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## A WINGED FRUIT FROM THE TERTIARY OF QUEENSLAND

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A 5-winged fruit from Miocene sediments near Kingaroy, southeast Queensland possesses characters consistent with those of fossil and living apetalous members of *Ceratopetalum* Sm. A flower-like specimen from a similar stratigraphic horizon at a nearby locality is also reminiscent of *Ceratopetalum*, but characters diagnostic of the genus are not preserved. □ *Winged fruit, fossil, Tertiary, Queensland, Australia.*

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A radially symmetrical fossil plant structure comprising five spatulate wings arranged at right angles to the vertical axis and resembling fruits of *Ceratopetalum* Sm. (Cunoniaceae) recently has been recovered from Tertiary sediments near Kingaroy, southeast Queensland. Part and counterpart of the fruit are exposed following splitting of the sediment irregularly along the lateral plane between the upper and lower surfaces of the fruit. Imperfect outlines of the wings and indications of their venation and attachment to a central ovary are displayed. None of the organic matter has survived, but some has been replaced by limonite.

*Ceratopetalum* fruits in the Australian fossil record were first recognised by Holmes & Holmes (1992) who allocated their species, *C. priscum*, to *Ceratopetalum* after detailed comparisons with fruits of extant species. They demonstrated that sepal venation pattern was a useful discriminatory criterion and concluded that a 5-winged specimen allocated by Ettingshausen (1883) to *Getonites wilkinsonii* Ettings. is also a fossil representative of *Ceratopetalum* rather than having affinities with the Combretaceae as originally suggested. The relationship of the fossil fruits with *Ceratopetalum* was reaffirmed by Barnes & Hill (1999) who described two further species, *C. westermanii* and *C. maslinensis*, from the Tertiary of southeastern Australia.

No other fruits having 4-6 wings are known from Australian Cainozoic sediments in contrast to their frequent representation in Tertiary sediments of Europe, North America, and Asia. Although all the Northern Hemisphere forms are superficially similar in gross morphology, investigation of their ovaries and wing characters has revealed they are taxonomically diverse.

Among the fossil taxa reported (Manchester & Crane, 1987; Manchester, 1991; Manchester & Hably, 1997; Hably & Manchester, 2000; Wang & Manchester, 2000) are *Asterocarpinus*

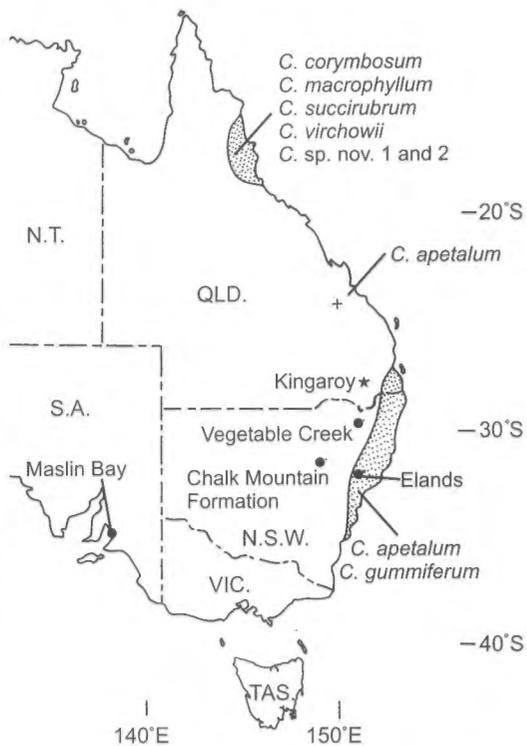


FIG. 1. Map of eastern Australia showing distribution of extant species of *Ceratopetalum* and localities from which fossil fruits of *Ceratopetalum* have been reported (after Barnes & Hill, 1999). + distribution record fide A. Rozefelds; \* Kingaroy fossil locality.

Manchester & Crane (Betulaceae), *Chaneya* Wang & Manchester (Simaroubaceae), *Cruciptera* Manchester (Juglandaceae), *Raskya* Manchester & Hably (family affinities possibly with Simaroubaceae), and an extinct member of *Tetrapterys* Cav. emend. A. Juss. (Malphigiaceae).

Notwithstanding imperfect preservation of the fruit fossil from Kingaroy, sufficient characters are represented for comparisons with fruits of *Ceratopetalum* and those of extant and fossil members of several other families.

#### LOCATION AND AGE

The specimen was collected along with other plant fossils from a ~30cm thick outcrop of ironstained mudstones overlying a thin band of coarse sandstones beneath some 50cm of volcanogenic breccia south of Kingaroy (QML1329 at 26°35'18.6"S 151°56'32.1"E; Fig. 1). Cainozoic sediments in the Kingaroy district formed in small lacustrine basins within an extensive palaeodrainage system, and are considered part of the Tertiary Main Range Volcanics (Sawers & Cooper, 1986), which have been dated as 22-24 my.

#### SYSTEMATIC PALAEOBOTANY

Family CUNONIACEAE  
*Ceratopetalum* Sm., 1793

TYPE SPECIES. *Ceratopetalum gummiferum* Sm.

*Ceratopetalum* sp.  
(Figs 2, 3A-F, 4A-D)

**DIAGNOSIS.** Fruit radially symmetrical with five wings disposed in a plane at right angles to a semi-inferior ovary; the wings arise from the margin of a short tube and have longitudinally aligned primary vascular bundles that branch distally to form an imperfect reticulum.

**DESCRIPTION.** Limonite stained impression of a 5-winged fruit that has split between the upper and lower surfaces of the perianth members that arise from the circular margin of a receptacle ~2 mm in diameter. Calyx members fused at base, lobes spatulate in outline, ~7 mm long, ~4 mm wide and each with 7-9 longitudinal vascular bundles, the central of which enter the receptacle whereas the laterals unite with corresponding bundles in the adjacent lobes below their common sinus. Vascular bundles dichotomise in distal regions of sepals and some of the secondary veins fuse to form an imperfect reticulum.

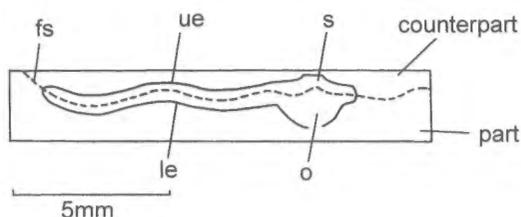


FIG. 2. Transverse section of sediment in which the Kingaroy specimen of *Ceratopetalum* (QMF51124) is preserved (diagrammatic). fs, fracture surface; le, lower epidermis; o, ovary; s, style base; ue, upper epidermis.

Petals not observed. Ovary incompletely preserved; fracture surface concave on part and convex on counterpart. Diameter of fruit 17.5mm.

**DISCUSSION.** Propeller-like fruits superficially resembling those of the impression occur in many species of dicotyledons distributed amongst at least 12 families belonging to the Rosid, Asterid, and Caryophyllid clades (Magallón et al., 1999). The widespread taxonomic distribution of taxa with such fruits is evident in the sample of extant and fossil genera listed in Table 1. Of those genera only *Ceratopetalum* possesses the set of characters exhibited by the fossil described above which is thus assigned to that genus for the following reasons. The ovary though incompletely preserved is interpreted as semi-inferior as the sepaline whorl arises from the receptacle, and not the pedicel (Fig. 3C,E; Fig. 4B); the sepals arise initially as a short tube from the margin of which develop five lobes; the primary vascular bundles of the sepals are of two kinds in that the central members enter the receptacle but the laterals of adjacent lobes unite in the tissue below their common sinus (Fig. 3C,F; Fig. 4B,C) and in distal regions of the sepals the vascular bundles dichotomise, the dichotomies forming an imperfect reticulum (Fig. 4D); the sepals are constricted at their bases (Fig. 3A,B; Fig. 4A,B). This character set also occurs in *Aphanopetalum* Endl. formerly regarded as closely related to *Ceratopetalum* (Bentham, 1864) but now considered belonging to a clade with *Tetracarpaea*, Haloragaceae and Penthoraceae (Savolainen et al., 2000) or to the Saxifragales (Bradford & Barnes, 2001), but not in other extant and fossil taxa studied with superficially similar 4-6 winged fruits (Table 1). The impression has been assigned to *Ceratopetalum* rather than

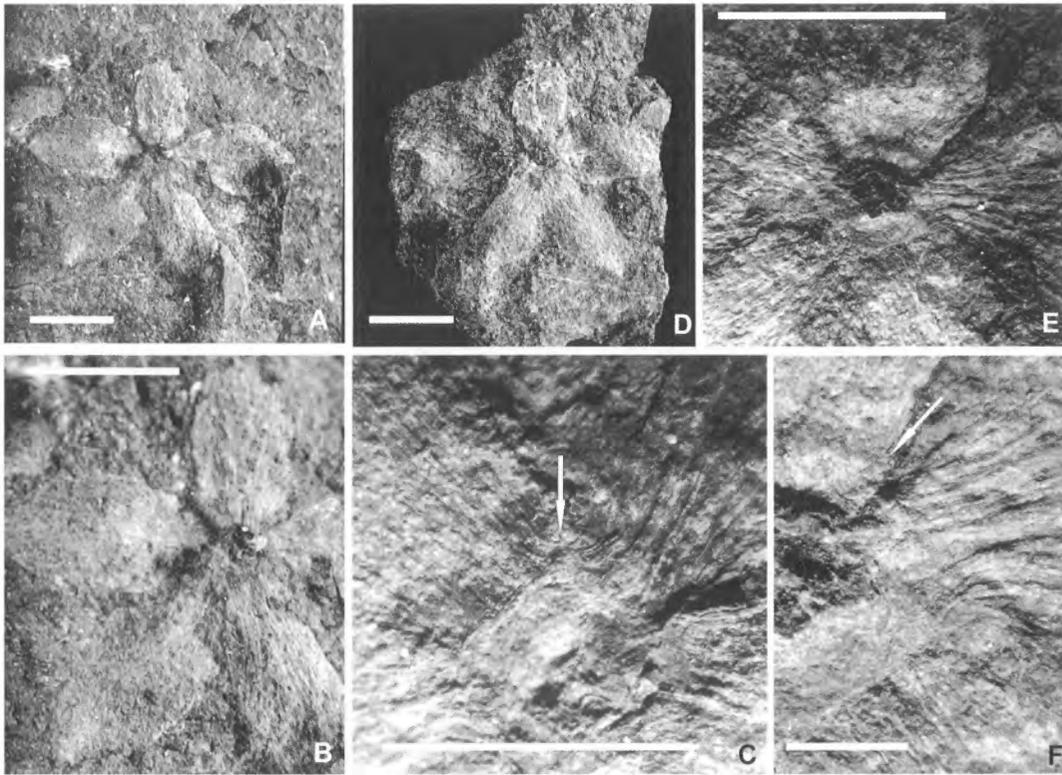


FIG. 3. Fossil fruit of *Ceratopetalum* sp., specimen QMF51124 (A-C) and counterpart (D-F). A, B, showing 5 sepals and impression of ovary, scale bars = 5mm. C, detail of bases of sepal lobes showing vascular traces, and fusion of laterals of adjacent sepal lobes (arrow) near the ovary, scale bar = 2.5mm. D, E, showing venation of sepal lobes and ovary of counterpart, scale bars = 5mm and 2.5mm respectively. F, central area of fruit near ovary showing fusion of lateral vascular strands of adjacent sepal lobes (arrow), scale bar = 1mm.

*Aphanopetalum* because the latter has four rather than five wings, which are commonly represented in the former genus (Dickison, 1975).

The Kingaroy specimen lacks petals and possesses 7-9 longitudinal primary veins in each sepal lobe and in these respects resembles more closely fruit of extant *Ceratopetalum succirubrum* and *C. virchowii* than fruits of other extant members of the genus. The apetalous fossil taxa, *C. westermanni* Barnes & Hill and *C. maslinensis* Barnes & Hill, differ in possessing sepal lobe venation of three traces. Other described fossil taxa, *C. priscum* Holmes & Holmes and *C. wilkinsonii* (Ettings.) Holmes & Holmes, differ in possessing petals. Although distinct from other fossil taxa we prefer not to institute a formal species pending recovery of further and better preserved specimens.

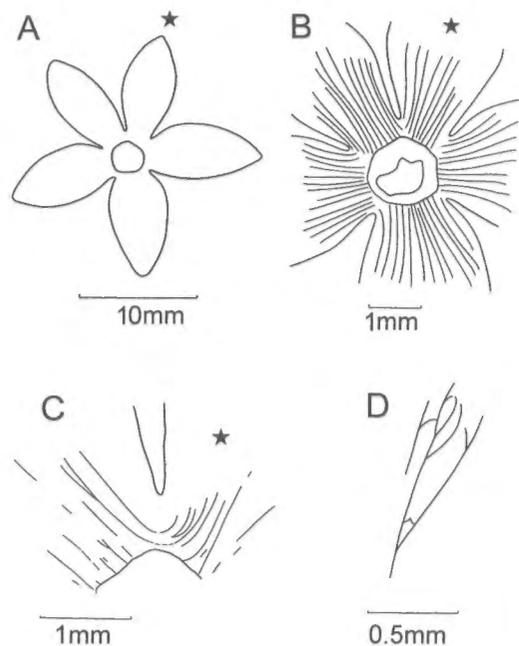
A limonite compression designated as 'compositaceous compound head' (Hill et al.,

1970, pl. Cz X1, fig. 3; UQF10731) from a nearby locality at Goodyer, some 10km S of Kingaroy has sepal-like structures which in shape and size resemble those of fruits of *Ceratopetalum* (Fig. 5A,B). However, neither the venation pattern nor the structure of the central portion of the fossil has been preserved and so the affinities of the fossil remain in doubt.

Nevertheless, the Kingaroy fruit identified as *Ceratopetalum* sp. confirms the genus in the Queensland Tertiary and extends its known fossil range northwards by some 3° of latitude. Previous reports of fossil fruits of the genus are from Tertiary sediments in South Australia (Christophel & Blackburn, 1978; Christophel, 1994; Barnes, 1999; Barnes & Hill, 1999) and New South Wales (Ettingshausen, 1883; White, 1990; Holmes & Holmes, 1992).

Table 1. Wing and ovary characters of genera with fruits superficially resembling those of *Ceratopetalum*. (e) = extant; (f) = fossil.

Genus	Family	Ovary	No., derivation of wings	Calyx lobes free/united at base	Venation		
					Lateral veins of adjacent lobes united	Number of primary veins/lobe	Vein branching
<i>Ceratopetalum</i> Sm. (e. & f.)	Cunoniaceae	Semi-inferior	4-6, sepals	United	Yes	3-9	Reticulate
<i>Cruciptera</i> Manchester (f.)	Juglandaceae	Inferior	4(5,6), sepals	Free	No	15+	Dichotomous
<i>Asterocarpinus</i> Manchester & Crane (f.)	Betulaceae	Inferior	4-5(6-7), bracts	Free	?	1	Pinnate
<i>Calycopteris</i> Lam. (e.)	Combretaceae	Inferior	5, sepals	United	?	3	Reticulate
<i>Tetrapterys</i> Cav. (e. & f.)	Malphiaceae	Superior	4, bracts	United	No	15+	Dichotomous
<i>Petrea</i> L. (e.)	Verbenaceae	Superior	4-6, sepals	United	No	1	Reticulate
<i>Ancistrocladus</i> Wall. (e.)	Ancistrocladaceae	Inferior	5, sepals	United	No	Several	Reticulate
<i>Raskya</i> Manchester & Halby (f.)	?	Superior	4, sepals	Free	No	12-15	Dichotomous
<i>Picrasma</i> Bl. (e.)	Simaroubaceae	Superior	4-5, sepals	United	No	?	Dichotomous
<i>Chaneya</i> Wang & Manchester (f.)	?Simaroubaceae	Superior	5, sepals	United	No	5	Reticulate/ Dichotomous
<i>Porana</i> Burm. (e.)	Convolvulaceae	Superior	5, sepals	Free	No	5	Reticulate
<i>Dinetus</i> Sweet (e.)	Convolvulaceae	Superior	4-5, sepals	Free	No	3	Reticulate
<i>Astronium</i> Jacq. (e.)	Anacardiaceae	Superior	6, sepals	?	?	1-3	Dichotomous
<i>Monotes</i> A. DC. (e.)	Dipterocarpaceae	Superior	5, sepals	United	No	5	Reticulate
<i>Waterhousea</i> B. Hyland (e.)	Myrtaceae	Inferior	4-6, sepals	United	No	3	Reticulate



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FIG. 4. Fossil fruit of *Ceratopetalum* sp., QMF51124. A, outline of fruit. B, detail of preserved ovary and vascular traces at bases of sepal lobes. C, detail of vascular traces below sinus of two adjacent sepal lobes. D, detail of venation in distal region of sepal lobe.

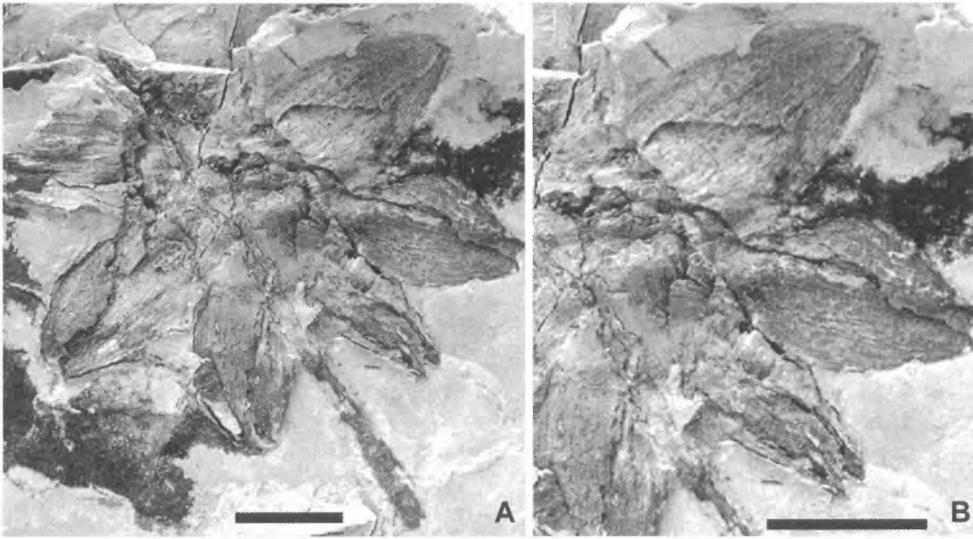


FIG 5. A,B, fossil specimen (UQF10731) having superficial resemblance to fruits of *Ceratopetalum*, but lacking detail of ovary and wing venation. Scale bars = 5mm.

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