

1 **The first Australian palynologist: Isabel Clifton Cookson**  
2 **(1893–1973) and her scientific work**

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6 Cookson (1893–1973) and her scientific work. *Alcheringa*.

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8 Isabel Clifton Cookson (1893–1973) of Melbourne, Australia, was one of that country's  
9 first professional woman scientists. She is remembered as one of the most eminent  
10 palaeontologists of the twentieth century and had a distinguished research career of 58  
11 years, authoring or co-authoring 93 scientific publications. Isabel worked with great  
12 distinction on modern and fossil plants, and pioneered palynology in Australia. She was a  
13 consummate taxonomist and described, or jointly described, a prodigious total of 110  
14 genera, 557 species and 32 subspecific taxa of palynomorphs and plants. Cookson was a  
15 trained biologist, and initially worked as a botanist during the 1920s. At the same time she  
16 became interested in fossil plants and then, Mesozoic–Cenozoic terrestrial (1940s–1950s)  
17 and aquatic (1950s–1970s) palynomorphs. Cookson's research into the late Silurian–Early  
18 Devonian plants of Australia and Europe, particularly the *Baragwanathia* flora, between  
19 the 1920s and the 1940s was highly influential in the field of early plant evolution. The  
20 fossil plant genus *Cooksonia* was named for Isabel in 1937 by her principal mentor in  
21 palaeobotany, Professor William H. Lang. From the 1940s Cookson focussed on Cenozoic

22 floras and, with her students, elucidated floral affinities by comparative analyses of  
23 micromorphology, anatomy and *in situ* pollen/spores between fossil and extant taxa. This  
24 lead to an interest in pre-Quaternary and Quaternary terrestrial pollen and spores, hence  
25 Isabel was the first palynologist in Australia. Her work on Paleogene and Neogene pollen  
26 and spores during the 1940s and 1950s provided incontrovertible evidence of the former  
27 widespread distribution of many important elements of Southern Hemisphere floras.  
28 During the early 1950s, while approaching her 60<sup>th</sup> year, Isabel turned her attention to  
29 marine palynomorphs. She worked with great distinction with Georges Deflandre and  
30 Alfred Eisenack, and also as a sole author, on acritarchs, dinoflagellate cysts and  
31 prasinophytes from the Jurassic to Quaternary of Australia and Papua New Guinea. She  
32 also co-authored papers on aquatic palynomorphs with Lucy M. Cranwell, Norman F.  
33 Hughes and Svein B. Manum. Isabel Cookson laid out the taxonomic basis for the study of  
34 Australasian Mesozoic and Cenozoic marine palynofloras by establishing, or jointly  
35 establishing, 76 genera and 386 species of marine microplankton. Her studies throughout  
36 her career, although especially in marine palynology, concentrated largely on taxonomy.  
37 However, she was one of the first palynologists to demonstrate the utility of dinoflagellate  
38 cysts for relative age dating and correlation in geological exploration.

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46

47 THE pioneering Australian botanist, palaeobotanist and palynologist Isabel Clifton  
48 Cookson (ICC) (1893–1973), affectionately known as ‘Cookie’, ‘indefatigable Cookie’ or  
49 “Isa”, was one of Australia’s foremost female scientists. She undertook some of the early  
50 research into botany in Australia, did benchmark research on early land plants and  
51 Cenozoic plant fossils of Australia, helped elucidate Australia’s floral history, and went on  
52 to become one of the four pre-eminent dinoflagellate cyst researchers during the early part  
53 of the modern era of palynology. The other three pioneer workers on fossil dinoflagellates,  
54 Georges Deflandre (1897–1973), Alfred Eisenack (1891–1982) and Maria Lejeune-  
55 Carpentier (1910–1995), were all from Europe. Cookson collaborated with Deflandre and  
56 Eisenack. This contribution documents Isabel’s remarkable life, the 58 year scientific  
57 career yielding 93 papers published over a period of 61 years (Online supporting data:  
58 Appendix 1) and her many achievements, particularly in relation to her research on  
59 palynology (Tables 1–5). Other accounts of the life and work of ICC have been published  
60 by Baker (1973a,b), Morgan (1981), Dettmann (1988, 1993) and Turner (2007).

61

62 **Table 1 to be placed near here.**

63

64 **The early years (1893–1916)**

65 Isabel Clifton Cookson was born on Christmas Day 1893 in Hawthorn, Melbourne,  
66 Victoria, Australia. She was the youngest of three daughters of the English-born John  
67 Cookson, and the only child of John's second wife Elizabeth Cookson (*née* Somers) who  
68 originated from Adelaide. John and Elizabeth Cookson were 60 and 35 respectively when  
69 Isabel was born. She had two older half-sisters, Cassy and Mary, who were 33 and 27 in  
70 1893 and a half-brother, John, who predeceased her birth. Isabel attended Hambleton  
71 Ladies' College and later the prestigious Methodist Ladies' College (MLC) in Kew, a  
72 suburb of Melbourne. She passed her Junior Public and Junior Commercial examinations  
73 in 1910 and, from an early age, had a penchant for the natural sciences, particularly in  
74 biology. Isabel's father died during 1909, when she was a schoolgirl. John Cookson's  
75 legacy to his wife was the house in Hawthorn; the two half-sisters Cassy and Mary  
76 received his other assets. Elizabeth Cookson earned a relatively meagre income after the  
77 death of her husband. Therefore, Elizabeth and Isabel Cookson were not wealthy at this  
78 time, but had at least a comfortable home. Their modest lifestyle may have stimulated  
79 Isabel's shrewd stock market investments later in life.

80 Isabel excelled in anatomy, botany and physiology in her Senior Public  
81 Examination in 1911. She was an extremely talented pianist, and a prefect at MLC.  
82 Cookson was also a highly gifted tennis player and represented her school, as part of the  
83 'First-Four', and the University of Melbourne in intervarsity events against Adelaide  
84 University. She became an undergraduate in 1913 at the University of Melbourne, and  
85 obtained honours in biology in the first two years of her bachelors course. ICC graduated  
86 with a BSc with first class honours and the exhibitions in botany and zoology during April  
87 1916 (Fig. 1). As the first recipient of the Final Honours Scholarship in botany in 1917,  
88 Isabel was required to demonstrate in practical classes (Gillbank 2010). She was elected as  
89 an Associate Member of the Royal Society of Victoria during 1916.

90

91 Fig. 1 to be placed near here.

92

93 **A botanical career (1916–1929)**

94 Isabel Cookson's initial research was on modern plants. Whilst completing her  
95 undergraduate studies, Professor Alfred J. Ewart acknowledged Isabel for providing  
96 descriptions and figures for five new taxa published in his book *Flora of the Northern*  
97 *Territory* (Ewart & Davies 1917); a Government Research Scholarship funded this work.  
98 Isabel's first professional position was as a research student to Frederick Chapman at the  
99 then National Museum of Victoria (now Museum Victoria) immediately following  
100 graduation in 1916 (Rasmussen 2001). She began research work for a Master of Science in  
101 botany in 1917 under the guidance of Alfred Ewart, studying fungi, and concurrently was  
102 a part-time demonstrator in botany in the Department of Biology at the University of  
103 Melbourne. She also tutored biology undergraduates at Newman College. These various  
104 strands represented the beginning of a research career that was to last for the remainder of  
105 her life, i.e., a remarkable 58 years! Cookson was to remain professionally associated with  
106 the University of Melbourne until her death, 58 years later in 1973, when she was a  
107 Research Fellow.

108 With Alfred Ewart's guidance, Isabel continued to attract research funds.  
109 Supported financially by another Government Research Scholarship, she began research  
110 into the longevity of cut flowers in April 1917. By 1918 she was a full time (but poorly  
111 paid) demonstrator (Gillbank 2010), and continued to be successful at obtaining research  
112 grants. Her principal mentors in Melbourne were Frederick Chapman, Alfred J. Ewart,  
113 Ethel I. McLennan and Samuel M. Wadham. The young Isabel clearly enjoyed the  
114 research and teaching environment, and worked on angiosperms and fungi. Together with

115 her close colleague Ethel McLennan, a noted mycologist and plant pathologist (Parbery  
116 1989), she published on ascomycetes from Australia (McLennan & Cookson 1923, 1926).  
117 Isabel was to develop a long-standing interest in mycology (Cookson 1928, 1937a, 1947a).

118         Unfortunately, Isabel lost her job as full-time demonstrator in 1922, but continued  
119 to research on fungi, and developed an interest in fossil plants while demonstrating part-  
120 time. After a period of considerable departmental disharmony (Parberry 1989, Gillbank  
121 2010), she undertook the first of her many working visits to Europe in 1925–1926. Isabel  
122 travelled to the UK with Ethel McLennan in late 1925. Long-haul travel was different in  
123 those days, and the early trips to Europe and back were via long sea journeys. Both Ethel  
124 and Isabel worked on fungi with Professor Le Rayner at Imperial College London.

125 However, the fungal cultures Isabel brought from Australia degraded badly during the  
126 long journey to Europe. By contrast, McLennan’s fungal research was hugely successful.  
127 Luckily, Isabel also brought some Palaeozoic plant fossils with her, and liased briefly with  
128 Professor Sir Albert C. Seward of the University of Cambridge on her burgeoning interest  
129 in palaeobotany. Also in 1925, she also visited Professor William H. Lang at the  
130 University of Manchester in 1925 to discuss fungal research and palaeobotany.

131         Although Isabel returned to Melbourne from the UK in 1926 without a job, Ethel  
132 McLennan and Professor Samuel M. Wadham obtained a grant of £30 for ICC to  
133 investigate crown rot of the English walnut tree at Wandilagong in northeast Victoria.  
134 Isabel worked on this project in the Department of Agriculture at the University of  
135 Melbourne, and identified that this outbreak was due to the pathogen *Phytophthora*  
136 *nicotianae* B. de Haarn var. *parasitica* Dastur in diseased areas (Cookson 1929,  
137 McLennan *et al.* 1973). In terms of improving the cultivation and yields of walnuts,  
138 Isabel’s findings on the occurrence and life cycle of the fungal pathogen proved  
139 invaluable. She then visited Manchester again between late 1926 and early 1927 as a

140 mycologist in cotton research and to further work on Victorian Palaeozoic plants in  
141 collaboration with Professor William H. Lang (see below).

142         Following this rather uncertain period, and another working visit to the UK, Isabel  
143 returned to Australia. She was appointed as a permanent (but poorly paid) lecturer during  
144 1929, when a new Department of Botany was established by the University of Melbourne  
145 (Gillbank 2010). This was not an era of equality in pay; women earned around half the  
146 salary of men for the same job, and had no pension rights. This appointment made Isabel  
147 one of the earliest women to become a professional scientist in Australia (Carey 2001). At  
148 this time Isabel was 36 years old and this was her first substantive academic position. She  
149 designed, taught and demonstrated an evening class in botany to first year undergraduates  
150 in botany. Baker (1973b) recalled that her lectures and practical classes were of an  
151 excellent standard, that Isabel was very clear and that she displayed a “patient attention to  
152 detail.” Cookson also taught palaeobotany to advanced botany undergraduates. A  
153 testament to the excellence of Isabel’s teaching is the fact that some of her undergraduate  
154 students went on to have productive careers in research. These included, in chronological  
155 order, Suzanne L. Duigan, Kathleen M. Pike (later McWhae), John G. Douglas and Mary  
156 E. Dettmann.

157         Isabel published six papers on Southern Hemisphere botany at this time (Table 2).  
158 Following her contribution to Ewart & Davies (1917), Cookson’s first article was on  
159 angiosperms from Victoria (Cookson 1921) and was issued when Isabel was only 27 years  
160 old. This was followed by McLennan & Cookson (1923, 1926) and Cookson (1928, 1929)  
161 on fungi. Unusually in Cookson (1928, p. 268), she gave her professional address as the  
162 Barker Cryptogamic Research Laboratory of the University of Manchester, rather than the  
163 University of Melbourne. This reflects that this work, on the ascomycete fungal species  
164 *Melanospora zamiae* Corda 1837 from Malawi, was undertaken in Manchester during late

165 1926 to early 1927 (Table 1). Her work on mycology was acknowledged by Swart &  
166 Griffiths (1974), who established the genus *Cooksonomyces* for an epiphyllous fungus  
167 associated with *Banksia* leaves for Isabel. Cookson's interest in, and knowledge of, the  
168 Australian flora never waned (Cookson 1937a), and was to be especially important in her  
169 palaeobotanical work, especially on the Paleogene–Neogene floras of Australia.

170

171 **Table 2 to be placed near here.**

172

### 173 **Botanist to palaeobotanist (mid 1920s–1950s)**

174 At an early stage of her career, during the early 1920s, Isabel Cookson became  
175 increasingly interested in late Silurian to Early Devonian fossil plants, and this changed  
176 her research focus markedly. It seems likely that she was introduced to palaeobotany by  
177 her earliest mentor, Frederick Chapman, who was the palaeontologist at the National  
178 Museum of Victoria in Melbourne. Cookson's interest in fossil plants came despite her  
179 entire lack of formal education in geology, however it was a fascination that was to be an  
180 enduring one. It is possible that Isabel was also inspired by Adele V. Vincent, who was the  
181 first Australian female palaeobotanist (Turner 2007, p. 190). Vincent was a contemporary  
182 of Isabel's; she graduated from the University of Melbourne in 1917 and undertook MSc  
183 studies on Silurian–Devonian floras of Victoria (Vincent 1926, Douglas & Holmes 2006).  
184 Table 3 is a synthesis of the 22 publications on palaeobotany by Isabel Cookson and her  
185 collaborators.

186

187 *Palaeozoic palaeobotany (mid 1920s–1949)*



188 Isabel's introduction to plant fossils was, with Frederick Chapman, to catalogue the  
189 "Sweet" collection of Late Triassic plants from Leigh Creek, South Australia (Chapman &  
190 Cookson 1926). At the same time she investigated the National Museum of Victoria's  
191 collection of Palaeozoic plant fossils, including specimens earlier examined by Vincent  
192 (1926) from Walhalla and the Rhyll bore that had been collected by the Geological Survey  
193 of Victoria. Isabel described two specimens which she allocated to *Arthrostroma*, a  
194 Northern Hemisphere genus (Cookson 1926), and recognized that consultation with  
195 palaeobotanists in England would be useful in determining the identification of other  
196 specimens in the National Museum of Victoria's collection. This decision proved  
197 extremely fortuitous. After visiting Professor Sir Albert C. Seward at Cambridge, Isabel  
198 visited Manchester to consult with Professor William H. Lang, who was keen that she  
199 return with additional Australian fossil plant material, and arranged a position for her as a  
200 mycologist in cotton research at the University of Manchester from late 1926 to early  
201 1927. Many of the fossil plant specimens that Isabel took on her return visit to Manchester  
202 were from the collection of the National Museum of Victoria, but some she collected  
203 herself from localities in rough bushland near Woods Point, in the upper reaches of the  
204 Yarra Valley, and in adjacent high country in east Victoria. Of particular importance are  
205 those specimens of *Baragwanathia* that are associated with the graptolite *Monograptus* on  
206 the same bedding plane; some of these specimens were collected by Cookson. During the  
207 visit of late 1926 to early 1927, and on a further visit to Manchester funded by a grant in  
208 1929, several publications were prepared (Lang & Cookson 1927, 1931, 1935, Cookson  
209 1935). These proved to be highly significant to the understanding of early land plant  
210 evolution. She was awarded a Doctor of Science (DSc) in 1932 for her work on Palaeozoic  
211 plants; this was only the fourth time a woman had been awarded a DSc by the University  
212 of Melbourne. It is abundantly clear that William H. Lang was Cookson's true

213 palaeobotanical mentor; he, like Cookson, was a trained botanist who became interested in  
214 palaeobotany in later life (Salisbury 1961). The collaboration with Lang on the early  
215 Palaeozoic palaeobotany of Victoria was a sustained one.

216         The plant fossil material from Victoria that Cookson and Lang worked on was  
217 initially not well constrained stratigraphically. Lang & Cookson (1927) published  
218 preliminary notes and photographs of the leafy shoots of a then-unnamed plant and noted  
219 chronostratigraphical problems with this material. The majority of the specimens collected  
220 from the Jamieson area could not be assigned to any known pre-Carboniferous plant  
221 genus. This plant was famously described by Lang & Cookson (1935) as *Baragwanathia*  
222 *longifolia*, and identified as an early lycophyte (Fig. 2). Lang & Cookson (1927) also re-  
223 identified a specimen from the Rhyll Borehole as cf. *Thursophyton*. These authors  
224 commented that, on the basis of the entire flora, the material may be Middle Devonian. It  
225 was thought that the material exhibited an anomalously high level of cellular organization  
226 to be late Silurian in age. Subsequently, Lang & Cookson (1935) reported graptolite  
227 evidence indicating a late Silurian age for these plant-bearing strata. This discovery made  
228 these fossil plants the oldest vascular land plants then known in the world. The publication  
229 of Lang & Cookson (1935) was highly influential, and included unequivocal independent  
230 evidence from the graptolite genus *Monograptus* for the late Silurian (early Ludlow) age  
231 of the material collected along the Yarra Valley in Victoria by Isabel. The graptolite  
232 identifications were performed by Gertrude L. Elles of the University of Cambridge.  
233 *Baragwanathia* was named for George Baragwanath, who was then Secretary of Mines for  
234 Victoria. The age of the type material has been controversial (Jaeger 1966), but a late  
235 Silurian (Ludlow) age based on graptolite evidence has been confirmed by Garratt *et al.*  
236 (1984) and Rickards (2000). Further work on the Silurian–Devonian plants from Victoria  
237 was undertaken by Isabel in consultation with William H. Lang during the tenure of a

238 Grisedale Research Scholarship (1933–1934), and a Leverhulme Research Grant at the  
239 University of Manchester (1948–1949), resulting in several papers (Cookson 1935,  
240 1937b,c, 1945a, 1949). *Baragwanathia* has a worldwide distribution, and persisted at least  
241 until the late Early Devonian (Emsian) (Hueber 1983). The work of Lang & Cookson  
242 (1927, 1931, 1935) and Cookson (1935) on the late Silurian *Baragwanathia* flora of  
243 Australia, which includes a range of lycophytes, rhyniophytes, trimeriophytes and  
244 zosterophyllophytes, revolutionized the understanding of early Palaeozoic land plant  
245 evolution, and brought ICC well-deserved international recognition (Brown 1946, Garratt  
246 *et al.* 1984, White 1986).

247         William H. Lang (1937, p 249–250) named the primitive plant genus *Cooksonia*  
248 from the late Silurian–Early Devonian of England and Wales after ICC. Baker (1973a,b)  
249 erroneously stated that Croft & Lang (1942) described this genus. *Cooksonia* is a  
250 dichotomously branching, leafless plant with slender axes, terminating in large sporangia.  
251 *Cooksonia hemisphaerica* and *Cooksonia pertoni* were described by Lang (1937, p 250–  
252 257), the latter after Perton Quarry, Herefordshire. Lang (1937, p. 250) wrote: “On a short  
253 visit to the (Perton) quarry in company with Dr. Isabel Cookson, she collected three  
254 extremely interesting specimens from a sandy layer close to the base of the Downton  
255 Sandstone. I am indebted to her for giving me these specimens for investigation. As will  
256 be seen, they provided the proof that the terminal structures were sporangia.” Furthermore,  
257 “I propose the name *Cooksonia* in recognition not only of Dr. Isabel Cookson having  
258 collected the type specimens showing the sporangia with spores in connexion with the  
259 axes, but also of her important work on plants of still earlier geological age from  
260 Australia.” (Lang 1937, p. 253).

261         The collaboration with Lang was clearly very scientifically successful, and it was  
262 also an extremely congenial one (Watson 2005, p. 242). When Isabel died in 1973, she left

263 a legacy to the University of Manchester “in memory of a valuable and happy time spent  
264 there in the time of the late Professor W.H. Lang.”

265

266 Fig. 2 to be placed near here.

267

268 *Cenozoic palaeobotany (1940–early 1950s)*

269 During the 1940s, Isabel turned her attention to research on Oligocene–Miocene fossil  
270 plants and fungi (Fig. 3) from the brown coal-bearing strata of the LaTrobe Valley,  
271 Victoria and other Paleogene–Neogene sediments in southeastern Australia (Cookson  
272 1947a,b, 1953a, 1954a, Cookson & Duigan 1950, 1951, Cookson & Pike 1953a,b, 1954a,  
273 Clifford & Cookson 1953). The huge reserves of brown coal in the Latrobe Valley were  
274 being exploited by open cast mining for briquettes and electricity generation. Cookson’s  
275 first study of the brown coal flora was of Oleaceae leaves from Yallourn, Victoria and  
276 Moorlands, South Australia. Botanical affinities were demonstrated via comparative  
277 anatomical and morphological analyses of the mummified fossil leaves and leaves from  
278 extant taxa (Cookson 1947b). Associated with the fossil leaves, within the sediment  
279 matrix, were small disc-shaped objects representing the ascomata of epiphyllous fungi that  
280 Cookson had also observed in Paleogene–Neogene lignites from other localities in  
281 Australia, Kerguelen and New Zealand (Cookson 1947c,d). Suzanne (Sue) L. Duigan, who  
282 undertook MSc studies with Cookson, collaborated with her on fossil Banksieae and  
283 Araucariaceae from the Yallourn coals and sediments from other locations (Cookson &  
284 Duigan 1950, 1951). These studies involved maceration of the mummified leaves and  
285 cones, cuticle preparation, sectioning of leaves, and extraction of pollen from both fertile

286 material and the surrounding sediment. Suzanne Duigan then went to the University of  
287 Cambridge where she completed a PhD supervised by Professor Sir Harry Godwin, before  
288 returning to Melbourne around 1956, and collaborated once again with Cookson on fossil  
289 *Azolla* (Duigan & Cookson 1957). Kathleen M. Pike (later McWhae) also completed a  
290 MSc under Isabel. They collaborated on *Dacrydium*, *Phyllocladus* and *Podocarpus*  
291 (Podocarpaceae) cones, cuticles, leaves and pollen in Paleogene–Neogene coals and other  
292 sediments from Yallourn and other Australian localities (Cookson & Pike 1953a,b, 1954a).  
293 Kathleen Pike also studied Casuarinaceae and *Banksia* cones (Pike 1952), before travelling  
294 to Cambridge to work on Quaternary pollen with Harry Godwin. On her return to  
295 Melbourne, she continued pollen research with Cookson (Cookson & Pike 1954b, 1955,  
296 Pike 1956). Another plant fossil from Yallourn, *Muscites yallournensis*, which was then  
297 identified as a moss capsule, was described in collaboration with H. Trevor Clifford  
298 (Clifford & Cookson 1953). This has since been shown to be a *Typha* seed fossil by  
299 Clifford & Dettmann (2000). Other Australian Paleogene–Neogene plant taxa identified  
300 by Cookson from foliage/cuticle and/or pollen include *Acacia* and *Macrozamia* (see  
301 Cookson 1953a, 1954a).

302         Cookson’s palaeobotanical studies provided a rich legacy for subsequent workers,  
303 and paved the way for elucidating the floral history of Australia. Her detailed and holistic  
304 approach to anatomy, detailed illustration, *in situ* studies and morphology provided a  
305 sound basis for identifying the diverse elements of Australia’s Cenozoic vegetation.  
306 Although Cookson’s final contributions on palaeobotany were published in the early  
307 1950’s, her continuing work on palynomorphs also contributed enormously to our  
308 understanding of the Cenozoic floral history of Australia. She donated her collection of  
309 fossil plants to the National Museum of Victoria in 1950 (Rasmussen 2001).

310 Cookson was an invited speaker at the official opening of the Birbal Sahni Institute  
311 of Palaeobotany, Lucknow, India, on April 3<sup>rd</sup>, 1947. At this ceremony, she was appointed  
312 to the Australian National Research Council. ICC also undertook committee work in the  
313 subject. She was a regional delegate for Australasia and Oceania of the International  
314 Organisation of Palaeobotany (IOP), and sat on the IOP committee, between 1954 and  
315 1964 (Boureau *et al.* 1956, 1960). The Botanical Society of America made Isabel a  
316 Corresponding Member during 1957 in tribute to her contribution to botany, palaeobotany  
317 and palynology.

318

319 **Fig. 3 to be placed near here.**

320

321 **Table 3 to be placed near here.**

322

### 323 **Palaeobotanist to palynologist (early 1940s onwards)**

324 Cookson's venture into palynology was a spinoff of her palaeobotanical research on the  
325 Yallourn brown coal floras in the 1940s. During preparation of mummified leaves, she  
326 was aware that dispersed microfossils occurred in the coal matrix. As recounted to one of  
327 us (MED), her curiosity prompted her to prepare a small portion of a Yallourn briquette  
328 using the chlorination-acetolysis method of Erdtman (1943, 1960). She was amazed that  
329 the residue contained a myriad of beautifully-shaped and sculpted pollen and spores; these  
330 included pollen of *Nothofagus* (see Fig. 4/H,I) and Proteaceae, both forming the subject of  
331 later research. In the 1940s, the modern era of palynology was in its infancy and the  
332 discipline was developing rapidly due largely to significant breakthroughs in preparation  
333 techniques and marked improvements in microscope technology (Sarjeant 2002).

334

335 Fig. 4 to be placed near here.

336

337 Most practitioners of palynology at that time were based in Europe or North  
338 America. Palynology in Australia began on Permian material. The earliest paper on  
339 Australian palynomorphs was Newton (1875), on the prasinophyte genus *Tasmanites* from  
340 Permian oil shales from Tasmania. Shortly after this, Bertrand & Renault (1894) and  
341 Bertrand (1896) reported similar algal palynomorphs from the Kerosene Shale of Permian  
342 age from New South Wales. These represent the first reports of palynomorphs from  
343 mainland Australia. In New Zealand, Lucy M. Cranwell published on terrestrial  
344 palynofloras from Quaternary sediments, and pollen and spores from the extant flora (e.g.,  
345 Cranwell & von Post 1936, Cranwell 1939, 1940). The earliest work on Australian fossil  
346 sporomorphs was by the Indian researcher Chinna Virkki, who documented Permian  
347 pollen and spores from New South Wales and Victoria, Australia and India (Virkki 1937,  
348 1939, 1946). A concise account of the history of palynology in Australasia was given by  
349 de Jersey *et al.* (1987).

350 Isabel Cookson's interest in palynology was aroused by her experiment with the  
351 Yallourn briquette, and so began her next career on this discipline. Only the Permian and  
352 Triassic specialists Noel de Jersey and John A. Dulhunty were working on palynomorphs  
353 in Australia during the early to mid-1940s (de Jersey 1946, Dulhunty 1946, 1947, Webby  
354 1986). No one else in Australia was working on palynomorphs of pre- or post-Permian–  
355 Triassic age at that time, and ICC can be considered the founder of Australian palynology.  
356 She advised some of the other early workers on palynology in Australasia such as Basil E.  
357 Balme in Sydney and then Western Australia, R. Ashley Couper in Wellington (New  
358 Zealand), Noel de Jersey in Queensland and associates in Melbourne. Interest in

359 palynology in Australia increased significantly following oil discoveries at Rough Range  
360 in Western Australia in 1953, and at Moonie in the Surat Basin of Queensland in 1961.

361 Typically, Isabel cast her net wide, and she researched the Cretaceous to Neogene  
362 pollen and spores of Australia, and the Mesozoic and Cenozoic marine microplankton of  
363 Australia and Papua New Guinea. For all her extremely distinguished contributions on  
364 Palaeozoic palaeobotany between the 1920s and the 1940s, it is in palynology where  
365 Isabel made her greatest scientific impact. She worked on several aspects, including floral  
366 affinities and taxonomy. Cookson is not known for her work on biostratigraphy, and many  
367 of her papers do not discuss correlation and ranges in depth. Despite this, Isabel was one  
368 of the first palynologists to realise that palynomorphs had potential as reliable marker  
369 fossils. The first mention of this was Cookson (1953b, p. 468, 469), in a study on Jurassic–  
370 Cretaceous and Paleogene miospores from South Australia. It was stated that: “This  
371 difference in composition suggests that the two microfloras concerned represent the  
372 vegetation of two distinct geological periods....” Isabel prepared much of her pre-  
373 Quaternary material herself; she demineralized using hydrofluoric acid, normally followed  
374 by oxidative maceration using Schulze’s solution and finally treatment with dilute alkali  
375 solution (e.g., Cookson & Eisenack 1958, p 19, 20). For Quaternary and some Paleogene–  
376 Neogene material, she subjected her samples to bleaching by chlorination and/or  
377 acetolysis (Erdtman 1943, 1960, Delcourt *et al.* 1959). Noel de Jersey (personal  
378 communication to JBR, 2013) recalls her beautiful preparations, and the exquisite  
379 preservation of *Nothofagus* pollen that Isabel extracted from the Victorian brown coals  
380 (Fig. 4H).

381 ICC had to improvise in order to take photomicrographs of her palynomorphs.  
382 Photomicrographs published in her pre-1940 papers were taken by professionals or  
383 associates in the institutions she worked in. During the early 1940s, she sought the advice



384 of Ernst Matthaei, an optical instrument expert and former Zeiss technical agent of the  
385 Microscope Unit associated with the Botany Department of the University of Melbourne  
386 (Gillbank 2010). Matthaei advised her, maintained her Zeiss microscope (Fig. 5) and, from  
387 pre-war equipment, devised a bellows to fit into the trinocular tube of the microscope.  
388 Isabel would climb onto a chair to focus with a spy glass on a ground glass plate set into a  
389 wooden frame, prior to the insertion of a glass photographic plate into the frame on top of  
390 the bellows and using a light-proof covering. Cookson developed and printed all of her  
391 photographs in a dark-room adjacent to her office. A similar method, somewhat modified  
392 or improvised, was used when she was overseas (Manum 2003, p. 4). Despite these  
393 limitations, Isabel consistently produced excellent photomicrographs.

394

395 **Fig. 5 to be placed near here.**

396

397 *Terrestrial palynology (early 1940s onwards)*

398 Isabel's first palynological research was on pollen and spores as part of her studies on the  
399 Oligocene–Miocene brown coal-bearing successions of Victoria, Australia. Her initial  
400 contribution on palynology was a short paper on Paleogene–Neogene pollen from  
401 southeastern Australia, published when Isabel was 53 (Cookson 1945b). She made the  
402 point that the palynology of the Australian brown coal deposits had not hitherto been  
403 investigated despite their economic importance and in contrast to similar resources in, for  
404 example, Germany. She investigated isolated samples from several disparate coal-bearing  
405 successions in New South Wales, South Australia and Victoria. Several localities such as  
406 Altona, Maryvale and Yallourn in Victoria were mentioned, but no actual data were given  
407 except that she noted the predominance of pollen grains from wind-pollinated plants in the  
408 Yallourn assemblages. The potential of the correlation of individual coal seams based on

409 distinctive pollen spectra using the technique developed by Raistrick (1933) and Raistrick  
410 & Simpson (1933), and the elucidation of coal seam palaeoecology was also mentioned.  
411 She noted that, whereas the brown coal at Yallourn is dominated by coniferous wood,  
412 pollen of the southern beech *Nothofagus* is abundant suggesting that this genus occupied  
413 upland sites surrounding the coniferous coal swamp vegetation. Cookson realised that to  
414 further these palaeoecological studies, it was necessary to document pollen and spores of  
415 living Australian plants.

416 In this context, ICC noted fossil pollen similar to that of extant Proteaceae were  
417 also common in the samples she investigated. Isabel subsequently documented fossil  
418 pollen of *Nothofagus* from the sediments, categorizing alphabetically the ten different  
419 types she distinguished (Cookson 1946a), and relating the fossils to pollen of the extant  
420 *fusca* and *menziesii* groups of the genus. Cookson noted an intermediate type then  
421 unknown among living species, but subsequently found to be characteristic of the *brassii*  
422 group of species confined to New Guinea and New Caledonia (Cookson 1952). Following  
423 her systematic treatment of fossil *Nothofagus* pollen, which she later formalized as species  
424 using binomial nomenclature (Cookson 1959), Isabel systematically analysed lignites and  
425 associated sandstones from Kerguelen in the southern Indian Ocean forwarded to her by  
426 Sir Douglas Mawson and the Natural History Museum (Cookson 1946b, 1947d). The  
427 sporomorph and sporotype taxa described by her were attributed binomial names  
428 following the coenotype system of Erdtman (1947). This system was used by Isabel and  
429 collaborators for fossil pollen and spores until the mid 1950s; type specimens were not  
430 designated for the individual taxa. However, after attending the 1954 International  
431 Botanical Congress in Paris, France, and on learning of the nomenclatural methodology  
432 adopted by American palynologists, she thereafter treated the taxa as form genera and  
433 species, and designated types for individual species (Cookson 1957).

434 Isabel was given sabbatical leave in 1948 and visited the Palynology Laboratory at  
435 Stockholm, Sweden to work with Dr Gunnar Erdtman, funded by a grant from the  
436 Commonwealth Scientific and Industrial Research Organisation (CSIRO). Erdtman and  
437 ICC worked on detailing pollen of the Proteaceae, an important family of evergreen  
438 angiosperms with characteristic inflorescences, which are distributed throughout the  
439 Southern Hemisphere. The section on the Proteaceae in a classic book by Erdtman was co-  
440 written with ICC (Cookson & Erdtman 1952). This is the only co-authored section in  
441 Erdtman's (1952) landmark text on modern pollen morphology and taxonomy. During her  
442 stay in Stockholm, Isabel prepared her paper on fossil proteaceous-like pollen from the  
443 Australian Paleogene–Neogene (Cookson 1950).

444 On her return to Melbourne in 1949, and following discussions that began in 1947,  
445 the Brown Coal Pollen Research Unit (later referred to as the PRU) in the Botany  
446 Department of the University of Melbourne was established, and ICC was made the first  
447 head (Fig. 6). The PRU was sponsored by CSIRO and the State Electricity Commission of  
448 Victoria, and was administered by Professor John S. Turner who was head of the Botany  
449 Department and Dr Austin B. Edwards of CSIRO. Mary E. Dettmann, Suzanne L. Duigan  
450 and Kathleen M. Pike, all women, were research assistants in the PRU. This was not  
451 unusual because the world of palaeobotany was well-represented by women at this time  
452 (Watson 2005, p 249–250). When setting up this unit, Isabel must have drawn from her  
453 experiences during her visit to Gunnar Erdtman's palynology laboratory in Sweden the  
454 previous year. In her role as head of the PRU, the first one of its type in Australia, she no  
455 longer had undergraduate teaching duties and concentrated on palaeobotanical and  
456 palynological analysis of the extensive brown coal-bearing successions of Victoria.  
457 Studies of modern pollen and spores were also undertaken. Isabel worked with Suzanne L.  
458 Duigan, and independently, on the palaeobotany of Paleogene–Neogene brown coals of

459 Victoria and compared components of this material with extant plants (Cookson & Duigan  
460 1950, 1951, Cookson 1956a, Duigan & Cookson 1957). Duigan was appointed a lecturer  
461 in botany by the University of Melbourne in 1960. She died in 1993 and was honoured  
462 with a *Festschrift* four years later (Kershaw 1997). ICC and Kathleen M. Pike published  
463 extensively on the Paleogene and Neogene palaeobotany and palynology of Australia  
464 (Cookson & Pike 1953a,b, 1954a,b, 1955). During this period, Cookson had the first  
465 opportunity of examining borehole sequences, and recognized the potential  
466 biostratigraphical utility of pollen and spore taxa (Cookson 1953c, 1954b,c, Baker &  
467 Cookson 1955, Harris & Cookson 1965). Based on the occurrence of *Ruffordiaspora* (*al.*  
468 *Mohriopsisporites*; Fig. 4E), ICC suggested that the strata underlying a Paleogene–Neogene  
469 succession in the Otway Basin are Cretaceous in age. Moreover, she distinguished two  
470 successive microfloras, one of Paleocene age and the younger of probable Eocene age.  
471 Isabel also noted the presence of reworked Palaeozoic pollen and spores in Upper  
472 Cretaceous and Paleogene–Neogene palynofloras (Cookson 1955), and that calcareous  
473 tests of foraminifera are rendered translucent in hydrofluoric acid (Cookson & Singleton  
474 1954). A selection of pollen and spores described by Cookson are illustrated in Fig. 4.

475         In the later years of the 1950s, further work on Mesozoic palynofloras was  
476 undertaken (Cookson & Dettmann 1958a,b, 1959a,b,c, 1961). The terrestrial components  
477 were, in part, systematically analysed, successive microfloras noted and a range of  
478 stratigraphically significant species determined. The latter provided a reliable basis for  
479 correlation between marine and terrestrial sequences. Significantly, it was determined that  
480 the major thickness of the non-marine Otway and Strzelecki groups are of Early  
481 Cretaceous age, and not Jurassic as had been previously suggested early in the 20<sup>th</sup> century  
482 based on megaflores.

483           The PRU operated successfully over many years, and it unequivocally established  
484 Isabel Cookson as the leading palynologist in Australia. This research group demonstrated  
485 that palynomorphs could be used as biostratigraphical indices, and that fossil pollen-spore  
486 associations can help to trace floral evolution and history. Indeed, many of the species  
487 described and instituted by Cookson and her co-workers are important zonal indices in the  
488 pollen-spore zonal frameworks established for Australian Jurassic, Cretaceous, Paleogene  
489 and Neogene sedimentary rocks (e.g., Helby *et al.* 1987, Partridge 2006a,b,c). The work of  
490 the PRU significantly helped the intensive geological exploration of Australia for oil  
491 following World War II. The PRU sorority under Cookson published around 30 papers,  
492 and most of these were authored or co-authored by ICC with her colleagues Mary E.  
493 Dettmann, Suzanne L. Duigan and Kathleen M. Pike. The PRU is extant, and remains in  
494 the School of Botany at the University of Melbourne. It is now the Isabel C. Cookson  
495 Laboratory, however the name, personnel, research focus and funding model have all  
496 significantly changed (see <http://www.botany.unimelb.edu.au/Cookson/cookson.html>).

497           Isabel formed a close professional association with the Perth-based terrestrial  
498 palynologist Basil E. Balme, who worked at CSIRO in Sydney and then the University of  
499 Western Australia in Perth, during the 1950s (Playford & Truswell 1988). This came about  
500 while Balme was working on the Jurassic and Cretaceous pollen and spores of Western  
501 Australia (Balme 1957). Balme supplied several samples from Western Australia to Isabel  
502 during the late 1950s and early 1960s. This material was largely from boreholes drilled by  
503 West Australian Petroleum (WAPET), and originally released by J.R.H. McWhae.  
504 However, the Cookson and Balme team published only one paper together (Cookson &  
505 Balme 1962).

506           Fossil dispersed pollen and spore taxa named in her honour include the spore genus  
507 *Cooksonites* Pocock 1962, and a multitude of dispersed spore and pollen species of

508 Mesozoic and Cenozoic age. Additionally, several fossil fungal species bear the epithet  
509 *cooksoniae* in her honour (see <http://www.indexfungorum.org>). A synthesis of the 38  
510 contributions on terrestrially derived palynomorphs authored by Isabel Cookson and her  
511 co-workers is given as Table 4.

512

513 Fig. 6. to be placed near here.

514

515 Table 4 to be placed near here.

516

517 *Marine palynologist (1945 onwards)*

518 *Overview.* During her extensive studies of the Cretaceous and Paleogene–Neogene pollen  
519 and spores of southeast Australia in the 1940s and 1950s, Isabel became aware of the  
520 presence of several groups of aquatic palynomorphs in the Mesozoic and Cenozoic of  
521 Australia. Specifically, ICC first observed marine microplankton in 1945 from the Nelson  
522 Bore, Victoria (Baker & Cookson 1955), but gave priority to her pollen and spore work at  
523 this time (Baker 1973b, p vi). Nonetheless, she rapidly became interested in acritarchs,  
524 brackish/freshwater algae, dinoflagellate cysts and prasinophytes. This was at a time when  
525 aquatic palynology was in its infancy, and fossil dinoflagellate cysts were assumed to be  
526 the remains of the motile cell, prior to the observations of Evitt (1961) and Evitt &  
527 Davidson (1963). Upon looking further, both geographically and stratigraphically, she  
528 realized that aquatic microplankton from the Mesozoic and Cenozoic sedimentary  
529 successions of Australia are extremely abundant, diverse and well-preserved. Furthermore,  
530 ICC recognized that these marine palynomorphs were virtually entirely undescribed, and  
531 that they had considerable biostratigraphical potential. Consequently, she was frequently  
532 consulted by oil exploration companies and state geological surveys on age determinations

533 based on palynology. As a result of these contacts, ICC began to amass a large collection  
534 of Australian and Papuan samples that yielded superb dinoflagellate cyst assemblages. The  
535 material provided to her represented a valuable resource of subsurface core and cuttings,  
536 largely from hydrogeological boreholes, oil exploration wells and seismic shot-holes. Due  
537 to the moist, warm climate during the late Cretaceous and Cenozoic, most Australian  
538 outcrop samples have been intensely weathered over a long period of time (in many cases  
539 since the Cretaceous), and much of the palynomorph content has been destroyed by  
540 oxidation.

541         During 1952, ICC was promoted to Research Fellow and Senior Lecturer by the  
542 University of Melbourne. By that time equal pay legislation had been enacted and Isabel  
543 had, at last, a comfortable salary and pension rights. One year later, her first paper on  
544 organic-walled microplankton (both freshwater/brackish alga and dinoflagellate cysts) was  
545 published (Cookson 1953d); this was when she was 59, and only six years prior to Isabel's  
546 retirement! This, her 30th paper, was the first report of aquatic palynomorphs from  
547 Australia, and described Paleogene, Neogene and Quaternary hystrichospheres (as spinose  
548 dinoflagellate cysts were then known) from Victoria and Western Australia. Cookson  
549 (1953d) included the descriptions of 11 different 'hystrichospheres.' One new species, the  
550 dinoflagellate cyst *Emmetrocysta urnaformis* (as *Cannosphaeropsis urnaformis*) was  
551 formalized. *Emmetrocysta urnaformis* was the first fossil dinoflagellate cyst to be  
552 described from Australia, and the first of 386 species of aquatic palynomorphs described  
553 by Isabel and her co-workers (Table 5). Cookson (1953d) also documented *Botryococcus*  
554 *braunii* from the Paleogene to Quaternary of South Australia, New South Wales, Victoria  
555 and Western Australia, and *Pediastrum boryanum* from the Paleogene and Neogene of  
556 South Australia and Victoria.

557           It is clear that Isabel was working outside her botanical/palaeobotanical comfort  
558 zone at this time and she wrote: “The Hystriochosphaerid (dinoflagellate cyst) population of  
559 the Australian Tertiary rocks is actually greater than is indicated by this account. Several  
560 varieties more difficult to place systematically have been purposely omitted.” (Cookson  
561 1953d, p. 121, authors additions in parentheses). With this in mind, and perhaps mindful  
562 of her successful palaeobotanical research with Professor William H. Lang in the 1920s,  
563 Cookson sought to work with the leading European marine palynologists of the time. This  
564 led to significant collaborations with Georges Deflandre, Alfred Eisenack and Svein B.  
565 Manum. She also researched on marine palynomorphs with Lucy M. Cranwell and  
566 Norman F. Hughes. By far the majority of Cookson’s work on Australasian marine  
567 microplankton was done in collaboration with Eisenack (see below). Her work in this field  
568 also influenced her friend and colleague John G. Douglas, who published a paper on the  
569 Late Cretaceous and Paleogene dinoflagellate cysts from western Victoria (Douglas 1960).

570           Further to the collaborations summarized above, ICC later published as a sole  
571 author on dinoflagellate cysts from the Cretaceous and Paleogene of New South Wales,  
572 South Australia, Victoria and Western Australia (Cookson 1956b, 1965a,b). Cookson  
573 (1956b) is a short contribution; four new dinoflagellate cyst and one acritarch species were  
574 described from the Cretaceous and Paleogene of localities in New South Wales, South  
575 Australia, Victoria and Western Australia. The dinoflagellate species include  
576 *Dinogymnium nelsonense*, *Isabelidium cretaceum*, *Odontochitina porifera*, which are all  
577 early Santonian to early Maastrichtian marker species (Helby *et al.* 1987, fig. 40). The  
578 upper Eocene Browns Creek Clays of Victoria was the principal focus of Cookson  
579 (1965a), and one new dinoflagellate cyst genus, *Diphyes*, and five new microplankton  
580 species were described. The presence of the acritarch *Paucilobimorpha spinosa* in the  
581 Browns Creek Clays indicates a late Eocene (Bartonian) age (Wilson 1984, fig. 4).



582 Cookson (1965b) published the first part of a study on the dinoflagellate cysts of the  
583 Paleocene Pebble Point Formation of Victoria, erecting three new species, including  
584 *Palaeocystodinium australinum*, which is a marker for the Late Cretaceous (late  
585 Campanian) to Paleocene (Marshall 1984, Wilson 1984, figs 3, 4). *Glaphyrocysta*  
586 *retiintexta* was also reported. Wilson (1984, fig. 4) reported the range of *Glaphyrocysta* cf.  
587 *retiintexta* from New Zealand as being Paleocene to early Eocene (Ypresian/Lutetian).

588         A tabulated synopsis of synthesis of the 33 research papers on aquatic  
589 palynomorphs written by Isabel Cookson and her co-workers is given as Table 5. All  
590 aquatic palynomorph taxa below generic level mentioned herein are listed in Online  
591 supporting data: Appendix 2 with full author citations.

592

593 *The French connection (Deflandre and Cookson, 1954; 1955)*. Isabel spent her 1954  
594 sabbatical leave in France, and visited Professor Georges-Victor Deflandre at the  
595 Laboratoire de Micropaléontologie de l'École Pratique des Hautes Etudes, in Paris. At that  
596 time Deflandre was the leading authority on fossil dinoflagellates (Sarjeant 1973, 1999a,  
597 Evitt 1975, Noel 1975, Verdier 1975), and ICC sought to collaborate with him on prepared  
598 Jurassic to Neogene material from Australia (New South Wales, South Australia, Victoria  
599 and Western Australia) and Papua New Guinea. A preliminary account and a major  
600 monograph arising from this work were published (Deflandre & Cookson 1954, 1955  
601 respectively).

602         The study by Deflandre & Cookson (1955) represents the first comprehensive  
603 account of fossil marine microplankton from the Jurassic to Neogene of the Southern  
604 Hemisphere. Marine microplankton from 40 samples from throughout mainland southern  
605 Australia and Papua New Guinea were described. The research for this work was done  
606 entirely in Paris during 1954 on material, most of which, Isabel had prepared in

607 Melbourne. Most of the siliciclastic samples were powdered, boiled in hydrofluoric acid,  
608 then subjected to chlorination and acetolysis and finally treated with dilute alkali solution  
609 (Deflandre & Cookson 1955, p. 245). The sample W.451 from the Era River District of  
610 Papua New Guinea was stated to be from a Lower Cretaceous succession, but is clearly of  
611 Late Jurassic (Oxfordian) age due to the presence of the dinoflagellate cyst *Wanaea*  
612 *spectabilis* (see Helby *et al.* 1987, Riding & Helby 2001, Riding *et al.* 2010). This was one  
613 of Deflandre's last major papers on marine microplankton, and the only one which was  
614 written in English. He undoubtedly helped Isabel learn a great deal about aquatic  
615 palynomorphs, and ICC would have benefitted greatly from using *Le Fichier*  
616 *Micropaléontologique Général* and Deflandre's reference collection of microscope slides  
617 in Paris. This collaboration between Cookson and Deflandre was an effective one because  
618 the latter could readily identify species that had already been described from the Northern  
619 Hemisphere. Cosmopolitan dinoflagellate cyst species identified in Deflandre & Cookson  
620 (1955) include *Cordosphaeridium inodes*, *Deflandrea phosphoritica*, *Dinopterygium*  
621 *cladoides*, *Odontochitina operculata*, *Oligosphaeridium complex*, *Rigaudella aemula*,  
622 *Rottnestia borussica* and *Spiniferites ramosus*. Deflandre & Cookson (1955) described 45  
623 species including the key taxa *Apectodinium homomorphum*, *Circulodinium distinctum*,  
624 *Conosphaeridium striatoconum*, *Cyclonephelium compactum*, *Eisenackia crassitabulata*,  
625 *Heterosphaeridium heteracanthum*, *Hystrichokolpoma rigaudiae*, *Isabelidinium*  
626 *pellucidum*, *Lingulodinium machaerophorum*, *Odontochitina cribropoda*,  
627 *Oligosphaeridium pulcherrimum*, *Operculodinium centrocarpum* and *Wanaea spectabilis*.  
628 Furthermore, the important dinoflagellate cyst genera *Cyclonephelium*, *Eisenackia* and  
629 *Nematosphaeropsis* were also established. A brief analysis of the biostratigraphical  
630 potential was given, including a range chart for the Paleogene and Neogene forms  
631 (Deflandre & Cookson 1955, p 301–305, table 1). This section represents one of the

632 earliest accounts of this topic and was clearly written by Cookson; stratigraphical aspects  
633 were never discussed by Deflandre (Sarjeant 1973, p. 327).

634 Deflandre & Cookson (1955) demonstrated for the first time that marine Upper  
635 Cretaceous sedimentary rocks were present in Victoria. Specifically, this material was  
636 between 1882 m and 1757 m in the Nelson Bore, Victoria (Baker & Cookson 1955).  
637 Following this discovery, the Mesozoic successions of Victoria became targets in oil  
638 exploration operations in Victoria (Baker 1973b).

639 Isabel was known to be keen to collaborate further with Deflandre on another visit  
640 to Europe between November 1956 and April 1957. This was agreed well in advance with  
641 Deflandre, and Isabel duly booked her passage and prepared materials to study in France.  
642 However, this second visit to Paris was postponed by Deflandre during October 1956.  
643 Because of the significant logistics involved, ICC went ahead with her journey and instead  
644 sought collaboration with Alfred Eisenack in Germany. This brought about the end of her  
645 joint research with Georges Deflandre, and the only outputs from this collaboration are  
646 Deflandre & Cookson (1954, 1955). In ICC's first post-Deflandre paper on marine  
647 microplankton, it was stated that "The present and fourth contribution was to have been  
648 made in conjunction with Professor G. Deflandre of Paris, but pressure of work and other  
649 unforeseen circumstances rendered this impossible. Professor A. Eisenack then agreed to  
650 act as collaborator to assist with the taxonomic section of this paper." (Cookson &  
651 Eisenack 1958, p. 19).

652

653 *Germany calling (mid-late 1950s onwards)*. Because the collaboration with Georges  
654 Deflandre did not eventuate during the 1956–1957 visit to Europe, without one word of  
655 German, Isabel turned to the eminent palynologist Professor Alfred Eisenack of the  
656 University of Tübingen, Germany. Alfred Eisenack (1891–1982) was one of the pioneers

657 of palynology in modern times, and worked on a diverse array of palynomorph groups  
658 including acritarchs, chitinozoa, dinoflagellate cysts and scolecodonts from the  
659 Palaeozoic, Mesozoic and Cenozoic (Gocht 1982a,b, Gocht & Sarjeant 1983, Sarjeant  
660 1985, 1999b). Eisenack retired from his undergraduate teaching duties during 1957,  
661 therefore he had more time to spend on collaborative research. Thus began a long and  
662 extremely fruitful scientific partnership between Cookson and Eisenack on the Jurassic,  
663 Cretaceous and Paleogene organic microplankton of Australia and Papua New Guinea.  
664 Like Georges Deflandre, Alfred Eisenack had a wealth of knowledge on dinoflagellate  
665 cysts and could readily identify the cosmopolitan forms in Isabel's Australian  
666 preparations. The majority of the material that they studied was late Early Cretaceous  
667 (largely Aptian–Albian), Late Cretaceous and Paleogene (Table 5).

668 Isabel visited Germany again between October 1958 and March 1959; this was her  
669 last sabbatical as a member of the academic staff at the University of Melbourne. Isabel  
670 made five further visits to Tübingen, during 1961, 1965, 1968, 1970 and 1972, following  
671 her retirement in 1959, all of which were largely self-financed. However, ICC frequently  
672 referred to funding from CSIRO (e.g., Cookson & Eisenack 1960a, p. 18). She would  
673 travel to Germany for visits of several weeks at a time with prepared material from  
674 Australasia with her; Eisenack never travelled to Melbourne. Cookson stayed at the  
675 Eisenack family home in Reutlingen, and she and Alfred worked both at his flat and at the  
676 Geologisch-Paläontologisches Institut in nearby Tübingen. Gocht & Sarjeant (1983, p.  
677 472) reported that “Cookson became a close – if sometimes rather demanding – friend,  
678 staying with Alfred Eisenack and his wife Helene in Reutlingen during her visits to  
679 Germany”.

680 This scientific partnership was to last the remainder of Isabel's life and Cookson  
681 and Eisenack published 21 papers together between 1958 and 1982 (Table 5). These

682 include three that were published posthumously (Cookson & Eisenack (1974, 1979, 1982).  
683 It cannot be overstated how profoundly scientifically productive the Cookson and  
684 Eisenack team were. For example, they published three papers in 1960, three in 1965 and  
685 four during 1961 and 1962 (Cookson & Eisenack 1960a,b, 1961a,b, 1962a,b, 1965a,b,c,  
686 Eisenack & Cookson 1960).

687         Cookson & Eisenack (1962a, p. 497) stated that: “The authors’ names are arranged  
688 in alphabetical order, without implication of seniority.” Unequivocally, both authors  
689 contributed equally to these contributions, however only in Eisenack & Cookson (1960)  
690 was Alfred Eisenack listed as first author. This highly significant body of work was  
691 consistently characterized by attractive and well-balanced plates of superb  
692 photomicrographs. The photographs were mainly taken in Tübingen using an old Leitz  
693 monocular microscope to which Eisenack attached a box camera made from an old biscuit  
694 tin in order to project the image onto glass negatives or a camera (Fig. 7, Gocht 1982b,  
695 Gocht & Sarjeant 1983). The residues appear to be very clean of extraneous organic debris  
696 and resistant mineral grains. Many of the specimens figured are single grain mounts,  
697 however, Cookson’s use of Schulze’s solution as an oxidant followed by alkali solution  
698 would tend to produce ‘clean’ palynomorph assemblages. Five Mesozoic dinoflagellate  
699 cyst species described by Cookson and Eisenack are illustrated in Fig. 8. Cookson and  
700 Eisenack jointly erected 68 genera and 298 species of acritarchs, dinoflagellate cysts,  
701 prasinophytes and miscellaneous aquatic palynomorphs (Table 5). This prodigious effort  
702 laid the basis for the development of the Mesozoic–Cenozoic stratigraphical marine  
703 palynology of Australasia (e.g., Evans 1966, Morgan 1980, Wiseman 1980, Marshall  
704 1984, Wilson 1984, Davey 1988, 1999, Helby *et al.* 1987, 1988, 2004, Backhouse 1988,  
705 McMinn 1988, Bint & Marshall 1994, Burger 1996, Laurie & Foster 2001, Partridge

706 2006a,b,c,d, Mantle 2009a,b, Riding *et al.* 2010, Mantle & Riding 2012 and references  
707 therein).

708

709 **Fig. 7 to be placed near here.**

710

711           Several of the Cookson and Eisenack papers were significant monographs (e.g.,  
712 Cookson & Eisenack 1958, 1974, 1982), or important papers based on relatively large  
713 numbers of samples (e.g., Cookson & Eisenack 1960a,b, 1962a,b, 1969, 1970b). However,  
714 some of them were based on small numbers of samples; Cookson & Eisenack (1965b,  
715 1967a,b, 1971) were each based on single samples (Table 5). The Cookson and Eisenack  
716 publications were dominantly taxonomic, they rarely described or listed the entire  
717 assemblages and typically mentioned stratigraphical aspects relatively briefly. However, a  
718 significant biostratigraphical section and a range chart were given in the first paper  
719 (Cookson & Eisenack 1958, p 61–70, tables 1, 2). Furthermore, Cookson & Eisenack  
720 (1960a, p. 16) stated: “The present investigation definitely confirms the opinion earlier by  
721 Deflandre and Cookson (1955) and by Cookson and Eisenack (1958 and 1959 [1960b])  
722 that, whilst some Australian microplankton have a relatively long time range, others have  
723 a strictly limited vertical distribution” (present authors clarification in square parentheses).  
724 They also noted that the marine microplankton assemblages from the lower part of the  
725 Gearle Siltstone, the upper part of the Gearle Siltstone and the Toolonga calcilutite in the  
726 Rough Range South No. 1 Bore are distinct from each other. A basic range chart was also  
727 presented by Cookson & Eisenack (1960b, table 1). During the late 1960s and early 1970s,  
728 Cookson and Eisenack frequently included brief introductions by geologists with local  
729 knowledge of the samples studied (e.g., Cookson & Eisenack 1967b, 1970b, 1971). The

730 format and style of the Cookson and Eisenack papers did not discernibly evolve or  
731 progress between 1958 and 1982.

732         The first joint paper, Cookson & Eisenack (1958), was a large monograph on  
733 Jurassic and Cretaceous marine microplankton from New South Wales, Papua New  
734 Guinea, Queensland, South Australia and Western Australia. This work was published  
735 during March 1958, when Isabel and Alfred were 64 and 66 years old respectively. A log  
736 illustrating the positions of 43 samples from the Upper Jurassic and Lower Cretaceous  
737 succession at Omati, Papua New Guinea was given (Cookson & Eisenack 1958, fig. 2).  
738 This was most unusual; normally Cookson and Eisenack simply listed the successions they  
739 studied and typically the precise numbers of samples they studied is not clear. The Jurassic  
740 material is of Callovian to Tithonian age due to the occurrence of key markers such as  
741 *Dingodinium jurassicum* (Fig. 8D), *Herendeenia pisciformis*, *Nannoceratopsis pellucida*,  
742 *Omatia montgomeryi*, *Pyxidiella pandora*, *Scriniodinium crystallinum*, *Wanaea clathrata*,  
743 *Wanaea digitata* and *Wanaea spectabilis* (see Helby *et al.* 1987, figs 15, 21). The majority  
744 of the Cretaceous material is of Aptian–Albian age, and this interval produced index  
745 species such as *Dioxya armata*, *Endoceratium ludbrookiae* and *Endoceratium turneri* (see  
746 Morgan 1980). Some Late Cretaceous material from Western Australia was included and  
747 this yielded Santonian–Maastrichtian marker taxa such as *Dinogymnium westralium*,  
748 *Isabelidinium korojonense* and *Isabelidinium pellucidum* (see Helby *et al.* 1987, fig. 40).  
749 Twelve new genera, 53 new species and three new subspecies were described. The new  
750 genera include *Broomea*, *Dingodinium*, *Muderongia* and *Wanaea*. The publication of  
751 Cookson & Eisenack (1958) was one of the first to discuss dinoflagellate cyst  
752 biostratigraphy.

753         Their 1958 paper was followed two years later by three papers on the Mesozoic of  
754 Australia and Papua New Guinea which, between them, erected 73 new species (Cookson

755 & Eisenack 1960a,b, Eisenack & Cookson 1960). Cookson & Eisenack (1960a) published  
756 an important taxonomic paper on the Cretaceous (Albian to Campanian) marine  
757 microplankton of Victoria and Western Australia. Sixteen genera and 31 species of  
758 acritarchs and dinoflagellate cysts were described. The new genera include  
759 *Amphidiadema*, *Ascodinium*, *Gillinia*, *Microdinium*, *Nelsoniella* and *Xenikoon*. Many key  
760 marker species were established including *Amphidiadema denticulata*, *Ascodinium*  
761 *acrophorum* (Fig. 8B), *Disphaeria macropylla*, *Gillinia hymenophora* and *Nelsoniella*  
762 *tuberculata*. *Conosphaeridium striatoconum*, *Nelsoniella aceras* (Fig. 8C), *Odontochitina*  
763 *porifera*, *Palaeohystrichophora infusorioides* and *Xenikoon australis* were all recorded,  
764 and are Cenomanian to Campanian index species in the zonal scheme of Helby *et al.*  
765 (1987, figs 37, 40). The principal emphasis of Cookson & Eisenack (1960b) was on the  
766 Late Jurassic (Oxfordian to Tithonian) of Western Australia and Papua New Guinea,  
767 however some Lower Cretaceous (Aptian) material was included. Six new genera and 31  
768 new species were described. The new genera include *Belodinium* and *Komewuia*, and the  
769 most important new species described include *Belodinium dysculum*, *Egmontodinium*  
770 *toryna*, *Komewuia glabra* (Fig. 8A) and *Tubotuberella apatela*. The biostratigraphy of  
771 selected taxa were discussed (Cookson & Eisenack 1960b, p 259–261, table 1). The 1960  
772 paper by Eisenack & Cookson is an important study on the Early Cretaceous (Aptian and  
773 Albian) of Queensland, South Australia and Western Australia. It is a follow-up paper to  
774 that of Cookson & Eisenack (1960a). Three new genera, 17 new species and one new  
775 subspecies of dinoflagellate cysts were described. The three new genera include  
776 *Diconodinium* and *Trichodinium*. The new species include *Batioladinium micropodum*,  
777 *Trichodinium pellitum*, *Wrevittia cassidata* and *Wrevittia helicoidea*.

778 Cookson and Eisenack's (1961a) paper was the first by these authors on the  
779 Paleogene. It is on dinoflagellate cysts and prasinophytes from the Eocene of Rottneest



780 Island, Western Australia. The new dinoflagellate cyst genus *Rottnestia*, four new species,  
781 and two new subspecies were described. The presence of *Deflandrea phosphoritica*,  
782 *Diphes colligerum*, *Rottnestia borussica* and *Wilsonidium lineidentatum* is indicative of a  
783 probable early Eocene (Ypresian–Lutetian) age (Wilson 1984, fig. 4, 1988, fig. 4).

784 Cookson & Eisenack (1961b, 1962a,b) published three papers largely on the  
785 Cretaceous (Aptian–Campanian) of Australia. The first of these is on dinoflagellate cysts  
786 from the Belfast No. 4 Bore, Victoria; one new genus and five new species were erected.  
787 A probable Senonian (Coniacian–Campanian) age was invoked, however the occurrence  
788 of *Amphidiadema denticulata* and *Isabelidium belfastense* means that the samples are  
789 late Santonian in age (Helby *et al.* 1987, fig. 40). The 1962a paper by Cookson &  
790 Eisenack is an important contribution on Cretaceous (largely Albian–Cenomanian)  
791 dinoflagellate cysts and acritarchs from Western Australia, with additional material from  
792 Queensland, South Australia and Victoria. Four new genera, 23 new species and one new  
793 subspecies were described. The new dinoflagellate cyst genera include *Canninginopsis*  
794 and *Spinidium*. The most important new species described include *Amphidiadema*  
795 *rectangularis*, *Canninginopsis denticulata* and *Circulodinium attadalicum* (see Helby *et*  
796 *al.* 1987, figs 26, 37). Selected forms of aquatic microplankton from the Cretaceous and  
797 Eocene of Western Australia were described by Cookson & Eisenack (1962b). The  
798 majority of the samples are of Albian to Cenomanian age, however some Campanian and  
799 Eocene material was included. Four new genera, *Halophoridia*, *Horologinella*, *Lecaniella*  
800 and *Schizocystia*, were described. *Horologinella* is a dinoflagellate cyst. *Halophoridia* and  
801 *Schizocystia* are acritarchs, and *Lecaniella* is a green algal genus.

802 It is clear that, between 1963 and 1966, Cookson and Eisenack turned their  
803 attention from the Mesozoic to the Paleogene. They published five papers on the  
804 Paleogene marine palynology of southeastern Australia (Cookson & Eisenack 1965a,b,c,

805 1967a,b). All these papers, except Cookson & Eisenack (1965a), are on material of late  
806 Paleocene to Eocene age. The marine palynology of the Paleogene Dartmoor Formation of  
807 Victoria was studied by Cookson & Eisenack (1965b), and one new dinoflagellate cyst  
808 genus and seven new microplankton species were established. These include the  
809 cosmopolitan dinoflagellate cyst *Apectodinium hyperacanthum*, which is an important  
810 marker for the latest Paleocene to earliest Eocene (latest Thanetian–earliest Ypresian)  
811 (Powell 1992, figs 4.5, 4.6; Kender *et al.* 2012). Cookson & Eisenack (1965c) documented  
812 dinoflagellate cysts from the Paleocene Pebble Point Formation of Victoria, and described  
813 five new species. *Eisenackia crassitabulata*, *Rottnestia borussica* and *Senegalinium?*  
814 *dilwynense* indicate a late Paleocene to early Eocene (?Thanetian–Ypresian) age (Wilson  
815 1984, fig. 4, 1988, fig. 4). Four new microplankton species were described from Tasmania  
816 by Cookson & Eisenack (1967a). The occurrences of *Apectodinium homomorphum*,  
817 *Cordosphaeridium inodes* and *Wilsonidium lineidentatum* are suggestive of the late  
818 Paleocene to Eocene (Thanetian–Bartonian; Wilson 1984, fig. 4; 1988, fig. 4). Cookson &  
819 Eisenack (1967b) described the marine palynology of the late Paleocene Rivernook Bed of  
820 Victoria, and three new species were established. The presence of *Apectodinium*  
821 *hyperacanthum* and *Muratodinium fimbriatum* is consistent with a latest Paleocene to  
822 earliest Eocene (latest Thanetian–earliest Ypresian) age by comparison with Europe  
823 (Powell 1992, figs 4.5, 4.6; Stover *et al.* 1996, fig. 32). By contrast, the presence of  
824 *Cordosphaeridium inodes* and *Hystrichololpoma rigaudiae* are suggestive of an  
825 exclusively Eocene age by comparison with the Southern Hemisphere (Wilson 1984, fig.  
826 4, 1988, fig. 4).

827 Cookson & Eisenack (1965a) studied the marine microplankton from the upper  
828 Eocene Browns Creek Clays of Victoria, and established two new genera and 13 new  
829 species. Marker species such as *Deflandrea phosphoritica*, *Impagidinium elegans*,

830 *Phthanoperidinium? eocenicum* and *Schematophora speciosa* indicates a late Eocene  
831 (Priabonian) age (Wilson 1984, fig. 4).

832 Between 1968 and 1971, Isabel and Alfred focussed back on the Mesozoic, and  
833 Cookson & Eisenack (1968, 1969, 1970a,b, 1971) are largely on the Cretaceous (Albian to  
834 Campanian) of Western Australia. Only Cookson & Eisenack (1970a) includes Paleogene  
835 material and samples from Victoria.

836 Cretaceous dinoflagellate cysts were described from two samples from the Gingin  
837 Brook No. 4 Borehole by Cookson & Eisenack (1968). This material was supplied by A.E.  
838 Cockbain of the Geological Survey of Western Australia in response to a request for  
839 samples from Isabel in 1967. The uppermost sample is Late Cretaceous, probably  
840 Santonian, in age due to the occurrence of species such as *Gillinia hymenophora*,  
841 *Manumiella? cretacea* and *Manumiella lata* (see Marshall 1984; Helby *et al.* 1987, fig.  
842 40). The lowermost horizon is late Albian to early Cenomanian on the basis of key  
843 markers such as *Canninginopsis denticulata* and *Litosphaeridium siphoniphorum* (see  
844 Helby *et al.* 1987, fig. 37).

845 Dinoflagellate cysts from the Cretaceous Osborne Formation at Balcatta were  
846 documented by Cookson & Eisenack (1969). The material studied was stated to be of  
847 Albian–Cenomanian age, however it is clearly significantly younger, and is of latest  
848 Turonian to early Santonian age due to the occurrence of key markers such as  
849 *Chatangiella tripartita*, *Conosphaeridium striatoconum* and *Isabelidinium glabrum* (Fig.  
850 8F; Helby *et al.* 1987, figs 37, 40). Cookson & Eisenack (1970a) is a brief account of  
851 some green algae from the Cretaceous and Paleogene of Victoria and Western Australia.

852 The Cretaceous marine microplankton of the Eucla Basin was studied by Cookson  
853 & Eisenack (1970b). The new dinoflagellate cyst genus *Maduradinium* and 22 new marine  
854 microplankton species were established. The authors stated that the range of ages studied

855 is Albian–Cenomanian and Coniacian–Campanian. Many of the taxa are not established  
856 marker species, but the occurrences of *Dinogymnium westralium*, *Heterosphaeridium*  
857 *conjunctum*, *Maduradinium pentagonum* and *Magallanesium balmei* are indicative of a  
858 late Santonian to early Campanian age (Marshall 1984, Helby *et al.* 1987, fig. 40).  
859 Cookson & Eisenack (1971) is on the ‘Mid’-Cretaceous (Albian–Cenomanian) marine  
860 microplankton from the Eyre No. 1 Bore; the new acritarch genus *Enigmasphaera* and 11  
861 new marine microplankton species were described.

862           Three Cookson and Eisenack papers were published following Isabel’s death in  
863 1971. The first of these is a major monograph on the Late Jurassic, Cretaceous and  
864 Paleogene of Australia and Papua New Guinea (Cookson & Eisenack 1974). It was clearly  
865 a joint contribution. It was stated on p. 87 that, when the project was virtually finished,  
866 Eisenack received a message from Melbourne informing him of Cookson’s death on the 1<sup>st</sup>  
867 of July 1973. The dedication by Eisenack on the first page is “In memory of joint work”  
868 (*In Erinnerung an gemeinsame Arbeit*). Eisenack also commented in the epilogue (p. 87)  
869 that Isabel’s life was almost exclusively devoted to her scientific work, and how happy he  
870 was to have worked with her. These are touching tributes to a prodigiously productive 15-  
871 year collaboration between these legendary palynologists. The second posthumous  
872 contribution was Cookson & Eisenack (1979). This is a short paper which described three  
873 new genera of green algae from the Cretaceous (Albian and younger) from the Eucla  
874 Basin in Western Australia. Eisenack explained on p. 77 that, on her last visit to Tübingen  
875 in 1972, ICC left behind some Australian material for him to study and exploit as he saw  
876 fit. After the death of Isabel in 1973, Eisenack felt it was his duty to publish under both  
877 their names. Isabel Cookson’s final paper, published nine years after her death, was  
878 Cookson & Eisenack (1982) and is the second part (*Zweiter Teil*) of Cookson & Eisenack  
879 (1974). It was largely written by Eisenack, and was completed and submitted to the

880 journal by Hans Gocht, a long-time collaborator and colleague, following Eisenack's death  
881 in April 1982. Cookson & Eisenack (1982) is an extensive monograph on the Late  
882 Jurassic, Cretaceous and Paleogene of Queensland, South Australia, Tasmania and  
883 Western Australia. Material from the majority of the sample base of Cookson & Eisenack  
884 (1974) was treated, plus samples from additional sections from Queensland, South  
885 Australia and Tasmania.

886 The type material of the Australian dinoflagellate cysts described by Isabel  
887 Cookson and her co-workers between 1955 and 1974 was rephotographed and issued as a  
888 set of 35 mm colour transparencies by Helby & Partridge (1980).

889

890 **Fig. 8 to be placed near here.**

891

892 *Poles apart? An Australian-Norwegian alliance (1959–1964)*. On the basis of her  
893 distinguished work on Silurian–Devonian palaeobotany, Isabel was invited for an  
894 extended working visit to the University of Oslo in Norway by Professor Ove Arbo Høeg  
895 from late May 1959 to early January 1960. Jorunn Os Vigran was an undergraduate  
896 student at Oslo at the time, and recalls how “Miss Cookson” or “Missen” was treated with  
897 great respect by everyone in the Department (personal communication to JBR, 2013). Ove  
898 Høeg was an expert on the Devonian floras of Spitsbergen. It was during this trip to Oslo  
899 that ICC first worked with the first Norwegian pre-Quaternary palynologist, Svein Bendik  
900 Manum (Fig. 9). At that time Manum worked solely on terrestrial palynomorphs, and ICC  
901 and he discussed their shared interest in pollen and spores, and the stock market! Manum  
902 was specifically interested in the Paleogene palynology of the Arctic region, and had just  
903 received some supposedly marine sedimentary rock samples from the Paleogene of  
904 Spitsbergen that he had not prepared. The ever-enthusiastic, diligent and industrious Isabel

905 offered to process this material in Oslo in order to spend her Norwegian sojourn more  
906 productively. Manum (2003, p. 4) recounted how, two days later, ICC excitedly asked him  
907 to look at some distinctive large dinoflagellate cysts. This experience instantly made Svein  
908 interested in these fascinating marine palynomorphs. These large, bicavate peridiniacean  
909 forms with two distally-rounded prominent polar horns were later named for Isabel as  
910 *Svalbardella cooksoniae* by Manum (1960) (Fig. 10). This species is a cold-water form  
911 and is typical of the Oligocene of the Northern Hemisphere, although its total range is  
912 Eocene to Oligocene (Head & Norris 1989, Manum *et al.* 1989, Powell 1992, Van  
913 Simaeyns *et al.* 2005, Pross *et al.* 2010, Śliwińska & Heilmann-Clausen 2011). At this time,  
914 Svein Manum was working on the Paleogene of the Canadian Arctic in order to compare it  
915 with his work in Spitsbergen (Manum 1962), and searched the collections of the second  
916 Norwegian “Fram”-expedition (1892–1902) to the Queen Elizabeth Islands. He found  
917 samples of Paleogene coals, and also took a subsample of a soft, grey shale from Graham  
918 Island in Arctic Canada. This shale proved to be pre-Paleogene, and ICC eagerly offered  
919 to help in the study of the abundant dinoflagellate cysts and pollen. Indeed, Manum (1991)  
920 stated that Isabel “immediately insisted that we should work on it.” While in Oslo Isabel  
921 also met and befriended the palynologist Jorunn Os Vigran, however they never worked  
922 together.

923         This visit by ICC to Oslo in 1959–1960, and another trip to Norway between  
924 October and December 1961, resulted in three joint publications with Svein Manum  
925 (Table 5). Isabel also visited Norway in May 1963 during one of her German sojourns (see  
926 above). The 1961 visit was during winter and Manum recalls that Isabel was nervous of  
927 the slippery icy pavements in Oslo, and how he had to lead her by the arm on the  
928 homeward journey after work. Much of their joint research was done via correspondence  
929 because Isabel only visited Norway occasionally, and Manum never visited ICC in

930 Melbourne. The first of these three joint papers was Cookson & Manum (1960), a short  
931 contribution on the taxonomy of some prasinophytes from the Cretaceous and Paleogene  
932 of Australia, Papua New Guinea and Spitsbergen. Three species of the new genus  
933 *Crassosphaera* were described. Interestingly, this is only the second paper where Isabel  
934 gave an address other than the University of Melbourne; both authors are listed as being at  
935 the Institute of Geology, University of Oslo, Norway. Cookson & Manum (1964) was a  
936 brief note on the taxonomy of the Late Cretaceous dinoflagellate cysts now known as  
937 *Chatangiella tripartita* and *Chatangiella victoriensis* (see Fig. 8E) from Victoria and  
938 Western Australia.

939         Manum & Cookson (1964) is by far the most important output by the Cookson-  
940 Manum team, and built on the previous work of Manum (1963). This is a major work on  
941 the marine microplankton from the single shale sample from Graham Island, in Arctic  
942 Canada mentioned above. The bulk of this work is a systematic section, which included  
943 the descriptions of 11 new species of dinoflagellate cysts. The sample is rich in cavate  
944 peridiniacean taxa, especially representatives of *Chatangiella* and *Isabelidium*. Several  
945 species originally described from Australia were noted, including *Microdinium ornatum*,  
946 *Odontochitina costata* and *Trigonopyxidina ginella*. Fern spores and gymnospermous pollen  
947 are present, although angiosperm pollen was not encountered. Manum & Cookson (1964)  
948 assigned an early Late Cretaceous age to this sample, and assumed it to be from the Hassel  
949 Formation. However, Felix & Burbridge (1976) established that the sample is from the  
950 Kanguk Formation, and is of late Cenomanian to early Campanian in age. This age  
951 assessment can be refined further. The presence of prominent *Chatangiella* spp., together  
952 with *Heterosphaeridium difficile*, and the absence of the Cenomanian–Turonian markers  
953 *Litosphaeridium siphoniphorum* and *Stephodinium coronatum*, is indicative of a Coniacian  
954 to early Santonian age for this sample (Costa & Davey 1992, Nøhr-Hansen 1996, Stover *et*

955 *al.* 1996). Manum & Cookson (1964) also studied two samples stated to be from the  
956 Hassel Formation from Ellef Rignes Island, Arctic Canada, which yielded similar  
957 microplankton associations to the Graham Island sample. In fact they are from the Kanguk  
958 Formation (Felix & Burbridge 1976, Manum 1991). Marine microplankton from nearby  
959 Banks Island documented by Thorsteinsson & Tozer (1962) are also similar to the  
960 assemblages from Ellef Rignes and Graham islands. This major work was completed by  
961 correspondence between Melbourne and Oslo. Copies of Manum & Cookson (1964) were  
962 much in demand because it was published at a time when many oil companies were  
963 starting to explore the Canadian Arctic archipelago, and there was hardly any  
964 biostratigraphical data available from this region.

965 Svein Manum was appointed as a professor at Makerere University, Kampala,  
966 Uganda, where he was Head of Botany between 1967 and 1970. Isabel visited Svein there  
967 in November 1969, and they undertook a two-day safari to Murchison Falls National Park  
968 which Isabel thoroughly enjoyed.

969

970 **Figs 9 and 10 to be placed near here.**

971

972 *The old country revisited. Cambridge (1961–1964).* Isabel Cookson was one of several  
973 palynologists from Australia and New Zealand to work with Norman F. Hughes at the  
974 University of Cambridge during the 1950s and 1960s. The others were R. Ashley Couper,  
975 Mary E. Dettmann, Elizabeth M. Fowler (later Kemp then Truswell), Geoffrey Norris and  
976 Geoffrey Playford. ICC travelled to Cambridge, where she had previously visited the  
977 botanist and palaeobotanist Professor Sir Albert C. Seward in 1925, during 1959, 1961 and  
978 1963.



979 Isabel first worked on Cretaceous marine palynomorphs from three samples from  
980 the middle Albian and lower Cenomanian succession exposed in a cement quarry near  
981 Barrington, Cambridgeshire, UK during visits in 1959 and 1961. Two of these were  
982 collected and prepared by one of us (MED) for pollen and spores in 1959. A diverse and  
983 spectacular association of dinoflagellate cysts with some acritarchs and prasinophytes was  
984 discovered from the Gault, Cambridge Greensand and West Melbury Marly Chalk  
985 (formerly Chalk Marl) formations (middle Albian–lower Cenomanian), and ICC was  
986 extremely enthusiastic about documenting these assemblages. One paper, Cookson &  
987 Hughes (1964), resulted from this collaboration and nine new species were described,  
988 some of which are reliable index species in the ‘Middle’ Cretaceous. These marker taxa  
989 include *Apteodinium maculatum* subsp. *grande*, *Carpodinium obliquicostatum*,  
990 *Cauveridinium membraniphorum*, *Endoceratium dettmannae*, *Epelidosphaeridia spinosa*,  
991 *Leberidocysta chlamydata*, *Litosphaeridium siphoniphorum*, *Ovoidinium scabrosum*,  
992 *Ovoidinium verrucosum* and *Xiphophoridium alatum* (for example Verdier 1974, Foucher  
993 1981, 1983, Below 1984, Heilmann-Clausen 1987, Masure 1988, Costa & Davey 1992,  
994 Tocher & Jarvis 1996). The microtome sections of *Endoceratium dettmannae* and  
995 *Scriniodinium campanula* (see Cookson & Hughes 1964, pl. 7, figs 4, 8, 9) were made by  
996 one of us (MED) using the technique outlined by Hughes *et al.* (1962).

997 Cookson & Hughes (1964) unequivocally demonstrated that ICC had become an  
998 genuine expert in dinoflagellate cysts in the decade since her first paper on marine  
999 microplankton (Cookson 1953d). This is because Norman F. Hughes (1918–1994) was a  
1000 well known researcher on Cretaceous pollen and spores (Batten 1986). Hughes was  
1001 assuredly not a specialist on aquatic palynomorphs, and it is clear that Isabel was entirely  
1002 responsible for the systematic section in Cookson & Hughes (1964), which comprises the  
1003 overwhelming majority of this paper.

1004

1005 *Americana* (1967). Isabel's fifth and final collaborator on marine microplankton was Lucy  
1006 M. Cranwell of Tucson, Arizona, USA. ICC had known the New Zealand-born Cranwell  
1007 for many years largely due to their shared interest in *Nothofagus* pollen, and visited her  
1008 during early 1963. They published one paper, Cookson & Cranwell (1967) on the  
1009 palynology of a single sample of Eocene age from near Punta Arenas in southern Chile.  
1010 The original intention was to help determine the spatial and temporal distribution of the  
1011 southern beech tree, *Nothofagus*. However, although *Nothofagus* pollen was found, the  
1012 sample is dominated (>70–80%) by dinoflagellate cysts and Cranwell requested Isabel's  
1013 help with these. The genus *Deflandrea* is prominent, and the Eocene marker  
1014 *Areosphaeridium diktyoplocum* was recorded. *Deflandrea oebisfeldensis* and  
1015 *Thalassiphora pelagica* were also noted; these species are both typical of the Eocene  
1016 (Stover *et al.* 1996). The new species *Operculodinium severinii* was also described.

1017

1018 *Taxonomic tributes to Isabel Cookson from the world of dinoflagellate cysts.* Because of  
1019 her enormous contribution to dinoflagellate cyst taxonomy, the genera *Cooksonidium*,  
1020 *Cooksoniella*, *Isabelia* and *Isabelidium* were named after ICC. *Cooksonidium* was  
1021 erected by Stover & Williams (1995), and contains two Eocene species; the type species is  
1022 *Cooksonidium capricornum*. *Cooksoniella*, which was described by Vozzhennikova  
1023 (1967), is invalid because it is a junior synonym of *Chatangiella* according to Lentin &  
1024 Williams (1975). *Isabelia* was introduced by Lentin & Williams (1975) to accommodate  
1025 many of the Late Cretaceous cavate peridiniacean species described by Isabel and her co-  
1026 authors. This bicavate to circumcavate genus is characterized by an omegaform hexa  
1027 anterior intercalary periarchoepyle formed by the 2a plate, which is clearly visible in the

1028 type species, *Isabelidium korojonense*. However, the name *Isabelia* is preoccupied by a  
1029 Brazilian orchid, so Lentin & Williams (1977) established *Isabelidium* as a substitute  
1030 generic name. Additionally, there are eight dinoflagellate cysts with the specific name  
1031 *cooksoniae* (see Lentin & Williams 1989, p. 11); one of these is the appropriately-named  
1032 *Isabelidium cooksoniae*.

1033

1034 **Table 5 to be placed near here.**

1035

### 1036 **Retirement? (1959–1972)**

1037 Isabel officially retired from her position as Senior Lecturer in Botany at the University of  
1038 Melbourne in 1959, after returning from a sabbatical visit to Norway. However she  
1039 continued in active research as an Honorary Research Fellow until mid-1972. Her *alma*  
1040 *mater* generously provided Isabel with an office and laboratory facilities. With no  
1041 teaching, or administrative duties, Cookson had more time to pursue her life's work of  
1042 research into palaeobotany and palynology. ICC was prodigiously productive post 1959;  
1043 she published 33 of her 93 papers after her retirement! Isabel was also Honorary Associate  
1044 in Palaeontology at the National Museum of Victoria in Melbourne between 1959 and  
1045 1962; the majority of her type and figured palynomorph specimens from eastern Australia  
1046 are curated there. Type and figured material from Western Australia from Cookson &  
1047 Eisenack (1968) and subsequent papers on Western Australia is lodged with the  
1048 Geological Survey of Western Australia in Perth; all the earlier Western Australian  
1049 material is curated at Museum Victoria. ICC was also made a Full Member and,  
1050 immediately after this, a Life Member of the Royal Society of Victoria in 1959.

1051 Cookson continued to visit Germany to collaborate with Alfred Eisenack in  
1052 retirement, and she visited Tübingen in 1961, 1965, 1968, 1970 and 1972. All but one  
1053 (Cookson & Eisenack 1958) of her 21 joint papers with Eisenack were published after she  
1054 retired. During the 1940s her university salary had significantly increased, and Isabel  
1055 began to invest her savings in the stock market at this time. She quickly became an astute  
1056 and skillful investor, and used profits from share dealing to fund her research generally  
1057 and her working trips to Germany in retirement. One of Isabel's favourite stocks was  
1058 Mount Isa Mines of northwest Queensland, some of which she bought in the 1940s, for no  
1059 other reason that it reminded her of one of her nicknames ("Isa")! Despite this rather  
1060 subjective reasoning, Mount Isa Mines proved an excellent investment for her.

1061 A two day symposium on Mesozoic and Cenozoic palynology was held in honour  
1062 of Isabel during May 1971 at the 43<sup>rd</sup> Congress of the Australian and New Zealand  
1063 Association for the Advancement of Science (ANZAAS) at the University of Queensland,  
1064 Brisbane (Fig. 11). The symposium, convened by Geoffrey Playford, was well attended by  
1065 palynologists from geological surveys, oil companies and universities. The resulting  
1066 *Festschrift* volume (Glover & Playford 1973) was published by the Geological Society of  
1067 Australia and was reviewed by Hughes (1975) and Traverse (1975).

1068

1069 **Fig. 11 to be placed near here.**

1070

1071 Isabel sadly died of a heart attack on July 1<sup>st</sup> 1973, aged 79 years, 7 months, at her  
1072 home in Hawthorn, Victoria following a short illness. She passed away only six months  
1073 prior to her 80<sup>th</sup> birthday. Unfortunately, she died while her *Festschrift* (Glover & Playford  
1074 1973) was in press. Isabel was cremated, and later her estate was sworn for probate at

1075 AUS\$169,112. Baker (1973a) and Archangelsky (1974) published obituaries of Isabel.

1076 She bequeathed her palaeobotanical library to John G. Douglas.

1077           The Botanical Society of America has awarded the Isabel C. Cookson

1078 Palaeobotanical Award to the best paper or poster on palaeobotany or palynology

1079 presented at their annual meeting given by a student or early-career researcher since 1976

1080 (see [http://www.botany.org/awards\\_grants/detail/cookson.php#79](http://www.botany.org/awards_grants/detail/cookson.php#79)). The annual prize is of

1081 US\$300, which is paid from a legacy bequeathed by ICC. The first recipient was Elisabeth

1082 A. Wheeler of Harvard University for “Some fossil dicotyledonous woods of Yellowstone

1083 National Park” in 1976.

1084           Another posthumous honour was that Cookson Place in Banks, one of the

1085 southernmost suburbs of Canberra, Australia was named in honour of Isabel (Fig. 12). The

1086 theme of the street names in Banks is botany or natural history. The suburb of Banks was

1087 named for Sir Joseph Banks (1743–1820), the famous botanist who accompanied Captain

1088 James Cook on his first great Pacific voyage between 1768 and 1771.

1089

1090 **Fig. 12 to be placed near here.**

1091

## 1092 **Overview**

1093 Isabel Clifton Cookson was a larger-than-life character and had a long, active and very full

1094 lifetime. ICC’s pioneering work in botany, palaeobotany, and both terrestrial and marine

1095 palynology during her 58 year research career marks Isabel as a highly influential

1096 researcher over an extremely broad scientific spectrum. She is recalled by her peers as

1097 being astute in her thinking, and being significantly ahead of her time. Isabel made the

1098 journey from undergraduate to honorary research fellow over six decades at the University

1099 of Melbourne and travelled extensively throughout her career. It is remarkable how she

1100 undertook pioneering research in palaeobotany, then went on to become the first  
1101 palynologist in Australia. ICC is one of the great botanical taxonomists; she described, or  
1102 jointly described, a phenomenal total of 110 genera, 557 species and 32 subspecies (or  
1103 similar) of palynomorphs and plants (Tables 2–5). These taxa include 76 genera and 386  
1104 species of marine microplankton, and 29 genera and 137 species of sporomorphs (Tables  
1105 4, 5). With this taxonomic basis she, therefore, began the stratigraphical application of  
1106 palynology in Australia, and is unequivocally one of Australia’s most important women  
1107 scientists. It is extremely unfortunate that Isabel did not live to see her pioneering work in  
1108 Australian palynology develop and be used as an invaluable and precise tool in geological  
1109 exploration. Her impressive list of 93 scientific publications (Online supporting data:  
1110 Appendix 1) is *prima facie* evidence of her being creative, dedicated, hardworking and  
1111 perceptive; furthermore, she was obviously a very good team player. ICC’s scientific  
1112 legacy is even more impressive when one considers that she was a woman in an extremely  
1113 male-dominated world at the time, and that much of her research was undertaken under  
1114 very difficult conditions and frequently with little funding. In the early part of her career  
1115 particularly, she existed for long periods on short-term contracts (‘soft money’), and  
1116 funded herself personally after retirement. This is clear evidence of her determination,  
1117 drive and fortitude.

1118 Isabel did not have a privileged background; she supported and nursed her mother,  
1119 Elizabeth Cookson, through a long illness (dementia) during the 1940s as a young woman  
1120 under somewhat strained financial circumstances. She never married, and had no close  
1121 relatives after the deaths of her parents; her mother died in 1947. Her scientific work was  
1122 her entire life; she would routinely rise at around 04.45 h, and take the 06.00 h train from  
1123 home in the suburbs to her office at the University of Melbourne. Isabel made most of her  
1124 friendships and human contacts via her research; she definitely preferred scientific

1125 collaboration to working alone. She had no domestic issues preventing her from  
1126 undertaking her many extended working trips to Europe. One of us (MED) recalls that  
1127 Isabel was an entertaining conversationalist, and that her thoughts were never far from her  
1128 research. That speaks volumes about Isabel Cookson the consummate and dedicated  
1129 scientist, who published 33 papers after her retirement when she could easily have chosen  
1130 to take it easy and pursue non-scientific pastimes during a more relaxing and stress-free  
1131 post-working life. Isabel was a rather private person and did not like being photographed,  
1132 but had a small but close circle of friends with whom she shared an interest in music and  
1133 travel. In her later years she organized her work schedule to be free to listen to the  
1134 Australian Broadcasting Commission radio programmes 'Blue Hills' and 'The Argonauts.'  
1135 She could come across as being somewhat abrupt, but underneath she was very sensitive,  
1136 and her feelings were easily bruised by criticism or perceived criticism.

1137         Turner (2007, p. 190) noted that Isabel “only achieved senior lecturer status” at the  
1138 University of Melbourne. Clearly, a scientist as distinguished as ICC should have been  
1139 promoted beyond the rank of senior lecturer. However, sexual discrimination was endemic  
1140 in Australia and elsewhere at that time (Kelly 1993, Turner 1998). Morgan (1981) also  
1141 mentioned that ICC was relatively unacknowledged, and Traverse (1975, p. 239) stated  
1142 that ICC was "Handicapped by her sex and by her geographic isolation in Australia, Dr.  
1143 Cookson was not destined to achieve the monetary and other rewards of status a male  
1144 person of her stature from, say, the U.S.A. would probably have received.....”

1145         This contribution seeks to set the record straight in certain respects. Douglas and  
1146 Holmes (2006) regarded her as solely a plant taxonomist, and stated that she “never  
1147 ventured into the field.” This is not the case because Isabel unequivocally was a true  
1148 polymath and collected outcrop material of the Palaeozoic *Baragwanathia* flora from  
1149 bushland localities near Woods Point and Walhalla in east Victoria (Lang & Cookson

1150 1935). Furthermore, Lang (1937, p. 250) described fieldwork with Isabel to Perton Quarry  
1151 in Herefordshire, England where she collected fossil plant specimens that William H.  
1152 Lang described as *Cooksonia* in recognition of ICC. It has also been occasionally  
1153 suggested anecdotally that ICC was not a team player possibly because her palynological  
1154 collaboration with Georges Deflandre was relatively short. This is assuredly not the case.  
1155 Isabel successfully ran the Brown Coal Pollen Research Unit at the University of  
1156 Melbourne for many years, and the majority of her papers were joint ones; she published  
1157 with 22 co-authors (Online supporting data: Appendix 1).

1158

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1182

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1775

1776

1777 **Display material captions:**

1778

1779 *Fig. 1.* A group of biology students at the University of Melbourne taken probably  
1780 sometime between 1913 and 1917. Isabel Cookson is on the extreme right, top row. The  
1781 precise date and the photographer are unknown. Reproduced with permission of the  
1782 University of Melbourne.

1783

1784 *Fig. 2. Baragwanathia longifolia* Lang & Cookson 1935. Specimen number C115 in the  
1785 Isabel Cookson collection housed in Museum Victoria, Melbourne, Australia. It is part of a  
1786 well-preserved shoot 11.7 cm long with numerous long simple leaves, and is preserved as  
1787 a thin carbonaceous film. The specimen was originally illustrated by Lang & Cookson  
1788 (1935, pl. 29, fig. 1) and is from the Yarra Track locality, 27.36 km from Woods Point,  
1789 eastern Victoria, Australia. Isabel Cookson collected this material, which is situated in  
1790 rough bushland country in the upper reaches of the Yarra Valley. The beds yielding  
1791 *Baragwanathia longifolia* at Yarra Track are closely associated with stratigraphically-  
1792 significant late Silurian (Ludlow) graptolites.

1793

1794 *Fig. 3.* Fossil fungal material from Kerguelen Island and Yallourn, Victoria, described by  
1795 Isabel Cookson. **A, B,** – *Notothyrites setiferus* Cookson 1947. Material from a lignite bed  
1796 at Porte Jeanne d’Arc, Kerguelen Island, southern Indian Ocean. **A,** An ascoma in lateral  
1797 view exhibiting the basal setae. **B,** A basal view of the covering membrane. The scale bars  
1798 = 25 µm. These specimens were originally figured by Cookson (1947a, pl. 11, figs 4 and 5  
1799 respectively. **C,** – *Trichopeltinites pulcher* Cookson 1947. Material of Oligocene–Miocene  
1800 age from the State Electricity Commission’s open cut at Yallourn, Victoria. A thallus on  
1801 the upper epidermis of *Oleinites willisii* Cookson 1947 (Oleaceae) The scale bar = 50 µm.  
1802 This specimen was originally figured by Cookson (1947a, pl. 14, fig. 22).

1803

1804 *Fig. 4.* Seven Cretaceous, Paleogene and Neogene pollen grains (A–C, F–I) and two  
1805 spores (D, E) described by Isabel Cookson. The scale bars = 10 µm. **A,** – *Araucariacites*  
1806 *australis* Cookson 1947 ex Couper 1953. Museum Victoria specimen number P31031. The  
1807 lectotype originally illustrated by Cookson (1947d, pl. 13, fig. 3), and refigured by  
1808 Dettmann & Jarzen (2000, fig. 39). From a Miocene lignite at Porte Jeanne d’Arc,

1809 Kerguelen Island, southern Indian Ocean. This species is similar to the pollen of extant  
1810 *Agathis*, and is widespread in upper Mesozoic to Holocene sedimentary rocks and  
1811 sediments. **B**, – *Microcachryites antarcticus* Cookson 1947 ex Couper 1953. A syntype  
1812 illustrated by Cookson (1947d, pl. 14, fig. 18). Sample details as 1. This trisaccate species  
1813 is similar to pollen from extant *Microcachyrs* (Podocarpaceae) and is commonly abundant  
1814 in Mesozoic and Cenozoic strata throughout the Southern Hemisphere. **C**, –  
1815 *Podocarpidites ellipticus* Cookson 1947 ex Couper 1953. Museum Victoria specimen  
1816 number P31033. The lectotype illustrated by Cookson (1947d, pl. 13, fig. 6). Sample  
1817 details as 1. **D**, – *Cyatheacidites annulata* Cookson 1947 ex Potonié 1956. Museum of  
1818 Victoria specimen number P31046. The lectotype illustrated by Cookson (1947d, pl. 15,  
1819 fig. 53). Sample details as 1. This species is similar to the spores of extant *Lophosoria*, a  
1820 fern genus now confined to central and South America. **E**, – *Ruffordiaspora australiensis*  
1821 (Cookson 1953) Dettmann & Clifford 1992. Museum Victoria specimen P22034.  
1822 Illustrated by Dettmann (1963, pl. 9, figs 12, 13, 15) and Dettmann & Clifford (1992, pl. 8,  
1823 figs A–C). The specimen is from the Eumeralla Formation at 804 m in the Robe Bore 1,  
1824 Otway Basin, South Australia. This sample is within the *Coptospora paradoxa* spore-  
1825 pollen zone of Early Cretaceous (Albian) age (Partridge 2006a). This species is one of the  
1826 first Mesozoic *sporae dispersae* described by Cookson (1953b), as *Mohriospurites*  
1827 *australiensis*. It is the nominate species of the Early Cretaceous (Berriasian–Valanginian)  
1828 *Ruffordiaspora australiensis* spore-pollen zone in Australia (Partridge 2006a). The first  
1829 appearance of *Ruffordiaspora australiensis* defines the base of this zone, and corresponds  
1830 to the Jurassic/Cretaceous boundary (e.g., Helby *et al.* 1987, fig. 45, Partridge 2006a). **F**, –  
1831 *Tricolpites reticulatus* Cookson 1947 ex Couper 1953. Museum Victoria specimen number  
1832 P31064. The holotype illustrated by Cookson (1947d, pl. 15, fig. 45), refigured by Jarzen  
1833 & Dettmann (1989, pl. 1, fig. 1). Sample details as 1. This species is similar to the pollen

1834 of *Gunnera*, a genus of perennial stoloniferous herbs largely confined to the Southern  
1835 Hemisphere. **G**, – *Proteacidites adenanthoides* Cookson 1950. University of Queensland  
1836 Micropalaeontological Collection specimen UQY6532, housed at the Queensland  
1837 Museum. Specimen illustrated by Dettmann & Jarzen (1996, figs 14a–c). The specimen is  
1838 from the Paaratte Formation at 1720 m at Bridgewater Bay, Otway Basin, offshore  
1839 western Victoria; this sample is within the *Tubulifloridites lilliei* spore-pollen zone of Late  
1840 Cretaceous (middle–late Campanian) age (Partridge 2006b,c). This species is similar to  
1841 pollen of the Proteaceae. **H**, – *Nothofagidites emarcidus* (Cookson 1959) Harris 1965.  
1842 Museum Victoria specimen P17668. The holotype, illustrated by Cookson (1959, pl. 4, fig.  
1843 7) and Dettmann *et al.* (1990, pl. 3, figs 2a–c). This specimen is from a clay at the base of  
1844 the Yallourn Seam of the Yallourn Formation at Yallourn, Victoria; the sample is within  
1845 the *Triporopollenites bellus* spore-pollen zone of middle–late Miocene age (Partridge  
1846 2006c). Pollen of this type is produced by the *brassii* group of extant *Nothofagus*, which is  
1847 now restricted to New Caledonia and Papua New Guinea. **I**, – *Nothofagidites asperus*  
1848 (Cookson 1959) Romero 1973. Museum Victoria specimen P17663. A paratype,  
1849 illustrated by Cookson (1959, pl. 4, fig. 2) and Dettmann *et al.* (1990, pl. 1, fig. 2, pl. 2,  
1850 fig. 1). The specimen is from a mudstone underlying basalts dated as ~30 Ma (early  
1851 Oligocene) at Vegetable Creek near Emmaville, New South Wales. This species is the  
1852 nominate taxon of the middle Eocene to early Oligocene (Lutetian–Rupelian)  
1853 *Nothofagidites asperus* spore-pollen zone for the marginal basins of southeast Australia  
1854 (Partridge 2006c). Pollen of this type is produced by the *menziesii* group of *Nothofagus*.  
1855  
1856 *Fig. 5.* Isabel Cookson working at the microscope at the University of Melbourne in June  
1857 1942, during World War II. She is examining part of a Japanese "zero" fuel tank. The  
1858 photograph was taken by a reporter for the Herald Newspaper. This is Australian War

1859 Memorial photograph 136506 (<http://www.awm.gov.au/collection/136506>), and is  
1860 reproduced with permission.

1861

1862 *Fig. 6.* Isabel Cookson (seated) and an unidentified woman in Isabel's office in the Brown  
1863 Coal Pollen Research Unit (PRU) at the University of Melbourne in 1954. The  
1864 photographer is unknown. Reproduced with permission of the University of Melbourne.

1865

1866 *Fig. 7.* The rather primitive (by contemporary standards) Leitz monocular microscope  
1867 used by Alfred Eisenack. The camera tube was constructed by Eisenack from an old  
1868 biscuit tin in order to project images into a camera. An earlier iteration of this apparatus  
1869 had a plate for glass negatives at the top of the tin cylinder (see Gocht 1982, p. 151). Note  
1870 the lack of both an internal illumination unit and a mechanical stage. Eisenack's  
1871 photomicroscope is now housed in a display at Eberhard Karls Universität Tübingen,  
1872 Germany. Photograph copyright: Wolfgang Gerber, Department of Geosciences, Eberhard  
1873 Karls Universität Tübingen, reproduced with permission.

1874

1875 *Fig. 8.* Six Mesozoic dinoflagellate cysts described by Isabel Cookson and co-workers.  
1876 These images were scanned from slides 146, 19, 167, 82, 47 and 140 of Helby & Partridge  
1877 (1980), and are reproduced with permission. The scale bars in A–E and F = 50  $\mu\text{m}$  and 25  
1878  $\mu\text{m}$  respectively. **A**, – *Komewuia glabra* Cookson & Eisenack 1960. This species was  
1879 emended by Chen (1982, p. 32, 35). The holotype (Cookson & Eisenack 1960b, p. 257, pl.  
1880 39, fig. 8), from the upper part of the Jarlemai Siltstone of the Broome Number 3 Bore,  
1881 Western Australia at 317.60–305.10 m. Museum Victoria specimen number P17785.  
1882 *Komewuia glabra* is a proximate, biconical cyst with two prominent polar horns and a  
1883 single plate precingular archaeopyle. It is indicative of the late Kimmeridgian–Tithonian

1884 interval in the Southern Hemisphere; it is typically common/abundant in the ‘middle’  
1885 Tithonian (Chen 1982, fig. 3, Riding *et al.* 2010, fig. 12). **B**, – *Ascodinium acrophorum*  
1886 Cookson & Eisenack 1960. The holotype (Cookson & Eisenack 1960a, p. 5, pl. 1, fig. 19)  
1887 from the Osborne Formation of the Subiaco Bore, Perth, Western Australia at 109.12 m.  
1888 Museum Victoria specimen number P17251. This distinctive smooth, circumcavate  
1889 peridiniacean species with a combination apical/anterior intercalary archaeopyle is a  
1890 reliable marker for the latest Albian to early Cenomanian in Australia (Morgan 1980, fig.  
1891 8). Note the isolated process of a chorate cyst oriented approximately north-south in the  
1892 centre-left of the endocyst of this specimen. This broken part of another dinoflagellate cyst  
1893 specimen, probably a representative of *Oligosphaeridium*, settled by chance onto the  
1894 specimen of *Ascodinium acrophorum* during slide production. **C**, – *Nelsoniella aceras*  
1895 Cookson & Eisenack 1960. The holotype (Cookson & Eisenack, 1960a, p. 4, pl. 1, fig. 12)  
1896 from the Toolonga calcilutite of the Rough Range South Number 1 Bore drilled by Wapet  
1897 in the Carnarvon Basin, Western Australia at 745.85–742.19 m. Museum Victoria  
1898 specimen number P17798. This characteristic subcircular, epicavate peridiniacean species  
1899 lacks an apical horn/protuberance and has a slight apical concavity. It is a latest  
1900 Santonian–early Campanian marker in Australasia (Helby *et al.* 1987, fig. 40, Riding *et al.*  
1901 1992), and is especially characteristic of the Santonian–Campanian transition (Marshall  
1902 1984, McMinn 1988). **D**, – *Dingodinium jurassicum* Cookson & Eisenack 1958. The  
1903 holotype (Cookson & Eisenack 1958, p. 39, pl. 1, fig. 10) from the upper part of the Dingo  
1904 Claystone of the Broome Number 3 Bore, Western Australia at 434.95–428.24 m.  
1905 Museum Victoria specimen number P17241. Note the camocavate cyst organisation, the  
1906 thin, smooth periphragm, the relatively thick spinose endophragm, the small apical  
1907 horn/protuberance and the apparent lack of an archaeopyle. This distinctive form is an  
1908 index species for the early Oxfordian to the earliest Valanginian of Australia; it is

1909 especially prominent in the middle to late Tithonian *Dingodinium jurassicum* Zone (Helby  
1910 *et al.* 1978, figs 15, 21, Riding *et al.* 2010, fig. 12). **E**, – *Chatangiella victoriensis*  
1911 (Cookson & Manum 1964) Lentin & Williams 1976. The holotype in dorsal view  
1912 (Cookson & Manum 1964, p. 522, pl. 76, figs 3, 4) from the Belfast Mudstone of the Port  
1913 Campbell Number 3 Bore, Victoria drilled by the Frome-Broken Hill Company at  
1914 1344.20–1341.10 m. Museum Victoria specimen number P22986. This characteristic  
1915 bicavate peridiniacean form with a granulate/tuberculate periphragm, a discontinuous  
1916 cingulum and an anterior intercalary archaeopyle is an index species for the  
1917 Turonian/Coniacian to Santonian of Australia (Marshall 1984, Helby *et al.* 1987, figs 37,  
1918 40). **F**, – *Isabelidinium glabrum* (Cookson & Eisenack 1969) Lentin & Williams 1977.  
1919 The holotype (Cookson & Eisenack 1969, p. 3, fig. 1A) in ventral view; it is from the  
1920 Osborne Formation of the Balcatta Bore Number 1 at 73.15 m or 69.19–67.06 m, or the  
1921 Balcatta Bore Number 2 at 67.06 m. It is not clear in Cookson & Eisenack (1969), which  
1922 of these three samples the holotype is from. Geological Survey of Western Australia  
1923 specimen number F6629. *Isabelidinium glabrum* is a characteristic elongate, circumcavate  
1924 peridiniacean form with psilate periphragm and endophragm, prominent apical and left  
1925 antapical horns, and a steno-deltaform anterior intercalary archaeopyle. It is a marker  
1926 species for the early Turonian to early Coniacian of Australia (Marshall 1984, Helby *et al.*  
1927 1987, fig. 37).

1928

1929 *Fig. 9.* A candid photograph of Isabel Cookson relaxing in the flat of her collaborator  
1930 Svein B. Manum in Oslo, Norway in early January 1960. The photograph was taken by  
1931 Svein B. Manum (University of Oslo), and is reproduced with his permission.

1932

1933 *Fig. 10.* Two specimens of *Svalbardella cooksoniae* Manum 1960. Note the elongate  
1934 ellipsoidal, bicavate/cornucavate nature of this distinctive proximate peridinalean species,  
1935 which has extremely characteristic polar horns that are bluntly rounded distally. The  
1936 distally rounded nature of the apical and antapical horns distinguish *Svalbardella* from the  
1937 very similar genus *Palaeocystodinium*, which has distally pointed polar horns. These  
1938 specimens elegantly demonstrate the intraspecific variability of this species. *Svalbardella*  
1939 *cooksoniae* varies significantly in size, degree of elongation, low relief ornamentation and  
1940 the expression of tabulation. The genus *Svalbardella* is monospecific (Fensome and  
1941 Williams 2004, p. 643–644). **A**, – the holotype of *Svalbardella cooksoniae* from sample  
1942 R.F.-H.260M collected from Sarsbukta, west Spitsbergen (78° 40' N; 11° 40' E), which is  
1943 of probable Eocene age (Manum 1960). This specimen is significantly less elongate than  
1944 the specimen in 10B, and exhibits a definite equatorial cingulum. Note the elongate  
1945 anterior intercalary archaeopyle, and the longitudinal ridges which may represent plate  
1946 boundaries. The photograph was taken by Svein B. Manum (University of Oslo), and is  
1947 reproduced with his permission. **B**, – a smooth, relatively elongate and slender specimen  
1948 of *Svalbardella cooksoniae* from the Eocene/Oligocene boundary interval in Hole 1411B  
1949 of Integrated Ocean Drilling Program (IODP) Cruise 342, offshore Newfoundland,  
1950 Canada. The photograph was taken by Jörg Pross (Institut für Geowissenschaften, Johan  
1951 Wolfgang Goethe-Universität, Frankfurt am Main, Germany), and is reproduced with his  
1952 permission.

1953

1954 *Fig. 11.* Isabel Cookson outside the University of Queensland, Brisbane, at the symposium  
1955 on Mesozoic and Cenozoic palynology held in her honour in May 1971 at the 43<sup>rd</sup>  
1956 Congress of the Australian and New Zealand Association for the Advancement of Science



1957 (ANZAAS). The photograph was taken by John G. Douglas, and is reproduced with his  
1958 permission.

1959

1960 *Fig. 12.* Cookson Place in the suburb of Banks, Canberra, ACT, Australia. **A**, – A view of  
1961 Cookson Place looking east from the entry to the street; Banks is an outlying suburb, note  
1962 the virgin bush in the background. **B**, – A street sign for Cookson Place at the intersection  
1963 with Olive Pink Crescent. Olive Muriel Pink (1884–1975) was a prominent aboriginal  
1964 rights activist and gardener (<http://adb.anu.edu.au/biography/pink-olive-muriel-11428>).

1965 The photographs were taken by Clinton B. Foster, and are reproduced with his permission.

1966

1967 *Table 1.* A tabulated synopsis of the principal career milestones of Isabel C. Cookson.

1968 ANZAAS - Australian and New Zealand Association for the Advancement of Science.

1969

1970 *Table 2.* A tabulated synopsis of the seven research papers principally on modern

1971 botany/mycology by Isabel Cookson and her co-workers. No new genera were established.

1972 In the ‘Geography’ column, SA = South Australia.

1973

1974 *Table 3.* A tabulated synopsis of the 22 research papers principally on palaeobotany by

1975 Isabel Cookson and her co-workers. Key to abbreviations in the ‘Geography’ column:

1976 NSW – New South Wales; QLD – Queensland; SA – South Australia; TAS – Tasmania;

1977 VIC – Victoria; WA – Western Australia. In the ‘Comments’ column: IOP = International

1978 Organisation of Palaeobotany.

1979

1980 *Table 4.* A tabulated synopsis of the 38 research papers principally on terrestrially-derived

1981 palynomorphs (i.e., fungal spores, megaspores, microspores and pollen) by Isabel

1982 Cookson and her co-workers. Key to abbreviations in the 'Geography' column: NSW –  
1983 New South Wales; NZ – New Zealand; PNG – Papua New Guinea; QLD – Queensland;  
1984 SA – South Australia; TAS – Tasmania; VIC – Victoria; WA – Western Australia.  
1985  
1986 *Table 5.* A tabulated synopsis of the 33 research papers principally on aquatic  
1987 palynomorphs (largely marine dinoflagellate cysts) by Isabel Cookson and her co-workers.  
1988 Key to abbreviations in the 'Geography' column: NSW – New South Wales; PNG – Papua  
1989 New Guinea; QLD – Queensland; SA – South Australia; TAS – Tasmania; VIC –  
1990 Victoria; WA – Western Australia. In the 'Age of samples studied' column: ud –  
1991 undifferentiated.  
1992

| Year(s)   | The career milestones of Isabel C. Cookson   |
|-----------|--|
| 1916      | Awarded a BSc degree, with first class honours, in botany and zoology from the University of Melbourne                   |
| 1916      | Given a Government Research Scholarship to study the flora of the Northern Territory                                     |
| 1916      | Appointed a research student to Frederick Chapman at the National Museum of Victoria                                     |
| 1916      | Elected a Member of the Royal Society of Victoria  |
| 1917      | Began MSc research on modern fungi with Alfred J. Ewart  |
| 1917      | Awarded a Government Research Scholarship to study the longevity of cut flowers  |
| 1917      | Appointed a demonstrator in Botany at the University of Melbourne  |
| 1917      | Appointed a tutor in Botany at Newman College, University of Melbourne   |
| 1921      | The first scientific paper published (Cookson 1921), on botany   |
| 1925-1926 | The first trip to Europe as a Visiting Researcher at Imperial College London   |
| 1926      | Undertook grant-funded research on crown rot in the English walnut tree  |
| 1926      | The first papers on palaeobotany published (Cookson 1926, Chapman & Cookson 1926)  |
| 1926-1927 | Appointed a demonstrator in mycology at the University of Manchester   |
| 1929      | Appointed a lecturer in Botany at the University of Melbourne  |
| 1929-1930 | Awarded a grant to study the Silurian to Devonian flora of Victoria with William H. Lang at the University of Manchester |
| 1932      | Awarded a DSc degree by the University of Melbourne for research on Palaeozoic palaeobotany                              |
| 1933-1934 | Awarded a Grisedale Research Scholarship for collaboration on Palaeozoic palaeobotany in Manchester with William H. Lang |
| 1935      | Landmark paper on early plant evolution published (Lang & Cookson 1935)  |
| 1937      | The Devonian plant genus <i>Cooksonia</i> published by William H. Lang   |
| 1945      | The first paper on palynology published (Cookson 1945b)  |
| 1947      | The first paper on Cenozoic palaeobotany published (Cookson 1947b)   |
| 1947      | Keynote speaker at the opening of the Birbal Sahni Institute of Palaeobotany, Lucknow, India                             |
| 1948      | Sabbatical visit to Stockholm, Sweden to work with Gunnar Erdtman on modern Proteaceae pollen                            |
| 1948-1949 | Awarded a Leverhulme Research Grant for collaboration on Palaeozoic palaeobotany in Manchester with William H. Lang      |
| 1949      | Appointed as the head of the Brown Coal Pollen Research Unit (PRU) at the University of Melbourne                        |
| 1952      | Appointed a Senior Lecturer and Research Fellow in Botany at the University of Melbourne                                 |
| 1953      | The first paper on aquatic palynomorphs published (Cookson 1953d)  |
| 1954      | Sabbatical leave to work with Georges Deflandre in Paris, France on Australasian marine microplankton                    |
| 1955      | The first major paper on Australasian marine palynomorphs published (Deflandre & Cookson 1955)                           |
| 1956-1957 | Sabbatical leave to work with Alfred Eisenack in Tübingen, Germany on Australasian marine microplankton                  |
| 1957      | Elected a Corresponding Member of the Botanical Society of America   |
| 1958      | The first paper in collaboration with Alfred Eisenack published (Cookson & Eisenack 1958)                                |
| 1959      | Sabbatical leave to work in Oslo, Norway, which led to a successful collaboration with Svein B. Manum                    |
| 1959      | Retirement from the University of Melbourne and appointment as an Honorary Research Fellow                               |
| 1959      | Made a Life Member of the Royal Society of Victoria  |
| 1959      | Made an Honorary Associate of the National Museum of Victoria  |
| 1971      | The ANZAAS Symposium on Mesozoic and Cenozoic palynology held in Brisbane in honour of Isabel C. Cookson                 |
| 1976      | The inaugural Isabel C. Cookson Paleobotanical Award made by the Botanical Society of America                            |

| Author(s)          | Year  | Geography          | Plant types | No. of new species | No. of new subspecies etc. | Comments   |
|--------------------|-------|--------------------|-------------|--------------------|----------------------------|--|
| Ewart & Davies     | 1917  | Northern Territory | angiosperms | 5                  | ...                        | Ewart, with Cookson, described five new angiosperm species               |
| Cookson            | 1921  | Victoria           | angiosperms | ...                | ...                        | On floral abnormalities observed in two angiosperm genera                |
| McLennan & Cookson | 1923  | Victoria           | fungi       | 2                  | 1                          | A short taxonomic study on ascomycete fungi from Australia               |
| McLennan & Cookson | 1926  | SA, Victoria       | fungi       | 3                  | ...                        | A further taxonomic study on SE Australian ascomycete fungi              |
| Cookson            | 1928  | Malawi             | fungi       | ...                | ...                        | On the life cycle and morphology of the fungus <i>Melanospora zamiae</i> |
| Cookson            | 1929  | Victoria           | fungi       | ...                | ...                        | On fungal pathogens affecting the English walnut tree in Victoria        |
| Cookson            | 1937a | Victoria           | fungi       | 1                  | ...                        | A description of a new species of phycomycete fungi from Victoria        |

| Author(s)             | Year  | Age of material                 | Geography                  | No. of new genera | No. of new species | No. of new subsp. etc. | Comments   |
|-----------------------|-------|---------------------------------|----------------------------|-------------------|--------------------|------------------------|--|
| Cookson               | 1926  | Devonian                        | Victoria                   | ...               | ...                | ...                    | A description of two specimens of the vascular stem <i>Arthrostroma gracile</i>                |
| Chapman & Cookson     | 1926  | Triassic                        | South Australia            | ...               | 3                  | ...                    | A restudy of an important Triassic macroflora from Leigh's Creek, South Australia              |
| Lang & Cookson        | 1927  | Late Silurian                   | Victoria                   | ...               | ...                | ...                    | A preliminary study of the <i>Baragwanathia</i> macroflora                                     |
| Lang & Cookson        | 1931  | Late Silurian                   | Victoria                   | ...               | 2                  | 1                      | A description of a low-diversity macroflora from Victoria                                      |
| Cookson               | 1935  | Late Silurian                   | Victoria                   | 1                 | 1                  | ...                    | A major paper on a macroflora of fragments from near Alexandra, Victoria                       |
| Lang & Cookson        | 1935  | Late Silurian                   | Victoria                   | 2                 | 3                  | ...                    | On the <i>Baragwanathia longifolia</i> macroflora from graptolite-bearing strata               |
| Cookson               | 1937b | Late Silurian                   | Tasmania                   | ...               | ...                | ...                    | A description of the fragmentary <i>Hostimella</i> macroflora from NE Tasmania                 |
| Cookson               | 1937c | Late Devonian                   | Victoria                   | ...               | ...                | ...                    | A description of a single fossil wood specimen from Mansfield, Victoria                        |
| Cookson               | 1945a | Late Silurian-Early Devonian    | Victoria                   | ...               | ...                | ...                    | A short paper documenting records of the <i>Baragwanathia</i> macroflora in Victoria           |
| Cookson               | 1947b | Paleogene-Neogene (Oligo-Mio)   | South Australia, Victoria  | 1                 | 2                  | ...                    | A detailed study of the Family Oleaceae based on leaves and pollen                             |
| Cookson               | 1949  | Late Silurian-Early Devonian    | Victoria                   | ...               | ...                | ...                    | A description of the <i>Zosterophyllum</i> macroflora from Lilydale, Victoria                  |
| Cookson & Duigan      | 1950  | Paleogene (Oligocene)           | Victoria                   | 1                 | 6                  | ...                    | A detailed study of the Tribe Banksieae based on fossil cones and leaves                       |
| Cookson & Duigan      | 1951  | Paleogene-Neogene (Oligo-Mio)   | NSW, SA, TAS, Victoria     | ...               | 3                  | ...                    | A detailed study of the Family Araucariaceae based on macrofossils and pollen                  |
| Cookson               | 1953a | Paleogene (Oligocene)           | Victoria                   | ...               | 1                  | ...                    | A description of an Oligocene cycad species, <i>Macrozamia hopeites</i> , from Victoria        |
| Cookson & Pike        | 1953a | Paleogene (Oligocene)           | Victoria                   | ...               | 1                  | ...                    | A new species of <i>Dacrydium</i> was described from the Oligocene of Victoria                 |
| Cookson & Pike        | 1953b | Paleogene-Neogene (P.cene-Plio) | NSW, QLD, SA, TAS, VIC, WA | ...               | ...                | ...                    | On <i>Podocarpus</i> from the Paleogene and Neogene of mainland Australia and Tasmania         |
| Clifford & Cookson    | 1953  | Paleogene (Oligocene)           | Victoria                   | ...               | 1                  | ...                    | A description of what was believed to be a new moss capsule from the Oligocene of Victoria     |
| Cookson               | 1954a | Neogene-Quaternary              | Victoria                   | ...               | ...                | ...                    | Records of the leaves and pollen of <i>Acacia</i> from the Neogene and Quaternary of Victoria  |
| Cookson               | 1954d | Paleogene-Neogene               | NSW, QLD, SA, TAS, VIC, WA | ...               | ...                | ...                    | A brief general review of the Paleogene-Neogene floras of Australia                            |
| Cookson & Pike        | 1954a | Paleogene (Oligocene)           | New South Wales, Victoria  | ...               | ...                | ...                    | A study of fossil material of <i>Phyllocladus</i> and other podocarpaceous taxa from Australia |
| Boureau <i>et al.</i> | 1956  | N/A                             | N/A                        | ...               | ...                | ...                    | A review of the activities of the IOP, and an international bibliography of palaeobotany       |
| Boureau <i>et al.</i> | 1960  | N/A                             | N/A                        | ...               | ...                | ...                    | A review of the activities of the IOP, and an international bibliography of palaeobotany       |

| Author(s)            | Year  | Age  | Geography                          | No. of new genera | No. of new species | No. of subspecies etc. | Range chart | Comments                     |
|----------------------|-------|--|------------------------------------|-------------------|--------------------|------------------------|-------------|------------------------------|
| Cookson              | 1945b | Paleogene-Neogene (undifferentiated)       | New South Wales, SA, Victoria      | ...               | ...                | ...                    | ...         | pollen                       |
| Cookson              | 1946a | Paleogene-Neogene (Oligocene-Miocene)      | New South Wales, SA, Victoria      | ...               | ...                | ...                    | ...         | pollen                       |
| Cookson              | 1946b | Paleogene-Neogene (Oligocene-Miocene)      | Kerguelen                          | ...               | ...                | ...                    | ...         | pollen/spores                |
| Cookson              | 1947a | Paleogene-Neogene (Oligocene-Miocene)      | Kerguelen, NSW, NZ, Victoria       | 6                 | 11                 | ...                    | ...         | fungus palynomorphs          |
| Cookson              | 1947b | Paleogene-Neogene (Oligocene-Miocene)      | South Australia, Victoria          | ...               | 1                  | ...                    | ...         | plants/pollen                |
| Cookson              | 1947c | Holocene                                   | Tasmania                           | ...               | ...                | ...                    | ...         | pollen                       |
| Cookson              | 1947d | Paleogene-Neogene (Oligocene-Miocene)      | Kerguelen                          | 4                 | 24                 | ...                    | ...         | pollen/spores                |
| Cookson              | 1950  | Paleogene-Neogene (Oligocene-Miocene)      | New South Wales, SA, Victoria      | 2                 | 18                 | ...                    | ...         | pollen                       |
| Cookson & Duigan     | 1951  | Paleogene-Neogene (Oligocene-Miocene)      | NSW, SA, Tasmania, Victoria        | ...               | ...                | ...                    | ...         | plants/pollen                |
| Cookson              | 1952  | Paleogene (Oligocene), Holocene            | New Caledonia, PNG, Victoria       | ...               | ...                | ...                    | ...         | pollen                       |
| Cookson & Erdtman    | 1952  | Holocene                                   | Southern Hemisphere                | ...               | ...                | ...                    | ...         | pollen                       |
| Cookson              | 1953b | Early Cretaceous, Paleogene (undiff.)      | South Australia                    | 1                 | 8                  | 2                      | ...         | pollen/spores                |
| Cookson              | 1953c | Paleogene-Neogene, Holocene                | Kerguelen, NSW, SA, TAS, VIC, WA   | ...               | ...                | ...                    | ...         | pollen                       |
| Cookson & Pike       | 1953a | Paleogene-Neogene (Paleocene-Pliocene)     | NSW, PNG, SA, TAS, VIC, WA         | ...               | 1                  | ...                    | ...         | plants/pollen                |
| Cookson & Pike       | 1953b | Paleogene-Neogene (Paleocene-Pliocene)     | NSW, QLD, SA, TAS, VIC, WA         | 1                 | 1                  | ...                    | ...         | plants/pollen                |
| Couper <i>et al.</i> | 1953  | Jurassic-Quaternary (undifferentiated)     | New Zealand                        | ...               | ...                | ...                    | ...         | pollen/spores                |
| Cookson              | 1954a | Neogene-Quaternary (undifferentiated)      | Victoria                           | ...               | 2                  | ...                    | ...         | plants/pollen/spores         |
| Cookson              | 1954b | Cretaceous, Paleogene (Paleocene/Eocene)   | Victoria                           | ...               | ...                | ...                    | √           | pollen/spores                |
| Cookson              | 1954c | Paleogene (Paleocene/Eocene)               | Western Australia                  | ...               | ...                | ...                    | ...         | pollen                       |
| Cookson & Pike       | 1954a | Jurassic-Neogene (undifferentiated)        | NSW, QLD, SA, TAS, VIC, WA         | 1                 | 2                  | ...                    | ...         | plants/pollen                |
| Cookson & Pike       | 1954b | Paleogene-Quaternary (undifferentiated)    | NSW, PNG, QLD, SA, TAS, VIC, WA    | 6                 | 17                 | 4                      | ...         | pollen                       |
| Cookson              | 1955  | Late Cretaceous-Paleogene (Paleoc, Eocene) | South Australia, Victoria          | ...               | ...                | ...                    | ...         | Permian reworked pollen      |
| Cookson & Pike       | 1955  | Holocene                                   | New Caledonia, Papua New Guinea    | ...               | ...                | ...                    | ...         | pollen                       |
| Baker & Cookson      | 1955  | Late Cretaceous, Paleogene                 | Victoria                           | ...               | ...                | ...                    | ...         | dino. cysts, pollen/spores   |
| Cookson              | 1956a | Paleogene (Paleocene-Eocene)               | Tasmania, SA, Victoria             | ...               | ...                | ...                    | ...         | pollen                       |
| Cookson              | 1957  | Paleogene-Neogene, Holocene                | Indonesia, NSW, PNG, SA, VIC       | ...               | 12                 | 1                      | ...         | pollen/spores                |
| Duigan & Cookson     | 1957  | Quaternary (undifferentiated)              | Victoria                           | ...               | ...                | ...                    | ...         | pollen/spores                |
| Cookson & Dettmann   | 1958a | Cretaceous (mainly Albian)                 | NSW, PNG, QLD, SA, VIC             | 1                 | 6                  | ...                    | √           | megaspores and microspores   |
| Cookson & Dettmann   | 1958b | Early Cretaceous (undifferentiated)        | NSW, PNG, QLD, SA, VIC, WA         | 4                 | 21                 | ...                    | √           | spores                       |
| Cookson              | 1959  | Paleogene-Neogene (Eocene-Pliocene)        | New South Wales, SA, Victoria      | ...               | 10                 | ...                    | ...         | pollen                       |
| Cookson & Dettmann   | 1959a | Cretaceous-Paleogene (undifferentiated)    | Victoria                           | ...               | ...                | ...                    | √           | pollen/spores                |
| Cookson & Dettmann   | 1959c | Early Cretaceous (undifferentiated)        | South Australia, Victoria          | 1                 | ...                | ...                    | ...         | spores                       |
| Cookson              | 1961  | Cretaceous (Albian-Cenomanian)             | Queensland, SA, WA                 | 1                 | 1                  | ...                    | ...         | spores                       |
| Cookson & Dettmann   | 1961  | Early Cretaceous (Berriasian-Albian)       | NSW, Queensland, SA, Victoria      | ...               | ...                | ...                    | ...         | spores                       |
| Cookson & Balme      | 1962  | Cretaceous (?Albian-Cenomanian)            | Victoria, Western Australia        | 1                 | 1                  | ...                    | ...         | pollen                       |
| Cookson              | 1965c | Cretaceous (Albian-Cenomanian)             | South Australia, Western Australia | ...               | 1                  | ...                    | ...         | spores                       |
| Harris & Cookson     | 1965  | Early Cretaceous (?Val.-Albian), Paleogene | South Australia                    | ...               | ...                | ...                    | ...         | pollen/spores                |
| Cookson & Cranwell   | 1967  | Paleogene (Eocene)                         | southern Chile                     | ...               | ...                | ...                    | ...         | microplankton, pollen/spores |

| Author(s)           | Year  | Age of samples studied                        | Geography                | No. of samples | Acritarchs | Dino. cysts | Miscellaneous MP | Pollen/spores | No. of new MP genera | No. of new MP species | No. of new MP subsp. etc. | Range chart |
|---------------------|-------|---|--------------------------|----------------|------------|-------------|------------------|---------------|----------------------|-----------------------|---------------------------|-------------|
| Cookson             | 1953d | Paleogene, Neogene, Quaternary (undiff.)      | NSW, SA, VIC, WA         | 15             | ✓          | ✓           | ✓                | ...           | ...                  | 1                     | ...                       | ...         |
| Cookson             | 1956b | Cretaceous, Paleogene (Eocene)                | NSW, SA, VIC, WA         | 16             | ✓          | ✓           | ...              | ✓             | ...                  | 5                     | ...                       | ...         |
| Cookson             | 1965a | Cretaceous, Paleogene (Eocene)                | SA, Victoria, WA         | 19             | ✓          | ✓           | ✓                | ...           | 1                    | 5                     | ...                       | ...         |
| Cookson             | 1965b | Paleogene (Paleocene)                         | Dilwyn Bay, Victoria     | 2              | ...        | ✓           | ...              | ...           | ...                  | 3                     | ...                       | ...         |
| Deflandre & Cookson | 1954  | Cretaceous, Paleogene, Neogene (undiff.)      | NSW, Victoria, WA        | not known      | ...        | ✓           | ✓                | ...           | ...                  | ...                   | ...                       | ...         |
| Deflandre & Cookson | 1955  | Jurassic, Cretaceous, Paleogene, Neogene (ud) | NSW, SA, VIC, WA; PNG    | 18             | ✓          | ✓           | ✓                | ...           | 5                    | 45                    | 1                         | ✓           |
| Cookson & Eisenack  | 1958  | Middle-Late Jurassic, Cretaceous (undiff.)    | NSW, QLD, SA, WA; PNG    | at least 73    | ✓          | ✓           | ✓                | ...           | 12                   | 53                    | 3                         | ✓           |
| Cookson & Eisenack  | 1960a | Cretaceous (Albian-Campanian)                 | Victoria, WA             | at least 17    | ✓          | ✓           | ✓                | ...           | 16                   | 31                    | ...                       | ...         |
| Cookson & Eisenack  | 1960b | Late Jurassic, Early Cretaceous (undiff.)     | QLD, SA, WA; PNG         | at least 29    | ✓          | ✓           | ...              | ...           | 6                    | 25                    | ...                       | ✓           |
| Eisenack & Cookson  | 1960  | Early Cretaceous (?Aptian-Albian)             | Queensland, SA, WA       | at least 13    | ...        | ✓           | ✓                | ...           | 3                    | 17                    | 1                         | ...         |
| Cookson & Eisenack  | 1961a | Paleogene (Early Eocene)                      | Rottneest Island, WA     | 2              | ...        | ✓           | ✓                | ✓             | 1                    | 4                     | 2                         | ...         |
| Cookson & Eisenack  | 1961b | Late Cretaceous (Santonian)                   | Belfast 4 Bore, Victoria | 2              | ...        | ✓           | ...              | ✓             | 1                    | 5                     | ...                       | ...         |
| Cookson & Eisenack  | 1962a | Cretaceous (Aptian-?Campanian)                | QLD, SA, VIC, WA         | at least 32    | ✓          | ✓           | ...              | ...           | 4                    | 23                    | 1                         | ...         |
| Cookson & Eisenack  | 1962b | Cretaceous, Paleogene (Eocene)                | Western Australia        | at least 14    | ✓          | ✓           | ✓                | ...           | 4                    | 10                    | ...                       | ...         |
| Cookson & Eisenack  | 1965a | Paleogene (Late Eocene)                       | Browns Creek, Aire, VIC  | 5              | ✓          | ✓           | ...              | ...           | 2                    | 13                    | ...                       | ...         |
| Cookson & Eisenack  | 1965b | Paleogene (Late Paleocene- Early Eocene)      | Drajurk, Victoria        | 1              | ✓          | ✓           | ...              | ...           | 1                    | 7                     | ...                       | ...         |
| Cookson & Eisenack  | 1965c | Paleogene (Late Paleocene- Early Eocene)      | Dilwyn Bay, Victoria     | 3              | ...        | ✓           | ...              | ...           | ...                  | 5                     | ...                       | ...         |
| Cookson & Eisenack  | 1967a | Paleogene (Late Paleocene-Late Eocene)        | Strahan, Tasmania        | 1              | ✓          | ✓           | ...              | ✓             | ...                  | 4                     | ...                       | ...         |
| Cookson & Eisenack  | 1967b | Paleogene (Late Paleocene-Late Eocene)        | Pebble Point, Victoria   | 1              | ✓          | ✓           | ...              | ✓             | ...                  | 4                     | ...                       | ...         |
| Cookson & Eisenack  | 1968  | Cretaceous (Albian-Cenomanian, Santonian)     | Perth Basin, WA          | 2              | ✓          | ✓           | ...              | ...           | 2                    | 6                     | ...                       | ...         |
| Cookson & Eisenack  | 1969  | Late Cretaceous (Turonian-Santonian)          | Perth Basin, WA          | at least 15    | ...        | ✓           | ...              | ...           | 2                    | 4                     | ...                       | ...         |
| Cookson & Eisenack  | 1970a | Cretaceous, Paleogene (undifferentiated)      | Victoria, WA             | not known      | ...        | ...         | ✓                | ...           | 2                    | ...                   | ...                       | ...         |
| Cookson & Eisenack  | 1970b | Cretaceous (?Albian-Campanian)                | Eucla Basin, WA          | at least 10    | ✓          | ✓           | ✓                | ...           | 1                    | 22                    | ...                       | ...         |
| Cookson & Eisenack  | 1971  | 'Mid' Cretaceous (Albian-Cenomanian)          | Eucla Basin, WA          | 1              | ✓          | ✓           | ✓                | ...           | 1                    | 11                    | ...                       | ...         |
| Cookson & Eisenack  | 1974  | Late Jurassic, Cretaceous, Paleogene          | QLD, TAS, VIC, WA; PNG   | at least 18    | ✓          | ✓           | ✓                | ...           | 5                    | 28                    | 14                        | ...         |
| Cookson & Eisenack  | 1979  | Cretaceous (Albian and younger)               | Western Australia        | at least 6     | ...        | ...         | ✓                | ...           | 3                    | 3                     | ...                       | ...         |
| Cookson & Eisenack  | 1982  | Late Jurassic, Cretaceous, Paleogene          | QLD, SA, VIC, WA         | at least 21    | ✓          | ✓           | ✓                | ...           | 2                    | 23                    | 1                         | ...         |
| Cookson & Dettmann  | 1959b | Cretaceous (Albian-?Cenomanian)               | Queensland, SA, Victoria | at least 7     | ...        | ...         | ✓                | ...           | 1                    | 4                     | ...                       | ...         |
| Cookson & Manum     | 1960  | Early Cretaceous, Paleogene                   | Svalbard; PNG; WA        | at least 4     | ...        | ...         | ✓                | ...           | 1                    | 3                     | ...                       | ...         |
| Cookson & Manum     | 1964  | Late Cretaceous (Turonian-Santonian)          | Victoria, WA             | 6              | ...        | ✓           | ...              | ...           | ...                  | 1                     | ...                       | ...         |
| Manum & Cookson     | 1964  | Late Cretaceous (Coniacian-early Santonian)   | Arctic Canada            | 1              | ✓          | ✓           | ✓                | ✓             | ...                  | 11                    | ...                       | ✓           |
| Cookson & Hughes    | 1964  | 'Mid' Cretaceous (Albian-Cenomanian)          | southeast England        | 3              | ✓          | ✓           | ✓                | ...           | ...                  | 9                     | ...                       | ✓           |
| Cookson & Cranwell  | 1967  | Paleogene (Eocene)                            | southern Chile           | 1              | ✓          | ✓           | ✓                | ✓             | ...                  | 1                     | ...                       | ...         |

