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The type of *Acacia aneura* (Mulga: Fabaceae) and ambiguities concerning the application of this name

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Abstract

Maslin, B.R., O'Leary, M., Reid, J.E. & Miller, J.T. The type of *Acacia aneura* (Mulga: Fabaceae) and ambiguities concerning the application of this name. *Nuytsia* 22(4): 269–294 (2012). *Acacia aneura* F.Muell. ex Benth. is a member of a large, taxonomically complex group of plants that are very common in the Australian arid zone. In order to help determine the application of this name the type collection of *A. aneura* at the National Herbarium of Victoria (MEL) is reassessed after visits to the type locality. This collection comprises rather fragmentary specimens mounted on three sheets (MEL 724215, 724218 and 724219), each labelled as having been collected [in 1851] by Ferdinand von Mueller from 'Cudnaka'. This locality is now known as Kanyaka, located in the South Flinders Ranges, South Australia, between Quorn and Hawker. The holotype is confirmed as the depauperate fruiting specimen on MEL 724218. The fertile specimen on MEL 724219 is confirmed as belonging to a Mulga taxon of uncertain status and is not a type. The sterile specimen on MEL 724215 and the sterile specimens on MEL 724219 may or may not be types, but their status cannot be determined with any certainty. The populations at Kanyaka that Mueller presumably visited were sampled by the authors in 2007, 2008 and 2010. Subsequent study showed there to be two distinct Mulga morphotypes in these populations. One morphotype corresponds to the type of *A. aneura* but the status of the second morphotype is uncertain. The latter does not match the fertile specimen on MEL 724219 and appears not to have been collected by Mueller; it may possibly represent a hitherto undescribed species. The taxonomic status of the first morphotype, and hence the application of the name *A. aneura*, is currently uncertain. Further field, morphological and genetic studies, especially of South Australian populations, are needed to resolve the application of the name *A. aneura* and also to establish the status of the second morphotype collected from the type locality.

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Background

Mulga is a large, variable and taxonomically complex group of plants allied to *Acacia aneura* F.Muell. ex Benth. that dominate significant areas of the vast Australian arid zone. The term Mulga is also used to describe vegetation communities in which these species predominate. The accompanying revision of Mulga in Western Australia by Maslin and Reid (2012) recognises 12 variable species as occurring in that State. While the taxonomy of Mulga is perhaps most complex in Western Australia the group also presents significant unresolved taxonomic challenges in the other mainland States.

The name *A. aneura* is based on material collected by Ferdinand von Mueller in 1851 from 'Cudnaka', now known as Kanyaka, in the South Flinders Ranges, South Australia, about 40 km north of Quorn on the road to Hawker. Mueller's collection is lodged at the National Herbarium of Victoria (MEL) and comprises a number of rather fragmentary specimens mounted on three separate sheets, namely, MEL 724215 (single sterile specimen), 724218 (single immature fruiting specimen) and 724219 (five sterile specimens and a single immature fruiting specimen). The specimen on MEL 724218 was regarded as the holotype of *A. aneura* by Pedley (2001) and the remaining material regarded as isotypes. However, the material contains discordant elements and not all the specimens were used when Bentham (1855) first described *A. aneura.* Clarification of these matters is important because the name *A. aneura* has been widely applied to plants of the Mulga group.

Accordingly, the aims of this paper are (1) to clarify the application of the name *A. aneura* by re-examining the type collection of the species at MEL and (2) to identify and characterize the particular entity of Mulga to which this name applies through field study at the type locality.

Original collection and description of *A. aneura*

From late September to mid-November in 1851, Mueller undertook a self-funded plant collecting expedition to the interior of South Australia. He departed Adelaide on about September 25th, travelling north to Crystal Brook and Mt Remarkable, inland to the southern tip of Lake Torrens and east to the southern slopes of Wilpena Pound before returning to Adelaide via Arkaba, Kanyaka, the Burra Burra Mine, Rocky River near Crystal Brook and Tanunda (where he arrived around November 12th). Details of this trip are given in Grandison (1990). It is the Kanyaka locality (Figure 1) which is of special interest to the present work because it was during Mueller's two day visit here that he made his collection of *A. aneura*.

The 'Kanyaka' run was a cattle station located about 40 km north of Quorn on the road to Hawker. It was established on July 1st 1851 (just three months prior to Mueller's visit) by the pastoralist Hugh Proby who died the following year while attempting to cross a flooded creek in the area. Kanyaka was obviously a prosperous enterprise because from the 1850s to the 1860s it is reported to have supported 70 families. It is not known what buildings existed at Kanyaka when Mueller was there but they were most probably temporary structures, not the substantial colonial homestead (constructed by 1855) or the stone shepherd's hut situated on the banks of Kanyaka Creek, the ruins of which can be seen to this day.

Located about 1 km to the east of the Kanyaka homestead ruins is the Black Jack Range (Figure 2), a low rocky range on the western face of which grow two adjacent populations of Mulga separated by an indistinct, low rocky spur (Figures 1B, 3). These are the only stands of Mulga in the immediate vicinity of Kanyaka and are the most southerly known occurrences of Mulga in the Flinders Range. The populations are clearly visible from the ruins of the old Kanyaka homestead and it is quite possible that Mueller gathered his Mulga specimens from one or other of these populations.

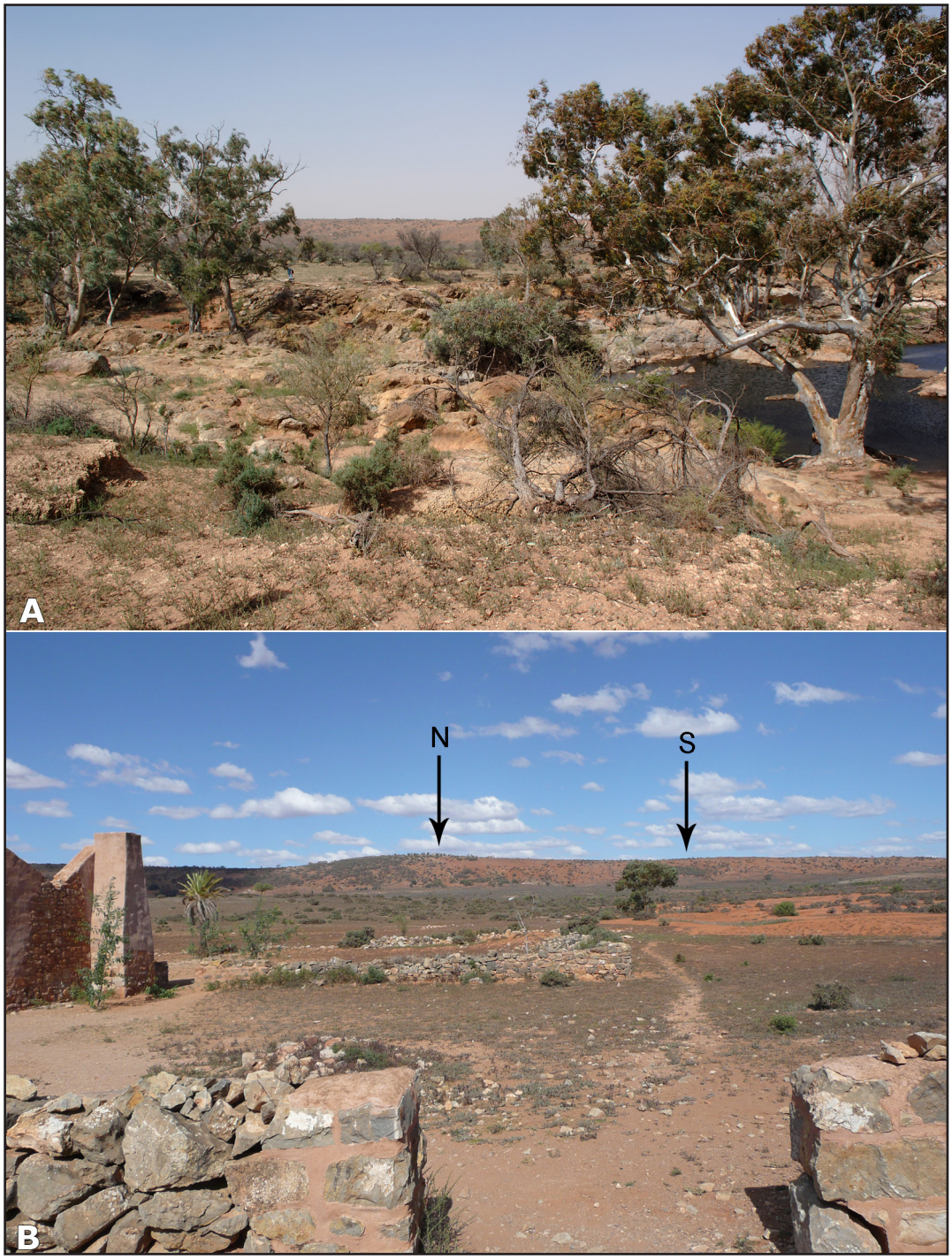

Figure 1. Kanyaka, type locality of *Acacia aneura*. A – Kanyaka Creek near ruins of Kanyaka homestead, with Black Jack Range in distance; B – Black Jack Range from ruins of shepherd's hut on former Kanyaka station showing two Mulga populations (northern – N and southern – S; see Figure 3 for closer view. Mueller presumably collected the type of *A. aneura* from one or other of these populations. Photographs by B.R. Maslin (A) and M. O'Leary (B).

Figure 2. Views of Black Jack Range, 1 km east of Kanyaka ruins. A – *B.R. Maslin & J.E. Reid* BRM 9572 collection site looking north; B – *B.R. Maslin & J.E. Reid* BRM 9580 collection site looking north. Photographs by B.R. Maslin.

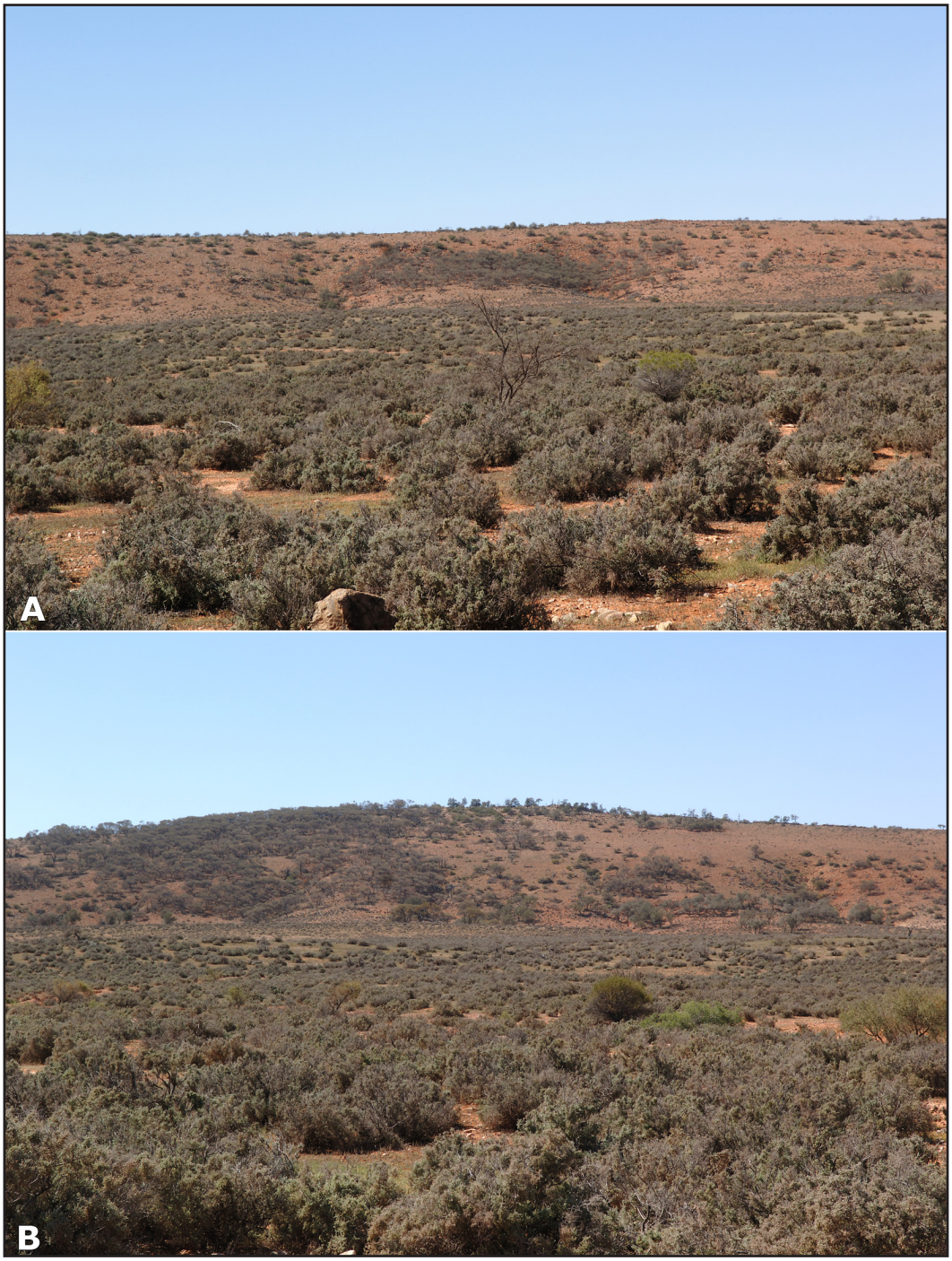

Figure 3. Mulga populations on Black Jack Range, 1 km east of Kanyaka ruins. A – southern population from which *B.R. Maslin & J.E. Reid* BRM 9572–9574 were collected (the northern population is to the left of this image); B – northern population from which *B.R. Maslin & J.E. Reid* BRM 9575–9580 were collected (the southern population is to the right of this image). Mueller presumably collected the type of *A. aneura* from one or other of these populations. Photographs by B.R. Maslin.

In August 1852 Mueller left South Australia for Victoria where he became the first Colonial Botanist (a position he held until his death in 1896). In the early 1850s Mueller sent his Mulga specimens (together with other South Australian wattles that he had collected) to George Bentham at the Royal Botanic Gardens, Kew, in London. Using this material Bentham published, in 1855, the original description of *A. aneura* citing 'Cudnaka' as the place of collection. This was quite an achievement for the times because it took only four years for this species to be formally described in a scientific journal on the other side of the world from where it had been collected. Mueller's specimens were subsequently returned to the National Herbarium of Victoria (MEL) where they reside today (none were retained at Kew).

The type of *A. aneura*

At MELthere are three sheets each with between one and five small specimens that hitherto have been regarded as types of *A. aneura*. These sheets are identified by MEL identification numbers 724218 (Figure 4), 724219 (Figure 5A) and 724215 (Figure 5B), and support specimens that are either sterile (i.e. without flowers or fruits) or bear immature pods. Each sheet has a label written in Mueller's hand indicating that the specimens were collected from 'Cudnaka'; on the reverse side of one label (on MEL 724218, Figure 4) is inscribed a small 'B' which indicates that Bentham saw the specimen to which the label refers[1]. Close examination of the two small fruiting specimens (which are mounted on separate sheets, namely, MEL 724218 – Figures 4, 6A–E and MEL 724219 – Figures 5A, 6F) shows that although the pods are immature they are clearly morphologically different, and were undoubtedly collected from different plants and almost certainly represent two different Mulga taxa. A description of the two fruiting specimens is given in Appendix 1. The most obvious difference between them is that the pods on MEL 724218 (labelled as the holotype of *A. aneura* by Pedley) are longer and differently shaped than those on MEL 724219 (labelled an isotype of *A. aneura* by Pedley). There are also important differences involving the pod margins, with those on MEL 724218 being rimmed or bevel-edged by an evident nerve along the dorsal and ventral margins close to the outer edge of the pods (Figure 6D) whereas on MEL 724219 this nerve is well-displaced internal to the outer edge so that the pods are winged (Figure 6F). Furthermore, the pods on MEL 724218 are often slightly shiny, obscurely reticulately nerved and together with the branchlets are glabrescent, whereas on MEL 724219 the pods are dull with a slightly more pronounced reticulum and together with the branchlets are more obviously hairy. There are no pods (or flowers) on the third sheet, MEL 724215 (Figure 5B).

From a taxonomic viewpoint the two most important questions relating to the MEL collection are (1) which of the specimens is the type of *A. aneura* and (2) whether Mueller collected more than one Mulga entity at Kanyaka?

Comparing Bentham's original description of *A. aneura* with the above two fruiting specimens it is almost certain that he used the specimen on MEL 724218, i.e. the specimen with long pods (Figures 4, 6A–E) to prepare his account. The most important features of this specimen that support this conclusion are its glabrescent branchlets and its narrowly oblong pods that are 30–40 mm long (in

[1]Until around the 1960s the Melbourne specimens and their labels were stored loose in papers, not affixed to herbarium sheets as they are today. Consequently, prior to them being mounted there existed a possibility that specimens or labels could become misplaced or mixed-up. While there is no way of knowing if anything untoward happened to Mueller's 'Cudnaka' material of *A. aneura* before it was mounted, it must always be kept in mind that this was a possibility.

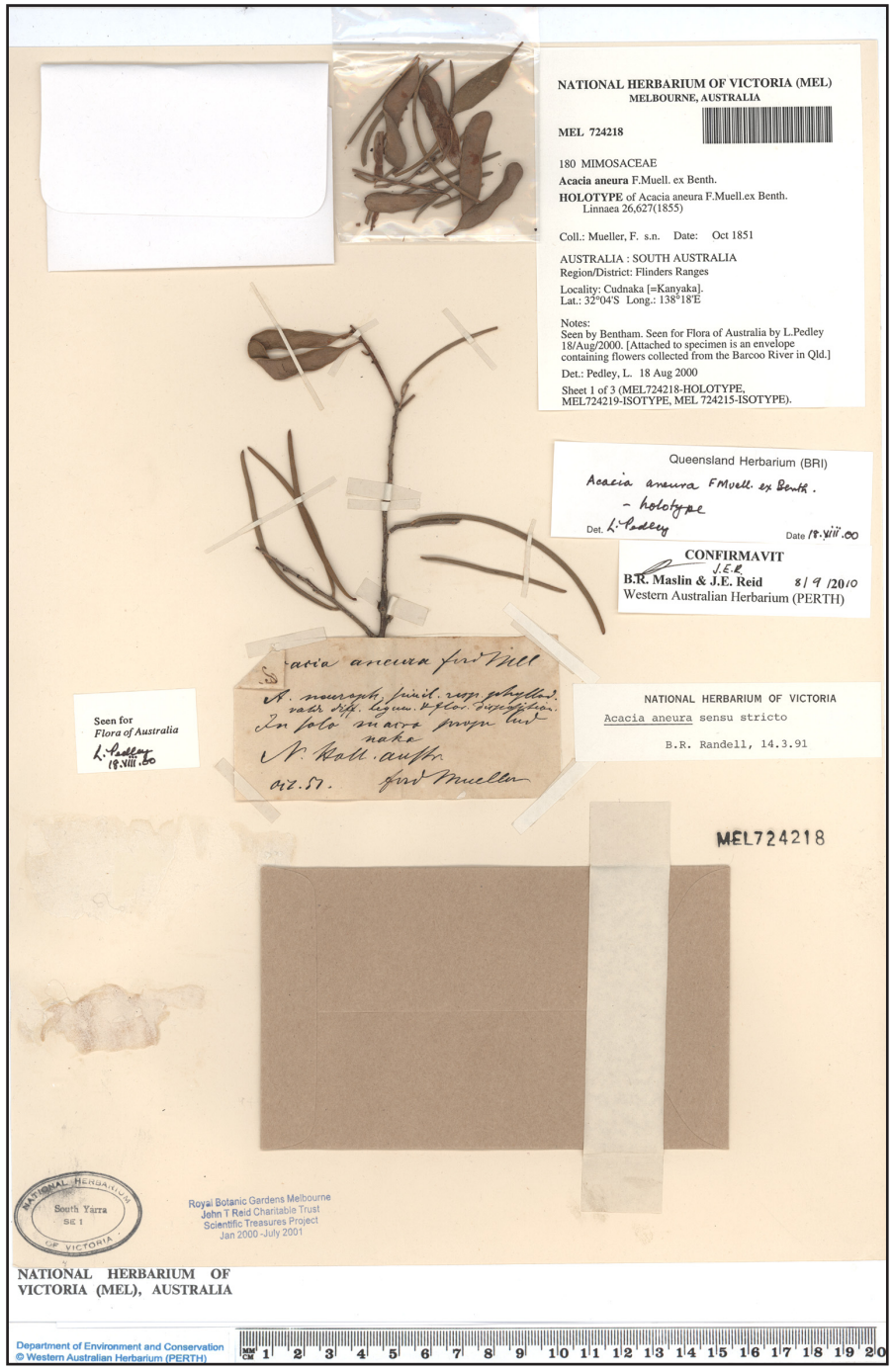

Figure 4. Holotype of *Acacia aneura* at the National Herbarium of Victoria, Melbourne (MEL 724218). Specimen details are shown in Figure 6A–E.

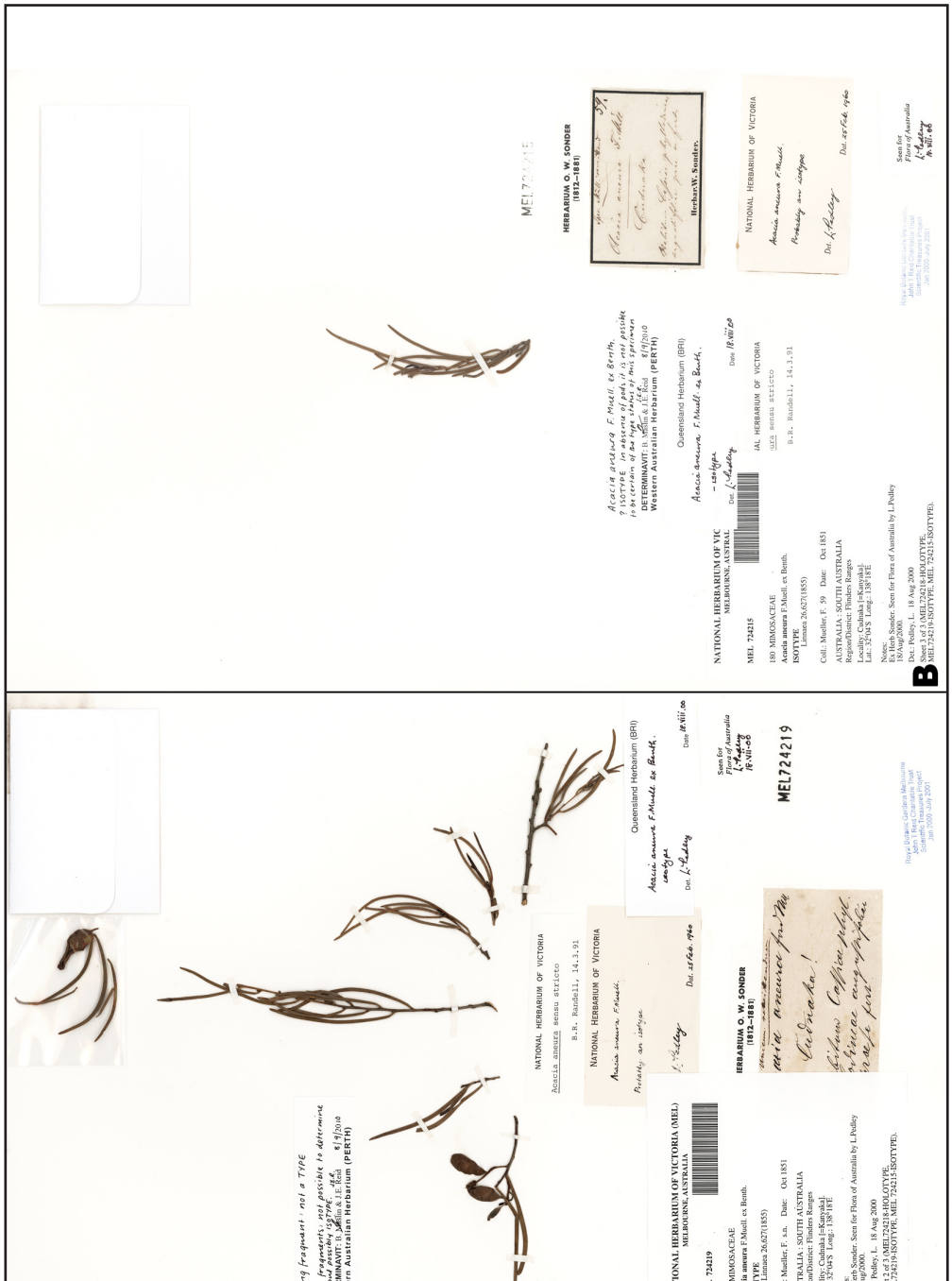

Figure 5. Specimens at the National Herbarium of Victoria, Melbourne that are purported to have been collected from Cudnaka (= Kanyaka) and were determined as isotypes of *Acacia aneura* by L. Pedley on August 18th 2000. A – MEL 724219, the fruiting fragment on this sheet is unlikely to be a type, the type status of the sterile fragments cannot be determined; B – MEL 724215, in the absence of pods it is not possible to determine the type status of this fragment (but it is possibly an isotype).

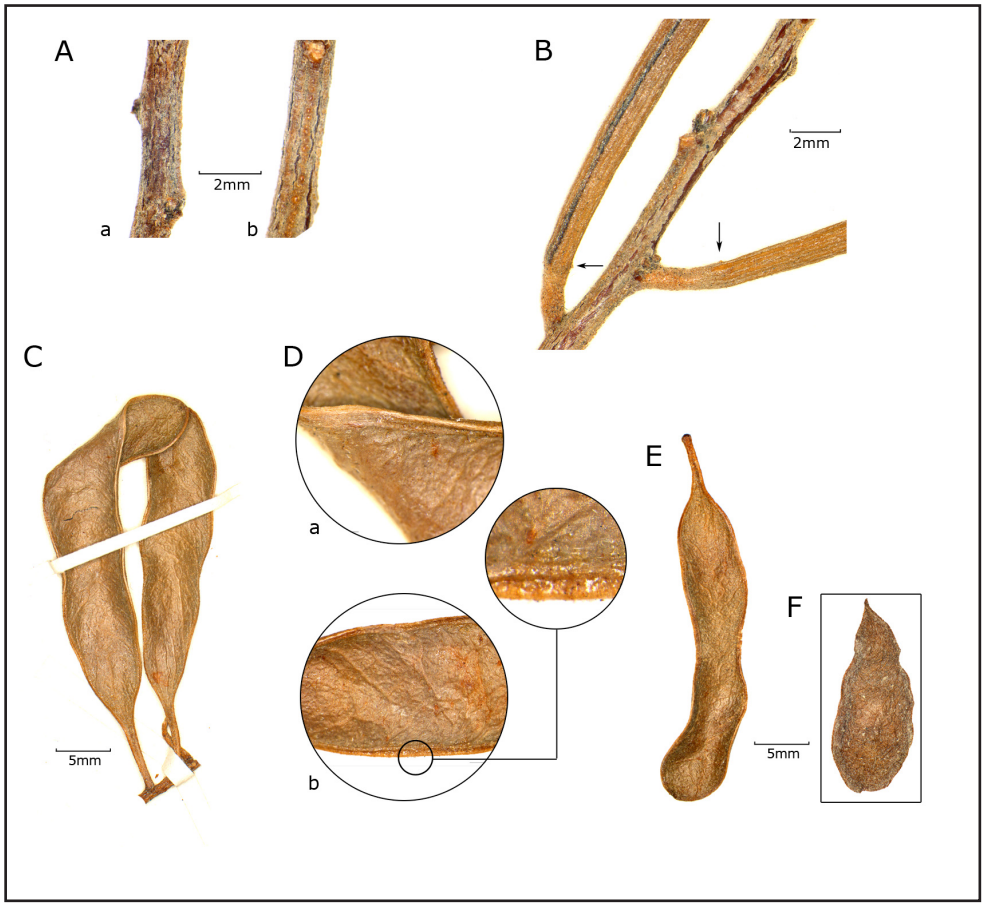

Figure 6. Details of holotype of *Acacia aneura* (MEL 724218) from specimens shown in Figure 4 (A–E) and pod from fruiting specimen on MEL 724219 shown in Figure 5A (F). A – upper branchlets glabrous and with a thin overburden of presumably translucent resin; B – phyllodes showing near-basal gland (arrowed); C – pods attached to holotype specimen; D – close-ups of bevel-edge margins on pods, note marginal nerve slightly displaced from outer edge of pod; E – pod from packet on holotype specimen; F – pod winged and more obviously hairy than C–E pods, also note size and shape difference. Scale bars shown on figure.

the protologue Bentham described the pods of *A. aneura* as 'oblongo-lineari' and 1–1.5 poll. long, i.e. about 25–40 mm). Furthermore, the label on MEL 724218 bears Bentham's 'B' insignia. This insignia does not appear on the MEL 724219 label. As to the pod specimen on MEL 724219 (Figures 5A, 6F) it is very unlikely that Bentham used this in the preparation of his original description of *A.aneura*. This conclusion is based on the fact that its branchlets are minutely but densely appressed-hairy (branchlets described as glabrous in the protologue) and the pods are oblong-elliptic to obovate and about 15–20 mm long (thus differently shaped and shorter than those described in the protologue). The pod specimen on MEL 724219 is therefore not considered to be a type of *A. aneura* despite having been labelled as isotype by Pedley on August 18th 2000. As already noted, it is probable that this fruiting specimen on MEL 724219 represents a different taxon to that of the holotype. While it is intriguing to speculate about its provenance (see discussion below) this matter is irrelevant to the application of the name *A. aneura*, notwithstanding Pedley's annotation.

As to the small sterile specimen on MEL 724215 (Figure 5B), we are unable to determine its type status because in the absence of pods we cannot say with certainty whether it belongs with MEL 724218

or MEL 724219, or perhaps neither. This specimen had been labelled as an isotype of *A. aneura* by Pedley. Similarly, we cannot be certain of the identity of the sterile specimens that are mounted on the fruiting specimen on MEL 724219.

Accordingly, the pod specimen on MEL 724218 is regarded as the holotype of *A. aneura* and is correctly annotated as such by Pedley (Randell's 1992 lectotypification of this name is regarded as unnecessary). It is the taxon represented by this specimen to which the name *A. aneura* must be applied. While at least some of the sterile specimens on the remaining MEL sheets are quite possibly the same taxonomic entity as the holotype, it is not possible to be certain.

Mulga at Mueller's Kanyaka type locality (2007–2010)

The *A. aneura* type locality at Kanyaka was visited by us on 1st October 2008 with the aim of trying to identify plants that match the holotype of *A. aneura* and, if possible, the taxon represented by the fruiting specimen on MEL 724219. Material was also collected for genetic analysis.

As already noted, there are two adjacent populations of Mulga on Black Jack Range about 1 km to the east of the present day Kanyaka ruins; these populations are referred to herein as the southern and northern populations and are shown in Figures 1B and 3. Mulga plants were common in both these populations but were more numerous in the larger, northern one. Prior to our visit many inland areas of arid Australia had been experiencing prolonged drought and as a consequence none of the plants that we sampled were with pods or flowers. Nevertheless, we were able to collect sterile specimens (plus a few old pods from the ground) and phyllodes for genetic analysis, and to familiarise ourselves with the range of variation in the growth form of the plants. In 2007 the second author had made an exploratory visit to the location and was able to collect near-mature pods from plants in the southern population and during a subsequent visit in 2010 mature pods from plants in both the northern and southern populations were collected. The following discussion is based on these 2007, 2008 and 2010 collections.

Judging from habit characteristics observed in the field there appeared to be two main Mulga morphotypes at Kanyaka. For the purpose of this discussion these are referred to as the lower stature morphotype and taller stature morphotype[2]. The former was most common in, but not exclusively confined to, the southern population and the latter most common in, but not exclusively confined to, the northern population. The two morphotypes were occasionally sympatric. Descriptions of these two morphotypes are provided in Appendix 2.

The two morphotypes are distinct and can be distinguished from one another by a number of characters, most notably their growth form and fruits (see descriptions in Appendix 2 and compare Figures 7, 8 and 9A [lower stature morphotype] with Figures 9B, 10 and 11 [taller stature morphotype]). Distinguishing features are as follows. Plants of the lower stature morphotype reach 4 m in height, are single-stemmed or sparingly divided at the base, and often have crooked stems with wide-spreading lower lateral branches sometimes persistent (Figure 7). The mature pods are brown but sometimes tinged orange, resinous (resin covers the entire surface of young pods but is restricted to the marginal zone of mature pods where it occurs as a thin, shiny veneer), glabrous or with a few, minute, appressed hairs, very obscurely reticulate (sometimes almost nerveless) by ±transversely orientated nerves, and rimmed or more commonly bevel-edged on account of a slightly thickened nerve that is located slightly internal

[2]In addition to these morphotypes there occurred in the northern population some stunted, sterile plants about 10 cm tall with very short phyllodes (Figure 12); this diminutive size is assumed to be the result of grazing by animals. Field observations by the second author in 2010 have determined that this stunted form is referable to the taller stature morphotype.

Figure 7. Lower stature morphotype collected by the authors from the southern population at *A. aneura* type locality. A – habit of *B.R. Maslin & J.E. Reid* BRM 9572 (right-hand plant); B – plant near *B.R. Maslin & J.E. Reid* BRM 9572 showing crooked main stem, wide-spreading lower lateral branches and obliquely ascending to erect upper branches; C – branchlet of *B.R. Maslin & J.E. Reid* BRM 9572 showing narrow, flat, mostly shallowly incurved phyllodes. Photographs by B.R. Maslin.

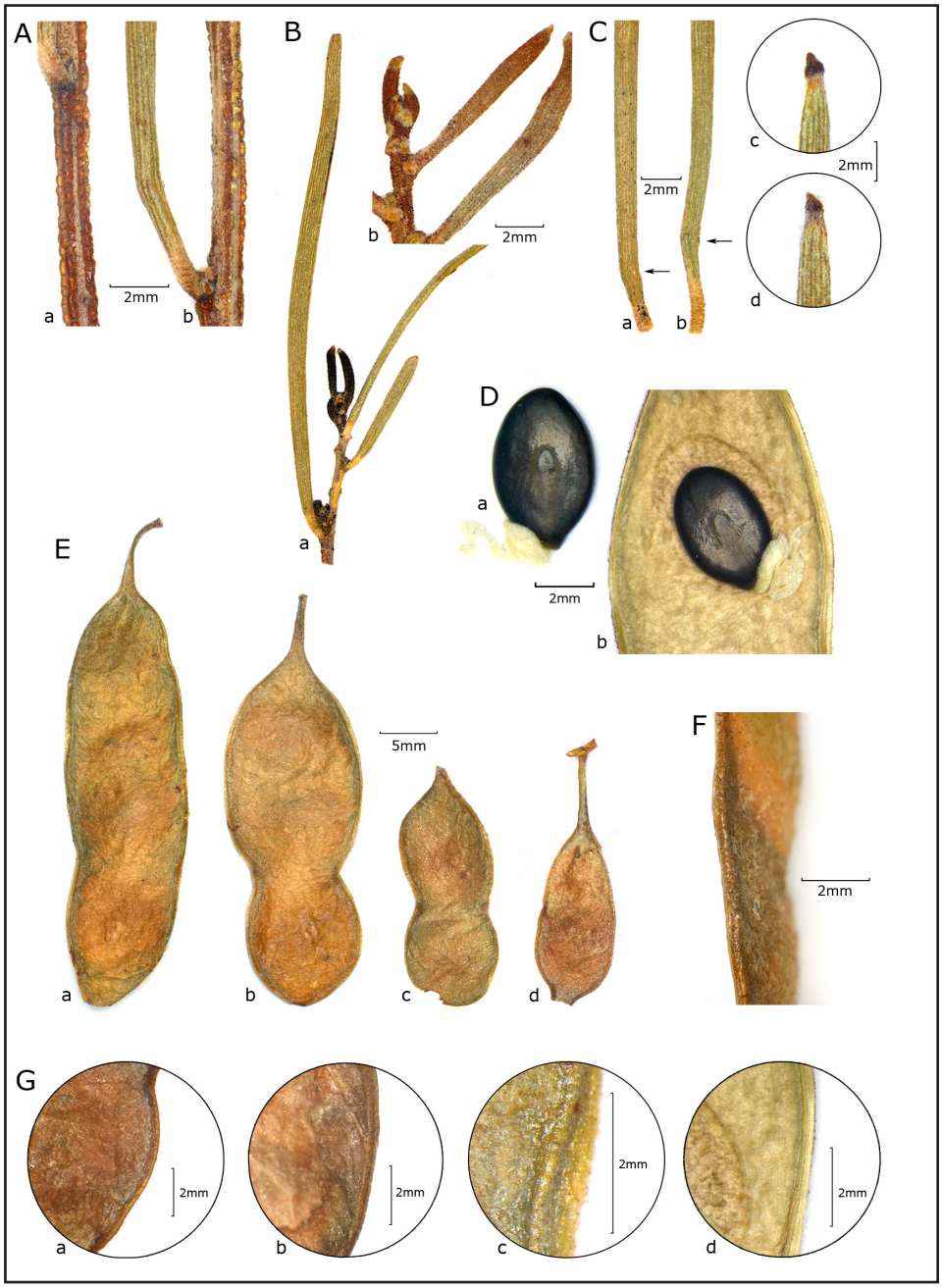

Figure 8. Lower stature morphotype collected by the authors from the southern population at *Acacia aneura* type locality. A – a, b) upper branchlet showing translucent resin over ribs; B – new shoots, a) dark-coloured resinous shoot, b) resin removed to show reddish glandular hairlets; C – a, b) phyllodes showing near basal gland (arrowed) with lamina slightly swollen/kinked at the gland, c, d) phyllode apices shallowly curved; D – a) seed, b) seed in pod; E – pods showing variation in shape and size, stipe broken on pod (c); F – pod rimmed, margin end view; G – pod margin variation, a) pod rimmed with marginal nerve coinciding with outer edge of pod, b) pod bevel-edge with marginal nerve close to outer edge of pod, c) pod bevel-edged with marginal nerve variably displaced from outer edge of pod, (d) pod bevel-edged, internal margin. Scale bars shown on figure; vouchers are listed in Appendix 4.

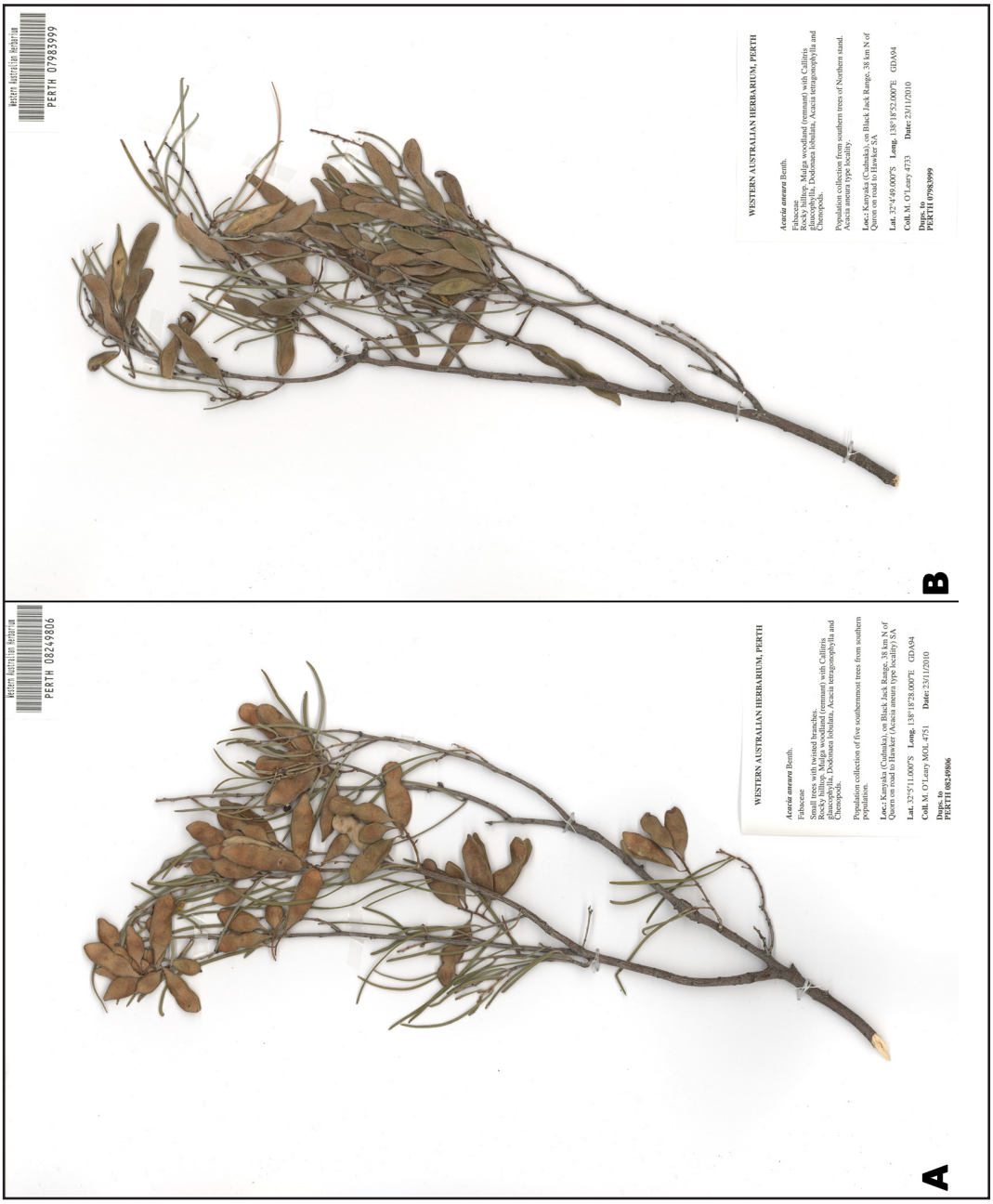

Figure 9. Herbarium specimens of lower stature morphotype (A) and taller stature morphotype (B) of *Acacia aneura*. A – *M. O'Leary* 4751; B – *M. O'Leary* 4733.

Figure 10. Taller stature morphotype collected by the authors from the northern population at *Acacia aneura* type locality. A–B – habit of *B.R. Maslin & J.E. Reid* BRM 9577 (A) and *B.R. Maslin & J.E. Reid* BRM 9580 (B) showing straight stems with no persistent wide-spreading lower lateral branches; C – close up of *B.R. Maslin & J.E. Reid* BRM 9577 straight stems; D – branchlet of *B.R. Maslin & J.E. Reid* BRM 9576 showing narrow, flat, sub-straight to shallowly incurved or wavy phyllodes. Photographs by B.R. Maslin.

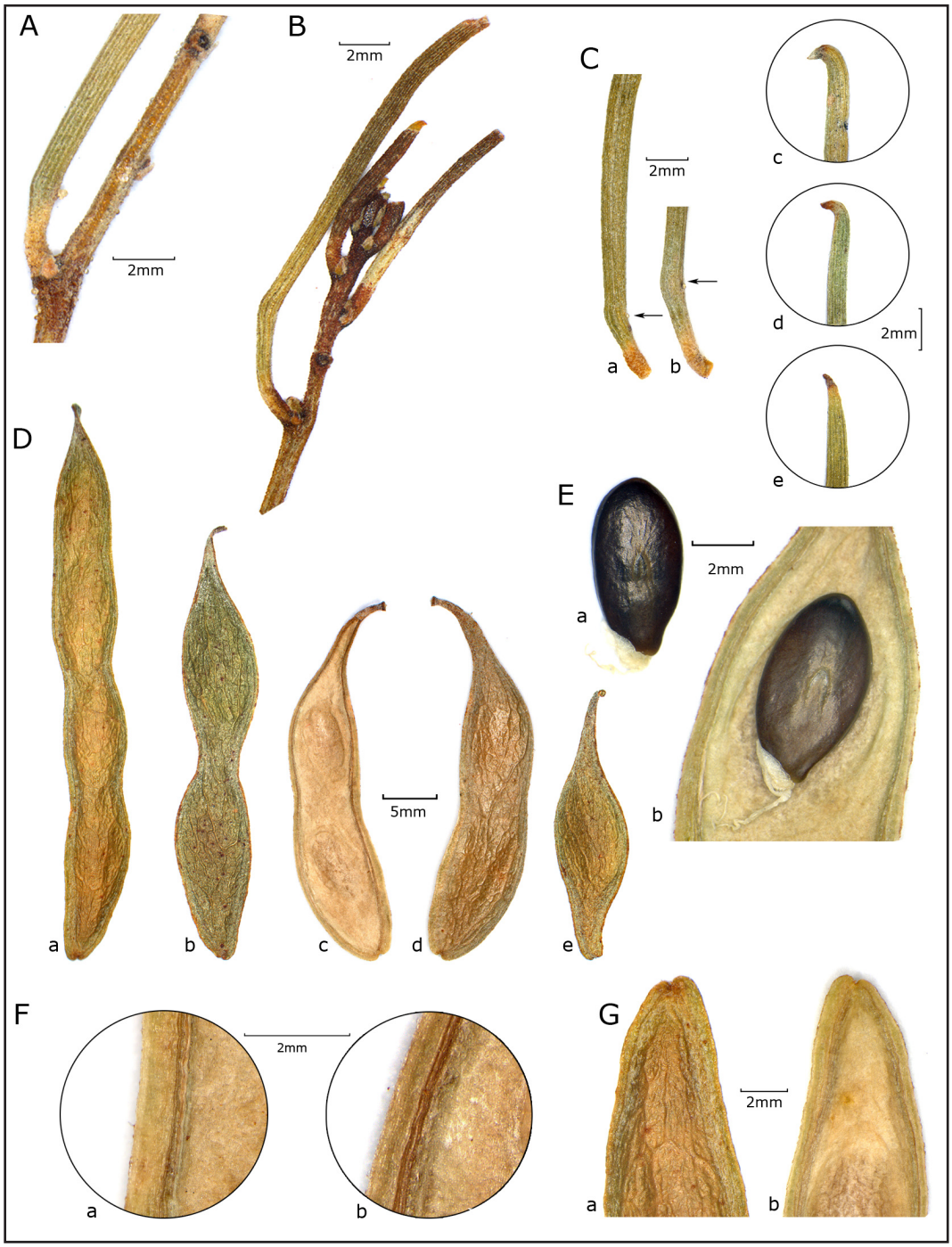

Figure 11. Taller stature morphotype collected by the authors from the northern population at *Acacia aneura* type locality. A – upper branchlet showing translucent resin over ribs; B – new shoot dark-coloured and resinous; C – a, b) phyllodes showing gland (arrowed) slightly removed from pulvinus and lamina slightly swollen/kinked at the gland, c, d) phyllode apices uncinate, e) phyllode apex curved; D – pods showing variation in shape and size; E – a) seed, b) seed in pod; F – pod wing variation; G – a) pod wing obscure on external side of pod, b) pod wing more obvious on internal side of pod. Scale bars shown on figure; vouchers are listed in Appendix 4.

Figure 12. Stunted plant of *Acacia aneura* from northern population dominated by taller stature morphotype shown in Figure 10. Dwarf stature due to grazing by animals. Photo of *B.R. Maslin & J.E. Reid* BRM 9578 by B.R. Maslin.

to the outer edge of the pod; the seeds are 4–5 mm long (Figures 8, 9A). Plants of the taller stature morphotype on the other hand reach 8 m in height, are normally multi-stemmed at or near the base and have straight stems with no persistent wide-spreading lower lateral branches (Figure 10). The pods are greyish brown, not resinous (except for a slight veneer of resin along the outer edge of the margin), minutely appressed-hairy along the margins (indumentum denser than above), finely but discernibly reticulate (the nerves slightly raised and clearly longitudinally orientated) and importantly, are narrowly winged by an intra-marginal nerve located 0.4–0.9 mm from the outer edge of the pod (this character is best observed by viewing the internal surface of the valves); the seeds are longer than those of the lower stature morphotype (mostly 6–7 mm) (Figures 9B, 11). While the upper branchlets of both morphotypes may possess translucent resin overtopping the ribs, those of the lower stature morphotype are less obviously hairy between the ribs than those of the taller stature morphotype. Also, in the lower stature morphotype the phyllodes appear to be morphologically quite uniform in being flat, relatively short, narrow, slightly thickened and shallowly incurved with normally straight apices (Figure 8Cc–d). While the phyllodes of the taller stature morphotype are sometimes similar they are more variable, ranging from flat to terete and commonly have curved to uncinate apices (Figure 11Cc–e); they are also often longer, wider, less thickened (when flat) and vary from nearly straight to shallowly sigmoid or wavy (this range of variation is sometimes found on a single plant).

Apart from these morphological differences, cpDNA genetic data (Miller *et al*., unpublished data) show the two morphotypes as separate, but located near one another on the same clade along with species of the Mulga Grey-green Alliance as defined by Maslin and Reid (2012).

Comparison of our 2007–2010 Mulga collections from Kanyaka with those of Mueller's 1851 collections

A comparison of our Mulga collections from Kanyaka with those of Mueller at MEL shows that our lower stature morphotype is a good match for the holotype of *A. aneura,* especially with respect to pod characters. Both the holotype (Figures 4, 6A–E) and the lower stature morphotype (Figure 8) have rimmed or more commonly bevel-edged pods that are smooth, ±glabrous and very obscurely reticulate by ±transverse nerves, and rather short phyllodes (mostly 50–75 mm long) that are flat, slightly thickened, shallowly incurved and with normally straight tips. However, the pod margins of the holotype are less obviously resinous than those of the lower stature morphotype; this may be due to the age of the holotype specimen or to curatorial processes following its collection in 1851. Our taller stature morphotype on the other hand differs significantly from the holotype in having winged pods that are discernibly longitudinally reticulate; they are also more obviously and consistently constricted between the seeds and possess a denser indumentum (hairs mostly confined to the marginal area). Also, the phyllodes vary from terete to flat, are often longer (mostly 60–100 mm) and the tips are commonly curved to uncinate (Figure 11). It is regrettable that the holotype does not possess mature seeds because in the lower stature morphotype the seeds are shorter than those of the taller stature morphotype (4–5 mm and 6–7 mm long respectively; compare Figures 8D and 11E).

The depauperate fruiting specimen on MEL 724219 (which, as already noted, is not a type) does not match anything we collected at Kanyaka. Its short, obovate to oblong-elliptic, winged pods are clearly different from those of both our lower stature and taller stature morphotypes. While the provenance and identity of the MEL 724219 specimen are uncertain, this taxon is clearly referable to the Mulga group.

In the absence of pods it is not possible to confidently determine the identity of the sterile, fragmentary specimens on MEL sheets 724215 (Figure 5B) and 724219 (Figure 5A) or to match them with the material we collected.

The identity of *A. aneura* and nomenclatural implications

Based on the above it is evident that the holotype specimen of *A. aneura* (i.e. the fruiting specimen on MEL 724218) and the lower stature morphotype that we collected at Kanyaka represent the same taxon. For the purpose of this discussion this entity will be called *A. aneura sens. typ.* and a description of it is provided in Appendix 3. However, the taxonomic status of *A. aneura sens. typ.* is unclear and therefore the application of the name *A. aneura* is currently ambiguous.

The sterile specimens on MEL 724215 and 724219 may possibly be isotypes of *A. aneura*, but in the absence of pods their identity cannot be confirmed. The fruiting specimen on MEL 724219 is of no type significance. The taller stature morphotype that we collected at Kanyaka represents a different taxon from that of *A. aneura sens. typ.* and will be referred to herein as *A. aneura* (Flinders Range variant); while this entity occurs elsewhere in the Flinders Range (e.g. Paralana Hot Springs, 24 Nov. 1975, *L.D. Williams* 7450, AD) it also occurs away from the Range near Woomera and Koonamore, South Australia, and may possibly represent a distinct, hitherto undescribed species of Mulga.

It is the taxonomic status of *A. aneura sens. typ.* that is of most relevance to the present discussions because this matter affects the application of the name *A. aneura*. Morphological evidence indicates that *A. aneura sens. typ.* is most closely related to *A. aptaneura* Maslin & J.E.Reid, especially because

in both entities the branchlet ribs are sometimes overlain by translucent (not opaque) resin and the plants often retain wide-spreading lower lateral branches (the upper branches are obliquely ascending to erect). The general facies of their pods are similar, but as will be discussed below there are differences relating to the pod margins. Maslin and Reid (2012) describe pods of typical *A. aptaneura* as being smooth, glabrous, ±nerveless or obscurely openly reticulate (nerves ±transverse) and often orange-brown. In these respects *A. aptaneura* pods closely resemble those of *A. aneura sens. typ.* (although in the latter taxon the pods are sometimes very sparsely appressed-hairy). However, there are slight but discernible differences between the two entities in the pod margins, but the taxonomic significance of these differences is not clear. In typical *A. aptaneura* the longitudinal nerve that extends along the dorsal and ventral sides of the pod is obscure and is often overlain by resin; this nerve coincides with the outer edge of the pod valve which is normally rounded (see Figure 16F in Maslin & Reid 2012). Pods having these margin characteristics are termed 'rimmed' (see Maslin & Reid 2012 for discussion). While the pods of *A. aneura sens. typ.* are sometimes partially rimmed they are more commonly 'bevel-edged'. Bevel-edging occurs when the nerve along the ventral and dorsal sides of the pod is slightly displaced internally relative to the outer edge of the pod; the very narrow band of tissue between the nerve and the outer edge of the pod is obliquely deflexed relative to the surface of the pod so that the overall effect is that the margin is bevelled (see Figures 6D, 8F–G). When the nerve is further displaced from the edge of the pod the margin begins to assume the characters of an extremely narrow wing (Figure 8Gc). Indeed, the bevel-edge has been interpreted as an extremely reduced wing (Rutishauser *et al.* 2010). Although the above-described pod margin differences between *A. aneura sens. typ.* and *A. aptaneura* appear to be superficially slight, they may ultimately prove to be taxonomically very significant.

Apart from pod margin differences, *A. aneura sens. typ.* differs most obviously from South Australian specimens of *A. aptaneura* by its consistently flat phyllodes that are grey-green to sub-glaucous in colour (but ageing dull green). In *A. aptaneura* the phyllodes are terete to sub-terete (rarely flat) and bright to dark green in colour. *Acacia aptaneura* occurs in the northern Flinders Range (e.g. *B. Copley* 3840 from Mt Fitton) but is not known from the vicinity of Kanyaka, which is in the southern Flinders Range. The taxonomic significance of these phyllode differences is yet to be assessed in relation to the variation that occurs within *A. aptaneura* over its wide geographic range within Australia (it occurs in all mainland States except Victoria, *fide* Maslin & Reid 2012).

In addition to the morphological differences discussed above, *A. aneura sens. typ.* and *A. aptaneura* appear to be genetically distinct. In a preliminary cpDNA analysis by Miller *et al.* (unpublished data) *A. aneura sens. typ.* (represented by some of our specimens of the lower stature morphotype from Kanyaka) is in a clade that is dominated by members of the Grey-green Alliance; this clade is well removed from the one containing *A. aptaneura*, a member of the Green Alliance[3]. The clade containing *A. aneura sens. typ.* also contained *A. aneura* (Flinders Range variant) (represented by some specimens of our taller stature morphotype from Kanyaka), but the two were on separate lineages within this clade. This genetic analysis focussed primarily on Western Australian species of Mulga and it remains to be seen if the same distant relationship between *A. aneura sens. typ.* and *A. aptaneura* will persist within the context of an expanded genetic analysis that includes more representatives of Mulga from areas outside that State.

In summary, current evidence suggests that, except for its bevel-edged pods, *A. aneura sens. typ.* is morphologically similar to *A. aptaneura* (which is a member of the Green Alliance) but genetically

[3]Mulga alliances are defined by Maslin and Reid (2012): the Grey-green Alliance comprises species with translucent branchlet resin and normally winged pods, the Green Alliance comprises species with the same resin type but normally rimmed pods

is more closely related to Grey-green Alliance taxa such as *A. paraneura* Randall, *A. pteraneura* Maslin & J.E.Reid, *A. aneura* (Flinders Range variant) and the broadly defined *A. aneura* of Maslin and Reid (2012).

It is regrettable that the taxonomic status of *A. aneura sens. typ.* remains uncertain because this affects the application of the name *A. aneura*. It is not known if it represents:

- a hybrid (most likely involving *A. aptaneura* as one of the parents);
- part of the natural range of variation of *A. aptaneura* or a variant thereof;
- a species in its own right.

Judging solely from pod morphology, the hybrid hypothesis is perhaps the most likely, although admittedly this is speculative. As already noted, Rutishauser *et al.* (2010) interpret the bevel-edge that is found on pods in a few Mulga taxa as being a highly reduced wing, characterised by the marginal nerve of the pod being located close to, but not coinciding with, the outer edge of the pod. It could be envisaged that a bevel-edged pod (with its slightly displaced marginal nerve) is intermediate between a rimmed pod (where the marginal nerve coincides with the outer edge of the pod) and a winged pod (where the nerve is clearly intra-marginal). Thus, *A. aneura sens. typ.* may possibly be a hybrid between *A. aptaneura* (which today apparently does not exist around Kanyaka) and *A. aneura* (Flinders Range variant). It is relevant to note here that in Western Australia Maslin and Reid (2012) report the existence of a few Mulga morphotypes with bevel-edged pods that occur within populations of *A. aptaneura* and certain Mulga species with winged pods. A number of these bevel-edged entities have the general facies of *A. aneura sens. typ*. If hybridity involving *A. aptaneura* is indeed responsible for at least some of the bevel-edged Mulga pods that occur in Australia, then these entities will have been independently derived and not the same genotype as *A. aneura sens. typ.* If *A. aneura sens. typ.* is subsequently proved to be of hybrid origin then name *A.* (×) *aneura* must apply to this entity from the South Flinders Ranges and consequently the broadly defined species that Maslin and Reid (2012) call *A. aneura* will require a new name.

Based on current knowledge it is not possible to know if *A. aneura sens. typ.* falls within the natural range of variation of *A. aptaneura*; however, available cpDNA evidence tends to militate against this possibility. Nevertheless, if this is subsequently shown to be the case then the name *A. aptaneura* will need to be placed in synonymy under *A. aneura.*

If on the other hand *A. aneura sens. typ.* is a distinct species in its own right then current evidence suggests that it would need to be very cryptically defined. Such a species would have close morphological affinities with *A. aptaneura* (*syn. A. aneura* var. *tenuis* Pedley).

From a morphological perspective it is the significance of the bevel-edged pod that will most likely prove important in determining the taxonomic status of *A. aneura sens. typ*. In Pedley's 2001 classification of *A. aneura* ten varieties were recognised, three of which have relevance to the present discussion, namely, var. *aneura*, var. *intermedia* and var. *tenuis*. The most important characters that Pedley (*l.c.*) used to distinguish var. *aneura* from var. *intermedia* were its generally narrow phyllodes and its pods which were either rimmed[4] or narrowly winged (pods always winged in var. *intermedia*, with the wings broader than those of var. *aneura*). However, a preliminary examination of specimens at the

[4]Although not all specimens cited by Pedley (2001) for var. *intermedia* have been seen, the one from Western Australia, *M.E. Trudgen* 440, is regarded by Maslin and Reid (2012) as *A. aptaneura* (pods rimmed); the definition of *A. aneura* by Maslin and Reid (*l.c.*) does not encompass rimmed pods.

State Herbarium of South Australia (AD) and the Northern Territory Herbarium (DNA, NT) shows that it is often not possible to confidently assign specimens to these varieties using these characters. The pods in particular show much variation, with some specimens being winged along both margins, with considerable variation in the width of the wing (these specimens accord with var. *intermedia*), some bevel-edged[5] along both margins (these specimens accord with var. *aneura*) while others are intermediate in having one margin winged and the other bevel-edged. Studies aimed at elucidating this variation should also include *A. aneura* var. *major* Pedley, a taxon which does not occur in Western Australia (Maslin & Reid 2012) but which occurs in all other mainland States (Pedley 2001).

The uncertainties concerning the taxonomic status of *A. aneura sens. typ.*, and hence the application of the name *A. aneura*, will only be resolved in the light of more detailed field, morphological and genetic studies than have been possible to date. In the first instance it would be appropriate that such studies focus on South Australian populations, but ultimately they should embrace the entire Australian Mulga flora. It is also important to further investigate the nature and significance of bevel-edge pods.

Concluding remarks

Although uncertainties remain concerning the application of the name *A. aneura*, this study has unambiguously identified the holotype and defined the Mulga morphotype to which we consider it belongs. Hypotheses are presented concerning the taxonomic status of *A. aneura sens. typ.*, providing a basis upon which future studies may proceed. The results of these studies will undoubtedly have broad implications because the name *A. aneura* is extensively used for a wide range of Mulga plants within Australia and (in cultivation) elsewhere.

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[5]Pedley (2001) did not use the term bevel-edge to describe Mulga pods; however, most specimens that he described as having very narrow wings (e.g. to *c*. 0.4 mm wide) may encompass what is here called bevel-edged.

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Appendix 1. Salient features of Mueller's collections from 'Cudnaka' (= Kanyaka) lodged at MEL, labelled as type of *Acacia aneura.*

MEL 724218 (Figures 4, 6A–E). The single (rather fragmentary) fruiting specimen mounted on this sheet is the holotype of *A. aneura*. There are also detached pods that clearly belong to the holotype in a white envelope at the top of the sheet. Additionally, there is very fragmentary material (including a flowering spike) in a blue packet inside a brown envelope at the bottom of this sheet that is labelled by Mueller as coming from the Barcoo [River, Queensland] it is of no type significance. The following notes refer to the holotype specimen and the detached pods in the white envelope. *Branchlets* with minute appressed hairs at extremities, soon glabrous, obscurely ribbed, the ribs thinly overlain by presumably translucent resin (age of the specimen and paucity of resin makes determination of resin type very difficult). *Phyllodes* linear, 60–75 × 1.5 mm, incurved, flat, slightly thickened, obscurely and uniformly multi-nerved; *apices* straight (not curved or uncinate) and obliquely mucronulate. *Gland* very obscure, 0–1 mm above the pulvinus, the phyllode lamina sometimes very slightly bent upwards (but not discernibly kinked) at the gland. *Pods* immature (apparently fully expanded but the seeds not swollen), narrowly oblong, not (or occasionally scarcely) constricted between the seeds, 35–40 mm long (including stipe *c.* 5 mm long), 7 mm wide, thinly coriaceous, brownish (colour difficult to assess because of immaturity of pods), with a thin layer of shiny translucent resin along the margins otherwise not or scarcely resinous, dull to very slightly shiny, smooth, glabrous to sub-glabrous (hairs minute, appressed and very scattered), rather obscurely and ±transversely and openly reticulate with the nerves scarcely raised; *margins* rimmed (i.e. not winged) and (when viewed end-on) rounded as in *A. aptaneura*, but more commonly with a slightly thickened nerve adjacent to (or fractionally displaced internally from) the outer edge of the pod in which case the margin is ±bevel-edged. *Seeds* not seen.

MEL 724219 (Figures 5A, 6F). We are of the opinion that the fruiting specimen mounted on this sheet is of no type significance, despite the sheet having been labelled isotype by Pedley (see discussion above). There are six small specimens of Mulga mounted on this sheet, the lower left hand specimen with very young pods attached, and there is one detached pod in the packet. The following notes refer to the left hand specimen with young pods (the other five specimens are sterile) and the detached pod (which appears to be slightly more mature than those on the specimen). *Branchlets* minutely but rather densely appressed-hairy, obscurely ribbed, the ribs not resinous. *Phyllodes* (very inadequate: only two present, one is broken off so length cannot be determined but it looks to be shallowly incurved, the other is damaged in the lower one-third so it is artificially kinked at 15 mm above the pulvinus, its length is 50 mm) linear, 1.5–2 mm wide, incurved, flat, slightly thickened (although the widest phyllode slightly less thick than narrowest phyllode), obscurely and uniformly multi-nerved. *Gland* difficult to see but presumably situated at distal end of pulvinus with the phyllode lamina not at all bent at the gland. *Pods* immature, obovate to oblong-elliptic, 12–15 mm long (including stipe *c.* 3 mm long), 7 mm wide (but detached pod to 8 mm wide), not constricted between seeds, sparsely appressed-hairy (detached pod glabrescent), scurfy, not shiny, obscurely reticulately nerved (nervation more prominent on detached pod); *margins* probably narrowly winged (*c.* 0.5 mm wide), but intra-marginal nerve extremely difficult to see on account of immature state of the pods.

The phyllodes and branchlets of the five sterile fragments mounted on this sheet are not dissimilar to those of the fruiting specimen, or to those of the holotype specimen. In the absence of pods it is not possible to determine with certainty their type status, although they may possibly be isotypes.

MEL 724215 (Figure 6B). This sheet contains a single, small sterile specimen that is very similar to the sterile specimens on MEL 724219. The above comments regarding to these specimens apply also to the one on this sheet.

Appendix 2. Salient features of the two Mulga morphotypes collected by the authors from the presumed *A. aneura* type locality, Kanyaka, in the southern Flinders Range, South Australia.

1. *Lower stature morphotype* (= *A. aneura sens. typ.*) (Figures 7, 8, 9A). Small *trees* about 3–4 m tall, single-stemmed or dividing at ground level into two main stems, the stems slightly to obviously crooked, the sometimes persistent but often dead lowermost branches wide-spreading, upper branches obliquely ascending to erect, crowns sub-dense. *Branchlets* often scurfy, with a layer of translucent resin on the ribs which is best developed at extremities, obscurely appressed-hairy between the ribs at extremities but soon glabrous. *New shoots* resinous (resin obscuring the underlying indumentum and nerves), greyish brown when dry, the minute, red-brown glandular hairlets scattered (best seen when resin is dissolved). *Phyllodes* (40–)50–60 mm long, 1–1.5 mm wide, mostly shallowly incurved but a few shallowly sigmoid, flat, slightly thickened, grey-green or sub-glaucous with oldest phyllodes dull green, lacking a clearly differentiated, discrete, resinous marginal nerve; *apices* straight (rarely shallowly curved on a few phyllodes) and terminating in a conical, callose point. *Gland* obscure, situated on upper margin of phyllode 0.5–2 mm above the pulvinus, the phyllodes normally slightly swollen and sometimes slightly but discernibly kinked at the gland. *Pods* (many slightly immature) oblong to narrowly oblong, straight-edged or a few shallowly constricted between the seeds, (10–)20–45 mm long (including slender stipe to *c.* 5 mm long), (6–)7–8(–9) mm wide, l: w = 3–7, firmly chartaceous to thinly coriaceous, light to mid-brown and sometimes tinged orange, resinous by a thin but distinct layer of translucent resin over entire surface when young but the shiny resin occurring mainly along the margins when mature (pod valves otherwise not resinous or with patchy resin), dull overall or with a very slight satin sheen (but when viewed under light microscope much of the resin is seen to be shiny), smooth, glabrous or sparsely and obscurely appressed-hairy (the hairs minute, appressed and sometimes obscured by the resin), obscurely and openly ±transversely reticulate (the nerves not longitudinally orientated and sometimes not or scarcely evident); *margins* sometimes partially rimmed (i.e. not winged) and (when viewed end-on) rounded as in *A. aptaneura*, or more commonly the margin ±bevel-edged by a slightly thickened nerve that extends along the ventral and dorsal sides of both pod valves adjacent to, or slightly displaced internally from, the outer edge of the pod. *Seeds* oblique in pods, obloid to obloid-ellipsoid, compressed, 4–5 mm long × 2.5–3.5 mm wide, mid- to dark brown.

Specimens examined. SOUTH AUSTRALIA: Kanyaka (Cudnaka), on Black Jack Range, 38 km N of Quorn on road to Hawker, 21 Oct. 2007, *M. O'Leary* 3510, 3514, 3515, 3516 (Sheet 4/6) and 23 Nov. 2010, *M. O'Leary* 4746, 4751 (all AD and PERTH); same locality, 1 Oct. 2008, *B.R. Maslin* & *J.E. Reid* BRM 9572, 9574 (both PERTH).

2. *Taller stature morphotype* (= *A. aneura* Flinders Range variant) (Figures 9B, 10, 11). This morphotype differs most obviously from lower stature morphotype in the following ways. *Trees* 4–8 m tall, obconic in outline with a rounded or sub-rounded crown, single- or multi-stemmed with main stem(s) dividing at *c.* 1 m above ground level into many, straight, obliquely ascending to erect main branches, no wide-spreading lower lateral branches present. *Branchlet* resin often absent or when present normally not as thick or as well-developed, the hoary indumentum sometimes denser. *Phyllodes* more variable than those of the lower stature morphotype, (50–)60–100 mm long, 1–3 mm wide, sub-straight to shallowly incurved, sigmoid or wavy, terete to flat; *apices* commonly curved to uncinate, sometimes straight. *Gland* 0–4 mm above pulvinus. *Pods* narrowly oblong, mostly shallowly constricted between the seeds, (20–)30–60(–75) mm long (including slender stipe *c.* 5 mm long), (5–)6–8(–9) mm wide, l: w (3–)5–9, thinly coriaceous, greyish brown (yellowish green prior to maturity), dull (but slightly shiny when viewed under light microscope), the resin less well developed and comprising a thin veneer along the outer edge of the margin (pod valve otherwise not resinous), minutely appressed-

hairy at least along margins (the central portion of valves commonly glabrous), finely but discernibly longitudinally reticulate with nerves slightly raised; *margins* narrowly winged, the wing scarcely discernible on external face of valve (best observed on internal face), 0.4–0.9 mm wide and either equal or more commonly unequal in width. *Seeds* longitudinal to longitudinally oblique in the pods, obloid to obloid-ellipsoid or ovoid, (5–)6–7 mm long × 2.5–3 mm wide, dark brown.

Specimens examined. SOUTH AUSTRALIA: Kanyaka (Cudnaka), on Black Jack Range, 38 km N of Quorn on road to Hawker, 21 Oct. 2007, *M. O'Leary* 3516 (Sheets 3/6, 5/6, 6/6) (all AD and PERTH) and 23 Nov. 2010, *M. O'Leary* 4724, 4725, 4733 (all AD and PERTH); same locality, 1 Oct. 2008, *B.R. Maslin* & *J.E. Reid* BRM 9573, 9575, 9576, 9577, 9579, 9580 (all AD, PERTH).

In addition to the above there occurred in the northern population some stunted plants about 10 cm tall (Figure 12); this highly reduced stature is assumed to be the result of grazing by animals. Judging from field observations by one of us (MOL) this stunted morphotype represents the same entity as the taller stature morphotype.

Specimens examined. SOUTH AUSTRALIA: Kanyaka (Cudnaka), on Black Jack Range, 38 km N of Quorn on road to Hawker, 21 Oct. 2007, *M. O'Leary* 3516 (Sheets 1/6 & 2/6) (both AD and PERTH); same locality 1 Oct. 2008, *B.R. Maslin* & *J.E. Reid* BRM 9578 (PERTH).

Appendix 3. Salient features of *A. aneura sens. typ*. based on Mueller's holotype specimen of *A. aneura* (i.e. MEL 724218, Figures 4, 6A–E) and on material collected by the authors from the Kanyaka type locality as the lower stature morphotype of *A. aneura* (Figures 7, 8, 9A). Characters considered the most important taxonomically are given in **bold**.

Small *trees* about 3–4 m tall, single-stemmed or sparingly divided at (or near) ground level, the **stems variably crooked, the lowermost branches wide-spreading** (but commonly lost as the plants mature), the upper branches obliquely ascending to erect. ***Branchlets*** appressed-hairy at extremities between the ribs which possess an overburden of **translucent resin**, the indumentum and resin soon lost as the branchlets mature. *New shoots* resinous, with scattered red-brown glandular hairlets. ***Phyllodes*** **(40–)50–75 mm long, 1–1.5 mm wide**, all or **mostly shallowly incurved**, **flat**, slightly thickened, **grey-green or sub-glaucous** but becoming dull green on oldest phyllodes, lacking a discrete, resinous marginal nerve; *apices* mostly straight and excentrically mucronulate or terminated by a ±centric, conical, callose point. *Gland* obscure, situated on upper margin of phyllode 0.5–2 mm above the pulvinus, the phyllodes normally slightly swollen and sometimes slightly but discernibly kinked at the gland. ***Pods*** oblong to narrowly oblong, 10–40 mm long (including slender stipe *c.* 5 mm long), (6–) 7–8(–9) mm wide, firmly chartaceous to thinly coriaceous, light- to mid-brown and sometimes tinged orange, **resinous to some degree** (resin covering entire surface of valves on young pods but confined to marginal areas on mature pods), **glabrous or sparsely and rather obscurely appressed-hairy**, **obscurely** and openly **±transversely reticulate** or sometimes **seemingly nerveless**; ***margins*** sometimes partially **rimmed** (i.e. not winged) but more commonly **±bevel-edged** by a **slightly thickened nerve** that extends along the ventral and dorsal sides of both pod valves **adjacent to, or slightly displaced internally from, the outer edge of the pod**. ***Seeds*** **4–5 mm long** and 2.5–2.8 mm wide.

Apart from our own Kanyaka gatherings (listed above) there are a number of other specimens at the State Herbarium of South Australia (AD) collected from the Flinders Range and a few localities elsewhere in South Australia which, judging from morphological criteria, appear to correspond to *A. aneura sens. typ.* A selection of these specimens at AD include the following: Wirrealpa H.S., 31 Oct. 1943, *H.M. Cooper s.n* (AD 7941324); 10 km SSW of Mt Gunson, 22 Oct. 1966, *Hj. Eichler* 18834; Moolooloo Stn, 6 Oct. 1918, *E.H. Ising* 595; Koonamore Stn, *R.H. Kuchel* 2410; Flinders Range, 1 Dec. 1980, *V.J. Levitzke* 0560; Gluepot Stn, Nov. 1991 *N. Taylor & T. Loffler* (photos of this plant show it to be a shrubby form with upright branching but the specimen seems a good match for this entity).

Note. Maslin and Reid (2012) provisionally recognise *A. aneura* for a few Western Australian specimens but in the absence of more detailed study, as discussed above, it is not known if the specimens cited there represent the same taxonomic entity as those described here as *A. aneura sens. typ.* from South Australia.

Appendix 4. Voucher specimens for figures in text. All vouchers are housed at the Western Australian Herbarium (PERTH).

Figure 8. A – a, b) *M. O'Leary* 3516 (sheet 4/6); B – a) *M. O'Leary* 3515, b) *B.R. Maslin & J.E. Reid* BRM 9574; C – a) *M. O'Leary* 3516 (sheet 4/6), b) *B.R. Maslin & J.E. Reid* BRM 9574, c, d) *M. O'Leary* 4751; D – a, b) *M. O'Leary* 4751; E – a, b) *M. O'Leary* 4751, c, d) *M. O'Leary* 3514; F – *M. O'Leary* 3514; G – a) *M. O'Leary* 3514, b) *M. O'Leary* 4746, c) *M. O'Leary* 3514, d) *M. O'Leary* 4751.

Figure 11. A – *M. O'Leary* 3516 (sheet 5/6); B – *B.R. Maslin & J.E. Reid* BRM 9577; C – a) *B.R. Maslin & J.E. Reid* BRM 9575, b) *B.R. Maslin & J.E. Reid* BRM 9573, c, d) *M. O'Leary* 4724, e) *M. O'Leary* 3516 (sheet 5/6); D – a) *M. O'Leary* 4724, b) *M. O'Leary* 4733, c, d) *M. O'Leary s.n.* (PERTH 07983980), e) *M. O'Leary* 4733; E – a) *M. O'Leary* 4733, b) *M. O'Leary s.n.* (PERTH 07983980); F – a, b) *M. O'Leary s.n.* (PERTH 07983980); G – a, b) *M. O'Leary* 4724.