to dehiscence, but pollination on the previous day was quite practicable. The procedure was relatively simple, and was effective in producing crossed seed.

Crosses Effected.

Over 600 seeds were obtained when using *D. leichhardtii* pollen on the acetylene treated *D. myoporoides* (Cross 1) and a lesser number from the reciprocal (Cross 2). It was found possible to use a tree of *D. myoporoides* some miles away as a male parent by keeping branches in water in the laboratory and using the pollen on two additional *D. leichhardtii* trees (Crosses 3 and 4). A small amount of seed was obtained from each of the latter. Seedlings were raised from all the hybrid seed in the summer of 1944-45. The percentage germination was very low but not less than that normally encountered in the parent species. Seven F1 plants of Cross 1 and one of each of Crosses 2, 3 and 4 were ultimately established in the field.

DESCRIPTION OF HYBRIDS.

The F1 plants from Cross 1 were similar to each other in general appearance, but the uniformity within the others could not be observed because only single plants were available. The only F1 plant which was noticeably different was that of Cross 2 (*D. leichhardtii* and *D. myoporoides* (Imbil)).

Three plants of Cross 1 and the single plant of Cross 3 had flowered by September, 1948. Flowering took place later than the peak period of *D. leichhardtii* but before that of *D. myoporides.* Seed set on the one tree examined was good even when selfed. In the previous season it was necessary to transplant the remaining trees and as a result their flowering was delayed.

The three principal characters used in distinguishing the parent species are the length and shape of the corolla lobes, the exsertion or inclusion of the stamens, and the shape of the leaves.

It will be seen from Figures 1, 2 and 3 that the flower of Cross 1 is morphologically intermediate between the flower types of the parent species,

but tends more towards the longer narrow-acuminate corolla-lobe shape of the pollen parent, *D. leichhardtii.*

Progenies from some of the naturally occurring intermediate forms were growing in the same plot as the hybrids and flowered about the same time. The intermediate group included flower types indistinguishable from those of the hybrids, as illustrated in Figure 4, which shows typical flowers from each group.

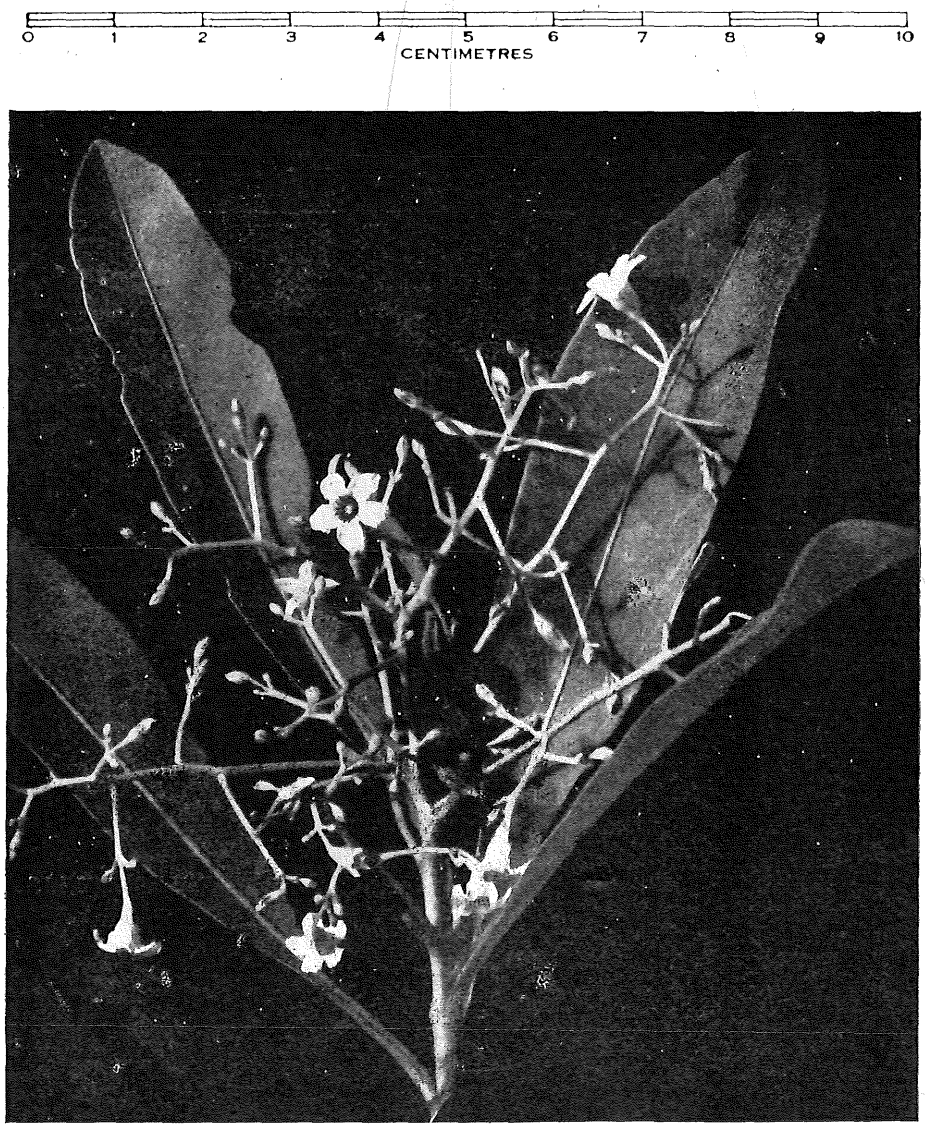
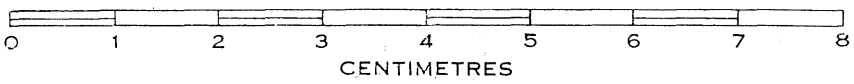


Figure 1
Typical flowers of *D. myoporoides.*

The exsertion or inclusion of the stamens has been used by Bailey (1901) as the main key character in distinguishing the two species. However, examination of a wide range of flowering specimens of *D. leichhardtii* has failed to reveal any evidence of exsertion and it must be assumed that the key is incorrect. The stamens of neither the parents nor the F1 are exserted.



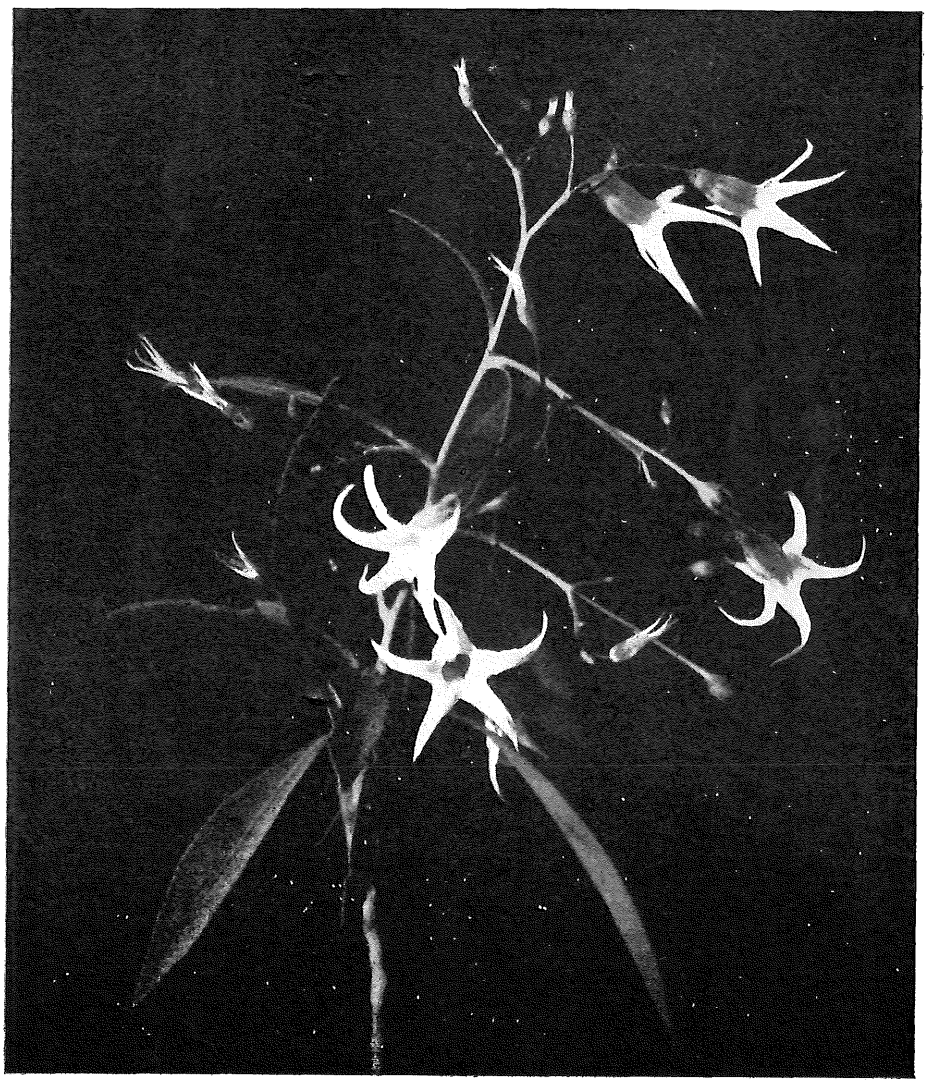


Figure 2
Typical flowers of *D. leichhardtii*.

The species differ fairly consistently in leaf shape. While the leaves of both species have been described as oblong-lanceolate, those of *D. leichhardtii* are roughly symmetrical about their transverse axis and those of *D. myoporoides* tend to be broader distally. A measure of the leaf shape can be obtained by bisecting the leaf transversely and expressing the area of the distal section

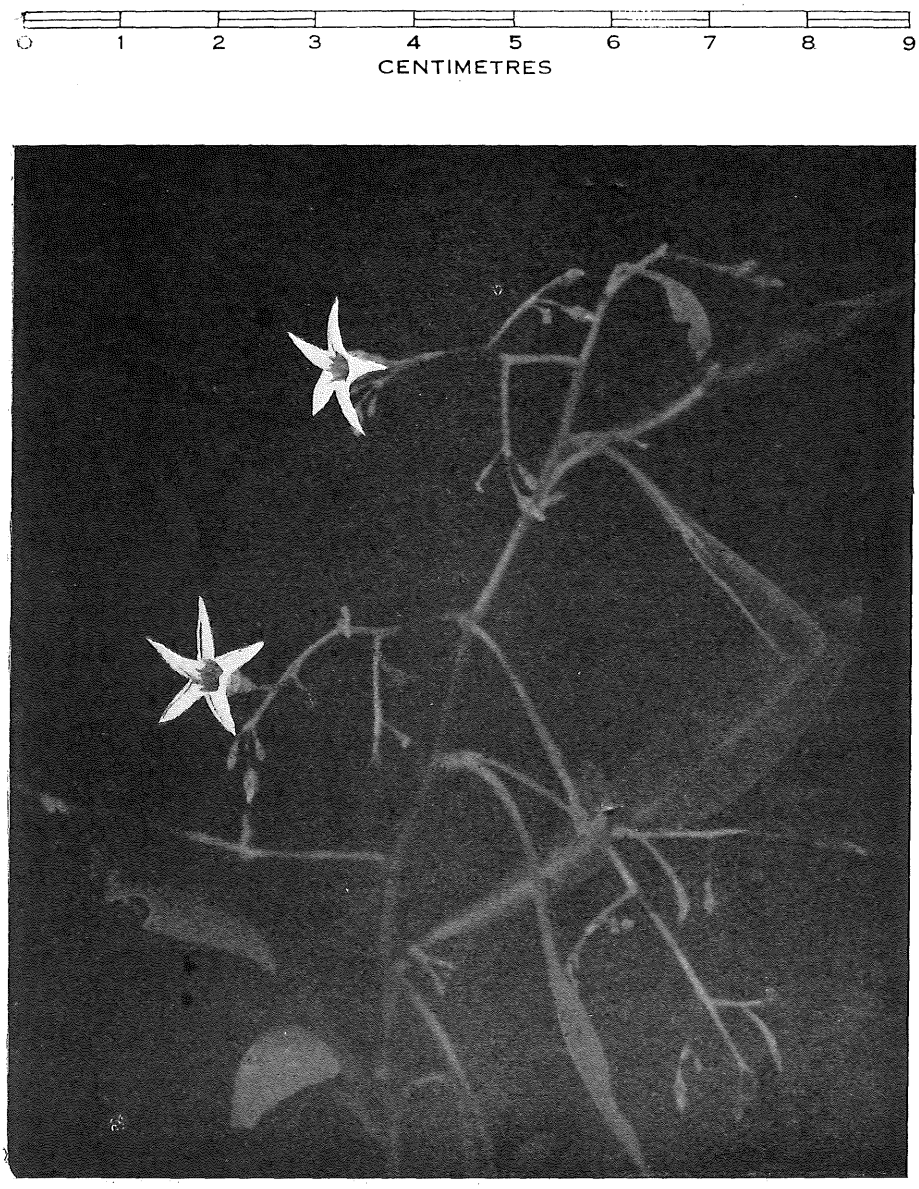


Figure 3
Typical flowers of the first generation hybrid (Cross 1).

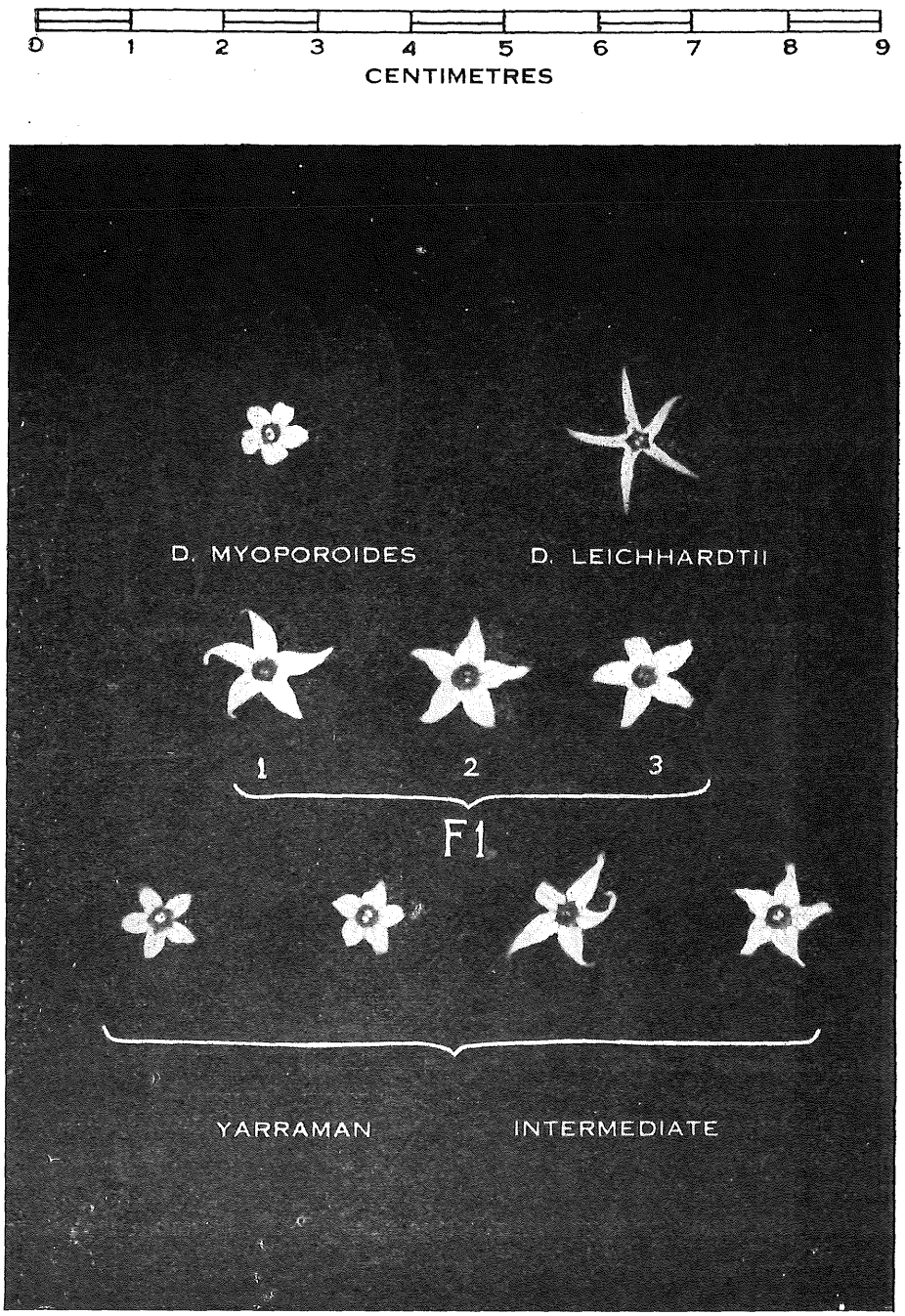


Figure 4

Flowers of parents, first generation hybrids, and a range of types from the naturally occurring intermediate forms.

as a fraction of the proximal section, when the value for a typical *D. leichhardtii* leaf will be less than that for *D. myoporoides*. Mean values of this index for selfed progenies of the parent trees were 1.29 and 1.70, respectively, while that of the hybrids was 1.34. Although only 15 leaves were measured from each tree, the figures confirm the general impression that the shape of the leaves of the hybrid is closer to that of *D. leichhardtii* than to that of *D. myoporoides*. Typical leaf shapes from Cross 1 and from the parent progenies are illustrated in Figure 5.

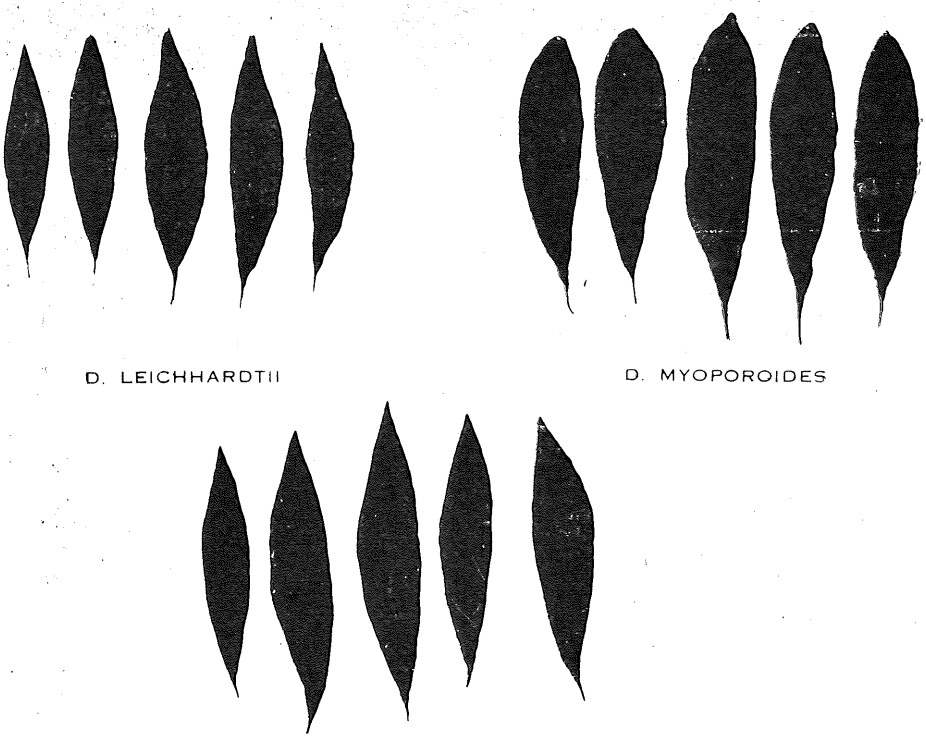


Figure 5
Leaf silhouettes of *D. leichhardtii*, *D. myoporoides*, and first generation hybrid (Cross 1).

The leaves of the parent species differ also in other characters, such as colour and texture. While these do not lend themselves to accurate determination, it is considered that in both respects Crosses 1, 3 and 4 are closer to *D. leichhardtii* and Cross 2 resembles *D. myoporoides*.

The parent species also differ in certain physiological characters, including resistance to frost, tolerance of waterlogging, and the nature of the alkaloids present in the leaves.

The hybrid appears to possess the frost resistance of the *D. leichhardtii* parent, as it has survived the Canberra (latitude 35° 12″ S.) winter equally

well. Under conditions of waterlogging at Nambour it was superior in survival and subsequent growth to the badly affected *D. leichhardtii*. The general impression gained was that the hybrid made better growth, even under adverse conditions, than did either parent.

Leaf samples were taken from six of the trees of Cross 1 on several occasions and from Crosses 2, 3 and 4 on two occasions. The samples were assayed by a modification of the method described by Loftus Hills, Trautner and Rodwell (1945).

In the Nambour area, *D. myoporoides* produced hyoscine and hyoscyamine, the percentage of the former alkaloid being higher in the Nambour material than in plants grown at either Yarraman or Canberra.

In Cross 1 the quantity and type of alkaloids varied from tree to tree and from time to time, but the variations were not consistent. In most cases the percentage of total alkaloids was as great as, or greater than, that of either parent. The tendency to produce hyoscamine was greater than in the *D. leichhardtii* parent, though in some instances only hyoscine was identified. One tree was outstanding in that it gave, in all assays, a higher percentage of total alkaloids than either parent and consistently had hyoscyamine as the major alkaloid.

The samples from Crosses 2, 3 and 4 also showed a tendency to yield a greater quantity of alkaloids than either parent, but hyoscine was the dominant alkaloid in all cases except in one sample from Cross 3, where hyoscine and hyoscyamine occurred in about equal proportions.

Variation appears to exist in the hybrid material, indicating the need for further study. The several F1's are being propagated vegetatively for this purpose. Some similarity between hybrids and intermediates is evident but their exact relationship cannot be determined at this stage. An F2 generation is being raised and the segregates are expected to shed further light on the subject.

REFERENCES

Bailey, F. M. 1901. The Queensland Flora Pt. IV. (pp. 1096-7). Brisbane: H. J. Diddams and Company.

Loftus Hills, K., Trautner, E. M., and Rodwell, C. N. 1945. A preliminary report upon variation in the nature and quantity of the main alkaloids in *Duboisia myoporoides* and *Duboisia Leichhardtii*. J. Counc. Sci. Ind. Res. (Aust.) 18: 234-53.