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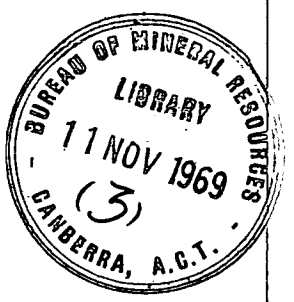

Palynological Observations of Jurassic and Cretaceous Strata at the Border of Queensland and New South Wales

by

D. Burger

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PALYNOLOGICAL OBSERVATIONS OF JURASSIC AND CRETACEOUS STRATA AT THE BORDER OF QUEENSLAND AND NEW SOUTH WALES

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SUMMARY

Upper Jurassic and Lower Cretaceous sediments covering the Eulo-Nebine Ridge and drilled in N.A.I. Whyenbirra No. 1, A.O.G. Talbalba Nos. 1 and 2 Scout, Queensland, and G.S.N.S.W. Bellfields Nos. 1-1A, yielded a sequence of plant microfossils that is identical to that from their counterparts of the Surat Basin towards the east and that in the Eromanga Basin further west and north.

The formal nomenclature of the drilled sediments is not used as neither the generally accepted Eromanga or Surat Basin nomenclature can be readily applied to the Whyenbirra and Bellfields sections. Instead, a lithological Zone system* is used to nominate five distinctly recognizable rock bodies. The basal Zone A represents probably the basement for the Mesozoic rocks and is regarded as of Devonian age in Whyenbirra. The unconformably overlying Zones B to E yield Upper Jurassic to Lower Cretaceous spore-pollen assemblages and dinoflagellates. Spore units J 5-6, K 1a, K 1b-c, K 1d, and K 2a are identified and described. The amount of available samples permitted detailed palynological correlation of the Zones with the formations in the Surat and Eromanga Basin.

Additional faunal datings from the Talbalba sections drilled through the Wallumbilla Formation confirm the palynological correlations of zones C, D, and E.

SOURCES OF INFORMATION

Bellfields Nos. 1-1A:

The Bellfields sections were drilled close together in northern N.S.W., Enngonia Sheet area, near Bellfield Station. A depth of 1338 feet was reached. The sections represent the first of a series of six bores, planned in the N.S.W. portion of the Great Artesian Basin by the Geological Survey of N.S.W., as part of an extensive sedimentological and paleontological study of the Basin. When the Geological Survey of N.S.W. made the samples from Bellfields available to me for palynological study, I gratefully accepted the opportunity for thorough investigation of the palyno-environments in

* The term Zone is used informally in this record and has no relation to a biostratigraphic zone.

TABLE 1: SPECIFICATION OF SAMPLES INVESTIGATED FROM BELLFIELDS NOS. 1 & 1A

BORE	DEPTH	MFP.	SPORE UNITS	DINOFLAGELLATE ZONES	DEPOSITIONAL ENVIRONMENTS
No. 1	150	4917	K 2a?	Odontochitina operculata?	brackish-marine
	175	4947	K 2a	?	brackish-nonmarine
	200	5024	K 1d?	?	brackish
	225	5032	inconclusive		
	250	5036	inconclusive		
	325	5042	K 1d	Dingodinium cerviculum	brackish-marine
	350	5037	barren		
No. 1A	375	5033	barren		
	400	4918	K 1b-c	Dingodinium cerviculum	brackish-marine
	525	4953	K 1b-c	Dingodinium cerviculum	brackish-marine
	675	5025	inconclusive		
	700	4946	K 1b-c	?	brackish-nonmarine?
	775	5026	inconclusive		
	850	4919	K 1b-c	Dingodinium cerviculum?	brackish-marine
	875	5044	K 1(a?)	?	brackish
	900	5038	barren		
	950	5027	barren		
	982	5039	barren		
	1000	5043	K 1a		nonmarine
	1055	4948	K 1a		nonmarine
	1200	4949	K 1a		nonmarine
	1278	4904	barren		

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BORE	SAMPLE	DEPTH	MFP.	SPORE UNITS		DINOFLAGELLATE ZONES	DEPOSITIONAL ENVIRONMENTS
				Evans	Burger		
WHYENBIRRA	swc. 9	600	4266	K 1d	K 1d	Muderongia tetracantha/Odontochitina operculata	brackish
	swc. 8	1000	4267	K 1b-c	K 1b-c	Dingodinium cerviculum	brackish
	swc. 7	1400	4268	K 1b-c	K 1b-c	Dingodinium cerviculum	brackish-marine
	swc. 6	1600	4269	K 1b-c?	K 1a		nonmarine
	swc. 5	1800	4270	K 1a	K 1a		nonmarine
	swc. 4	2000	4271	J 5-6+	K?	contaminated ?	
	core 1	2038	5093		K 1a		nonmarine?
	core 1	2055	4718	very few fossils , inconclusive data			
	swc. 3	2200	4272	J 5-6+	J 5-6		nonmarine
	swc. 2	2400	4273	contaminated microflora .			
TALBALBA	cutt	280-290	4860		K 2a	?	brackish-nonmarine
	cutt	682-688	4861	contaminated microflora			
	cutt	952-956	4859		K 1b-c	?	brackish

TABLE 2 : SPECIFICATION OF SAMPLES INVESTIGATED FROM WHYENBIRRA NO. 1 AND TALBALBA NOS. 1 AND 2

a little known area that forms the southeastern extension of the Eromanga Basin and in which sediments are laid down on top of the Eulo Ridge.

A system of informal lithological zones forms the base on which in this report the sediments in the Bellfields and Whyenbirra sections are correlated. Zone A (1338-1306 feet) consists of highly folded thin-bedded strata. Zone B (1306-1207 feet), overlying unconformably, contains cross-bedded, quartz-rich pebbly sandstone and siltstone, with occasional conglomeratic horizons. Zone C (1207-610 feet) shows alternating sandstone and argillaceous beds of varying thickness. Zone D (610-400 feet) represents a uniform mudstone, while the highest zone D (400-0 feet) again shows an alternative sandstone-mudstone sequence, of which the lower part is mainly sandy. The contacts between zones B and E seem to be conformable.

Continuous coring of the Bellfields sections enabled me to sample the 150-1200 feet interval regularly at 25 feet interspaced. The deeper sediments were unsuitable for palynology; nevertheless, a sample was taken for investigation from a silty horizon at 1278 feet. Twenty-two samples from selected horizons were treated in order to extract the botanical matter. Of these, twelve yielded sufficient microfossil residue for satisfactory age determination. The treated samples are represented in Table 1, specified by depth below surface, B.M.R. Palynological Sample Catalogue Number (MFP), palynological age and environment of deposition.

Full qualitative spore-pollen analysis of residue from the twelve samples disclosed, as completely as possible under the circumstances, the geological distribution of certain stratigraphic marker fossils. Of fifty spore-pollen and dinoflagellate species the vertical distribution is tabulated in the microfossil distribution chart of Figure 1. Spore assemblages are set out against the chronologic succession of samples, thus indicating their palynological age. In spite of the sporadic occurrence of some species, of which the distribution in time has been more accurately established elsewhere (Dettmann 1963; Burger 1968-bc), the occurrence of the essential zone microfossils brings out a palynological zonation that is identical to Evans' (1966-a) system of Lower Cretaceous spore units.

Whyenbirra No. 1:

The Whyenbirra well was drilled in 1966 by North American International Inc. in the Dirranbandi Sheet area, southern Queensland, location 147°21'55" E., 28°36'50" S. (Authority to Prospect 115 P), approximately 46 miles south of the town of Bollon (location map of Fig. 3). The well penetrated sediments at the western margin of the Surat Basin in search for possible potential stratigraphic traps that might originate from regional transgressive over-lapping sedimentation of the Hutton Sandstone and the basal units of the Blythesdale Formation against the eastern flank of the Eulo Ridge (Cundill, Meyers et Ass. 1967).

Cundill et al. divided the Mesozoic portion of the well section in terms of Whitehouse's (1954) stratigraphic nomenclature for the Surat Basin sediments. Below recent and Tertiary sediments down to 391 feet the "Roma Formation" was recognized in the 391-1920 feet interval and the "Blythesdale Formation" in the 1920-2750 feet interval. Basement rocks, regarded as the Devonian "Timbury Hills Formation" were encountered between 2750 feet and a total depth of ~~2824~~ 2832 feet.

Since Whitehouse, the nomenclature of the Surat Basin sediments has been variously revised as the result of more accurate mapping (Day 1964; Vine et al. 1967). I do therefore not follow Cundill & Meyers subdivision but introduce the above mentioned system of litho-logical zones, until more thorough knowledge of the area permits assembling the sediments into a permanent nomenclature. The logs of Whyenbirra show that zone A occurs as the "Timbury Hills Formation" in the ~~2824~~ 2837-2750 feet interval. Zone B represents the lower, coarsely sandy part of the "Blythesdale Formation" in the 2750-2145 feet interval. Zone C, reaching high up into the "Roma Formation" and containing the lowermost sandstone/mud-siltstone alternation in the section, is recognized between 2145 feet and 1220 feet. An upper part, in which thicker mudstones are developed, is recognized above 1680 feet and is correlated with identical rock features in Bellfields above 877 feet (Figure 3). Zone D forms a characteristic mudstone body of similar

thickness drilled in the Bellfields and Whyenbirra sections; it occurs in Whyenbirra between 1220 feet and 1010 feet, while the highest zone E occupies the rest of the section below 391 feet (Figure 3).

Three cores and nine sidewall cores were sampled, covering the section at regular intervals. Palynology of sidewall cores nos. 2-9 was briefly summarized by Evans (in Cundill, Meyers & Ass. 1967). For the sake of revaluating the microfossil data in the light of the latest spore-pollen information from the Cretaceous in the Surat Basin (Burger 1968-c) and the southern Eromanga Basin (Terpstra & Burger 1969) I have re-examined sidewall cores 2 to 9 in detail and also examined core 1, in connection with probably false information from swc, 4 (see PALYNOLOGY). The samples are specified, as in Table 1, by depth, Catalogue Number (MFP), palynological age and environment (Table 2). Selected microfossil species are listed in Figure 2 against the stratigraphic succession of samples; their vertical occurrence is thus visually comparable to those in the Bellfields section. Upper Jurassic spore units J 5-6 and Lower Cretaceous units K 1a to K 1d are recognized, permitting close palynological correlation of the Whyenbirra and Bellfields sediments.

Talbalba Nos. 1-2:

Australian Oil and Gas Corporation Ltd. drilled two scout bores in the Cunnamulla Sheet area, southern Queensland. Bore No. 1 (Location 146°34' E, 28°58' S) was drilled to a depth of 774 feet. Bore No. 2, located 600 feet further north, reached a depth of 1000 feet. Each section penetrated the Doncaster and Coreena Members of the Wallumbilla Formation (B. Senior, pers. comm.). Samples from cuttings were forwarded to the B.M.R. for micropaleontological examination. Lower Cretaceous foraminifera were recovered from Bore 1, 365-768 feet, and from Bore 2, 336-995 feet (Belford 1958). From No. 2 Bore, 336 feet and 388 feet, P.J. Jones (pers. comm.) recovered an Ostracod species which also occurred in the Coreena of B.M.R. Roma No. 9 Scout (core 1, 101 feet), the "Winton Formation" of Conorada Ooroonoo No. 1 (core 6, 1252-62 feet) and in D.S. Mornington Island No. 1 (core 3, 1112 feet). Spores and pollen grains from various levels indicated units K 1d to K2, i.e. Albian to Cenomanian age for the sediments (Terpstra & Evans 1962; Evans in McPhee 1963; Burger 1968-c).

Three samples from cuttings at the base, center and top of the sections, were palynologically examined. Microfossils recovered are listed in Figure 2. The stratigraphic merits of the assemblages are discussed at pages 9 and 11.

The Talbalba samples confirm palynological datings of the Wallumbilla Formation further north and east (Evans 1966-b; Burger 1968-bc). Palynological comparison of zones C, D and E with the Doncaster and Coreena Members is much facilitated by the intermediate location of the Talbalba sections.

PALYNOLOGY

Spore units J 5-6

Zone B:

The sediments of zone B in Bellfields were unsuitable for palynological investigation; one sample from 1278 feet (MFP 4904) produced fibrous matter of botanical origin, with a few single spores, among which Microcachryidites antarcticus (range Upper Mesozoic) was recognized. The palynological age of the sample is uncertain. Sidewall cores from the zone in Whyenbirra produced spores and microplankton. Examination of sidewall core 2 disclosed a mixture of upper Mesozoic spores and Cretaceous dinoflagellates, which were very likely partly introduced with impregnated mud and are therefore discarded. Sidewall core 3 yielded an Upper Jurassic-Lower Cretaceous spore-pollen assemblage, in which Foraminisporis dailyi (1 specimen) might point to a Lower Cretaceous unit K 1a age for the microflora. However, other K 1a indicators were not encountered, so that, in view of risk of contamination the assemblage is thought to represent Jurassic units J 5-6, with the probability of K 1a sediments lying immediately overhead.

Spore unit K 1a

Zone C:

Unit K 1a represents the interval in which the ranges of Cicatricosisporites spp. and Murospora florida overlap (Evans 1966-a). In Bellfields at the very base of zone C, a sample at 1200 feet yielded well preserved, presumed Lower Cretaceous fossils. Although there was no sign of the commonly accepted Cretaceous marker spore Cicatricosisporites, the assemblage contains Cyclosporites hughesi and Foveotriletes parviretis, which do not appear in the Australian sequence before Cicatricosisporites (Balme 1957; Dettmann 1963; Burger 1968-a; also 1969, in prep.). The presence of M. florida in addition strongly suggests a unit K 1a age for the microflora. Another common fossil is a large trilete spore, assigned to Minerisporites Potonié 1956, which is probably identical to certain forms described as Minerisporites cf. marginatus (Dijkstra) in Cootabarlow Bore No. 2, Great Artesian Basin, S.A., also in association with M. florida and Cyclosporites hughesi (Dettmann 1963).

Recent investigations (Burger, in prep.) demonstrated that, in the Surat Basin, Nevesisporites vallatus, initially described from the Jurassic in southeastern Queensland (De Jersey & Paten 1964) ranges into unit K 1a and disappears simultaneously with M. florida, at approximately the level in which the first distinct dinoflagellates are introduced. Observations from the Eromanga Basin, although still fragmentary, seem to agree with this; so that there is ample motivation to attach a K 1a age to samples MFP 4948 and 5043, in which N. vallatus was encountered. Microfloras from lowermost zone C sediments in Whyenbirra (core 1) give equally positive evidence of a unit K 1a age. The co-occurrence of Cyclosporites hughesi, Murospora florida, Foveotriletes parviretis, a form closely comparable to Crybelosporites stylosus and a monolete spore (B.M.R. 824), known from upper K 1a and lower K 1b-c assemblages in the Surat Basin, is inconceivable for Jurassic spore assemblages. The assemblage contained fragments of what resemble unidentified dinoflagellates. Non-marine environments for the sediments at 2038 feet are suggested but not certain.

Murospora florida ranges upwards as high as 1800 feet (MFP 4270) while Nevesisporites vallatus even occurs at 1600 feet (MFP 4269). Typical K 1b+ spores as Dictytotosporites speciosus and Pilosisporites notensis occur together at 1400 feet. The occurrence of D. speciosus at 1600 feet confirms the presumed existence of an overlap of its range with that of N. vallatus, it suggests correlation with the Minmi Member of the Blythesdale Formation in the Surat Basin and establishes a most likely uppermost K 1a age for microflora MFP 4269. Sidewall core 4 (2000 feet) produced an assemblage with D. speciosus and "Gen. et ap. A" Eis. & Cooks., slightly above what I consider as the lowermost K 1a sediments of core 1. While the occurrence of the latter form at 1800 feet can be explained readily from our knowledge so far of its position within unit K 1a, extension of their ranges downwards as far as 2000 feet seems unnatural. Very probably these forms must be regarded as contaminants; they are annotated in Figure 2 as such and unfortunately reduce substantially the stratigraphic value of the microflora.

A peculiar organism, described by Eisenack & Cookson (1960) as "Gen. et sp. indet. A" from presumedly Lower Cretaceous in the Great Artesian Basin ("Blythesdale Formation") and the Carnarvon Basin (Birdrong Formation) was encountered in Bellfields at 1055 feet (MFP 4948) and, as already mentioned also in Whyenbirra. The organism has elsewhere been observed in the Archer River area (Evans 1966-b), in the Surat Basin, upper Blythesdale Formation (Evans in Exon et al. 1967; Burger, in prep.), in the Otway Basin (locally in swarming quantities; Evans 1966-c). Everywhere the organism was connected with spore unit K 1a. Although its botanical affinity is unknown, its presence is very probably a sign of increasingly saline environments. The known occurrence, although not necessarily being exactly synchronous in various localities, suggest restricted time distribution, at least in the Great Artesian Basin, Queensland. The evidence from Bellfields and Whyenbirra carries the existence of the fossil through into the southernmost part of the Basin. Detailed search of zone C sediments is still required for more accurate determination of its geographical and vertical occurrence.

Spore units K 1b-c

Zone C:

Microfloras of K 1b-c age occur in the spore sequence between the last occurrence of Murospora florida and the first appearance of Crybelosporites striatus. Apparently in the Surat and Eromanga Basins, Pilosisporites notensis enters the sequence at approximately the level where M. florida and N. vallatus disappear. Together with Dictyotosporites speciosus also Dingodinium cerviculum and Muderongia tetracantha are persistent forms in the interval of the units. Microfloras of that age were recovered from the upper part of zone C in Bellfields and Whyenbirra. In the Bellfields section sample 4919 (850 feet) yielded the earliest distinct K 1b-c microflora, containing P. notensis, D. speciosus and Muderongia spp. Among the latter forms a new species occurs which Evans (1966-b) observed in the Archer River area, northern Queensland, likewise accompanied by D. cerviculum and Cannosphaeropsis mirabilis (Fig. 1). Cookson & Eisenack (1958) and Eisenack & Cookson (1960) describe C. mirabilis from W.A.and Papua within the levels at which Evans (op. cit.) identified unit K 1a microspores. Its presence in sample 4919 means that the microflora probably represents the boundary between units K 1a and K 1b-c. There was no trace of Scriniodinium attadalense, so that the microplankton might represent Evans' Lower Cretaceous Dingodinium cerviculum Zone, which is generally correlated with units K 1b-c.

The occurrence of Crybelosporites stylosus in assemblages MFP 4919 and 4946 agrees with observations in the Surat and Eromanga Basins of the species in basal K 1b-c microfloras, in which it slightly outranges M. florida and N. vallatus (Burger in Galloway & Ingram 1967). A lower K 1b-c age is therefore accepted for both assemblages.

Identical microspores were recovered from Whyenbirra swc. 7 (1400 feet), where N. vallatus has disappeared. In spite of the scarcity of the dinoflagellates, Dingodinium cerviculum gives evidence of marine incursion in the area.

Zone D:

Unit K 1b-c was also recognized in Bellfields MFP 4953 at 525 feet and MFP 4918 at 400 feet. Evans (1966-b) takes the overlap of Odontochitina operculata and Muderongia tetracantha in the sequence of the Rolling Downs Group below the Toolebuc Limestone as the M. tetracantha/O. operculata Dinoflagellata Zone, immediately succeeding that of Dingodinium cerviculum. Burger (1968-bc) reported O. operculata invariably as a constituent of K 1d and K 2 microfloras in the Queensland area. More recent (unpublished) evidence from the Papuan Basin and the Surat Basin demonstrate much earlier appearance of the species. This means that the present views on the vertical extent of the Dinoflagellate Zones must be revised. Under the circumstances the fact that assemblages MFP 4953 and 4918 occur within the range of D. cerviculum (Fig. 1) suggests that they represent the nominate Zone.

Zone E:

Although no samples were available from zone D in Whyenbirra, the K 1b-c assemblage recovered from swc. 8 in zone E establishes a position within the interval of unit K 1b-c for zone D, conform the Bellfields record.

The presence of D. cerviculum in the microplankton of swc. 8 indicates, according to the foregoing remarks, the D. cerviculum Dinoflagellate Zone.

Unit K 1b-c spores and pollen grains also occurred in Talbalba No. 2, cuttings from 952-956 feet, collected from within the Doncaster Member of the Wallumbilla Formation (according to B. Senior, pers. comm.). Palynological datings of cuttings are interpreted with caution, regarding the risk of contamination, but in view of the association of the Member with unit K 1b-c in the Surat and Eromanga Basins (Evans 1966-bd; Burger 1968-abc), the age of microflora MFP 4859 is regarded as reliable.

Spore unit K 1d

Zone E:

In the spore sequence of Bellfields the microfloras from 325 feet (MFP 5042) and 200 feet (MFP 5024) mark the incoming of Pilosisporites parvispinosus and Crybelosporites striatus, which is sufficient to date them as younger than units K 1b-c (Evans 1966-a; Burger 1968-bc; 1969). The presence of D. cerviculum at 325 feet confirms earlier discussed evidence from the Queensland area of its occurrence in lower unit K 1d assemblages (Burger 1968-bc). This appears to be a point of considerable interest to pursue in future drilling. Assemblage MFP 5042 is thus accepted to represent the lower part of unit K 1d.

In Whyenbirra, K 1d fossils were recovered from 600 feet (swc. 9), higher in the Zone. The absence of D. cerviculum may indicate that the assemblage is younger than basal unit K 1d and therefore younger than Bellfields MFP 5042.

Cuttings from Talbalba No. 2 at 682-688 feet (MFP 4861) in the interval of the Doncaster Member also yielded K 1d microspores. Fossils of this age have been identified in the (Lower to Middle) Albian Ranmoor and Coreena Members of the Wallumbilla Formation in the Eromanga Basin (Burger 1968-b), as well as in the Coreena Member of the western Surat Basin (Burger 1968-c). However, since foraminifera of Aptian age were recognized from as high as 489 feet in Talbalba No. 2 (Terpstra 1969) an Albian age for assemblage MFP 4861 is regarded highly improbable. Nevertheless, an Aptian age is inconceivable for unit K 1d in the light of the present knowledge from the Queensland area (Burger 1969), so that the sample most probably does not represent the alleged depth interval, being thoroughly contaminated by caving. The spore dating is therefore discarded.

Spore unit K 2a

Zone E:

Spores and pollen grains younger than units K 1 were encountered in Bellfields at 175 feet (MFP 4947) and 150 feet (MFP 4917). Coptospora paradoxa and Microfoveolatosporis canaliculatus are known to appear simultaneously in the upper Lower Cretaceous of eastern Australia (Dettmann 1963; Burger 1968-bc). The co-occurrence of M. canaliculatus, Cyclosporites hughesi and Dictyotosporites speciosus at 175 feet indicates a unit K 2a age for microflora MFP 4947 (Evans 1966-b; Burger 1968-bc).

Cicatricosisporites sp., a not yet formally described species in MFP 4917, appears sporadically in upper Lower Cretaceous microfloras and does not seem to occur below the uppermost part of unit K 1d (Burger 1968-bc). There is no reason to assume that the assemblage is younger than K 2a. The existence of sediments of post-K 2a age was established from scout drilling further west near the border (Terpstra & Burger 1969), so that their existence in Bellfields and Whyenbirra was not impossible. However, prolonged search for tricolpate pollen grains, which mark the beginning of units K 2b+ in the spore sequence, proved fruitless. Neither was there a trace of Appendicisporites spp., which occur in post-K 2a assemblages in the northern Eromanga Basin (Evans 1966-b; Burger 1968-b). Microflora MFP 4917 is thus most likely of unit K 2a age.

Cuttings form Talbalba No. 1, 280-290 feet (MFP 4860), yielded Coptospora paradoxa, Cicatricosisporites australiensis and Dictytotosporites speciosus, which is typical of unit K 2a. The overlap of the ranges of D. speciosus and C. paradoxa is very narrow and in the Great Artesian Basin it includes strata of the upper Coreena Member and the Toolebuc Limestone, where present, while the lower part of the Allaru Mudstone produced succeeding unit K 2b spores (Evans 1966-b; Burger 1968-bc). Albian faunas were collected in outcrop areas of these rock units (Day 1967; Vine & Day 1965; Vine et al. 1967). Terpstra (1969) recognized lower to Middle Albian foraminifera from Talbalba No. 1 below 290 feet.

Further west, K 2a spores occurred in the same samples from which Lower-Middle Albian foraminifera were collected (Terpstra & Burger 1969). An Albian age is thus obvious for assemblage MFP 4860. The possibility of the existence of younger, i.e. post K 2a sediments in the area is possible but there is no evidence of it in the Talbalba and Bellfields sections.

AGE AND CORRELATION OF LITHOLOGICAL ZONES

The palynological age of zones B to E is now sufficiently determined for a comparison with the standard stratigraphic nomenclature for the sediments in the Eromanga and Surat Basins. Zone A, of which we do not have palynological information, represents according to Cundill et al. (1967) in the Whyenbirra section the Timbury Hills Formation and is regarded as Devonian. Evans (1966-d) states (p. 5): "Sediments referred to the Timbury Hills Formation in A.A.O. Pickanjinnie No. 2 (M.E. White pers. comm.) in the Surat Basin, and in A.F.O. Purbrook No. 1 (Woods, in Mines Administration Pty. Ltd. 1963), in the Bowen Geosyncline have yielded Devonian plant remains". For the present time I regard zone A in Bellfields as the N.S.W. correlate of the formation.

A J5-6 age of the fossils from Whyenbirra at 2200 feet warrants correlation of at least the upper part of zone B with the lower interval of the Hooray Sandstone, which produced upper J 5-6 spores (Evans 1966-d; Burger in Galloway & Ingram 1967). Contemporaneous microfloras have also been recorded from the Orallo Formation and the Gubberamunda Sandstone in the Surat Basin (Evans 1966-a; Burger 1968-a; also Burger, in prep.).

When zone B in Bellfields is regarded of equally (Upper) Jurassic age, then a picture emerges of Jurassic sediments on top of the Eulo-Nebine Ridge, which are over 800 feet thick in Amoseas Alba No. 1 and Scalby No. 1 wells further north (Exon et al. 1967); 600 feet thick in Whyenbirra and maximum 100 feet thick in Bellfields, thus wedging out by overlapping Cretaceous unit K 1 sediments against the northern flank of the crystalline and Paleozoic massif, which surfaces south of the Darling River. Southern limits of sedimentation in the

TABLE 3 : CORRELATION OF LITHOLOGICAL AND PALYNOLOGICAL UNITS

<table>
<tr><th>ZONES</th><th>SPORE UNITS</th><th colspan="2">FORMATIONS
Members</th><th>AGE</th></tr>
<tr><td rowspan="2">E</td><td>K 2a</td><td colspan="2" rowspan="2">Coreena</td><td rowspan="2">LOWER TO MIDDLE ALBIAN</td></tr>
<tr><td>K 1d</td></tr>
<tr><td>D</td><td rowspan="2">K 1b-c</td><td colspan="2" rowspan="2">Doncaster</td><td rowspan="2">APTIAN</td></tr>
<tr><td rowspan="2">C</td></tr>
<tr><td>K 1a</td><td rowspan="2">HOORAY</td><td rowspan="2">BLYTHESDALE</td><td>NEOCOMIAN</td></tr>
<tr><td>B</td><td>J</td><td>JURASSIC</td></tr>
<tr><td>A</td><td></td><td colspan="2">TIMBURY HILLS</td><td>DEVONIAN</td></tr>
</table>

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Basin during upper Jurassic times are apparent and do not seem to be located far from Bellfields. Further to the south, Cretaceous strata might be expected to lie directly on the basement rocks.

Zones C and D are regarded as Lower Cretaceous sequences by the distinct K 1 microfloras produced. The lower part of zone C, approximately concurrent to the interval of spore unit K 1a, can be correlated with the upper part of the Hooray Sandstone, which Evans (1966-d) and Burger (in Galloway & Ingram 1967) proved to be of K 1a age. It is also palynologically equivalent with approximately the Blythesdale Formation in the Roma-Mitchell area, Surat Basin (Burger, in prep.). It may be, considering its stratigraphic position, partly of Aptian age, but very likely represents almost totally the Neocomian. K 1a microfloras were reported by Evans (1966-b) from sediments in A.P.C. Iehi No. 1 well, Papua, from which upper Neocomian foraminifera were recovered (Glaessner in Gay & Brown 1967). Day (op. cit.) describes Aptian faunas from the Minmi Member, Blythesdale Formation, and pre-Aptian, possibly Neocomian faunas from the underlying Nullawurt Member, which contains K 1a microspores (Burger, in prep.).

In Table 3 and Figure 3 correlation is shown on the basis of evidence for an identical palynological age of the Minmi Member in the Roma-Mitchell area and the strata immediately overlying the Hooray Sandstone in the Augathella Sheet area to the northwest (Burger in Galloway & Ingram 1967). Burger presumed the existence of K 1a sediments higher than the Hooray Sandstone which is expressed in Table 3, although positive K 1a spores have still to be found above the Sandstone.

The upper part of zone C, i.e. the 1680-1220 feet interval in Whyenbirra and the 877-610 feet interval in Bellfields, together with zone D, are closely comparable with the Wallumbilla Formation, Doncaster Member in Queensland. Slight discrepancies exist in regard with the age of the basal sediments of the Member, which have not yet been fully investigated. Day (1964; also in Exon et al. 1967) and Vine & Day (1967) date the Member as Aptian; hence an Aptian age for the upper parts of zone C as well as zone D is concluded.

Zone E, of which the lowermost beds yielded K 1b-c spores in Whyenbirra and appeared barren in Bellfields, contains mostly K 1d and K 2a sediments. It is therefore closely comparable with the Coreena Member of the Wallumbilla Formation in the western Surat Basin and the eastern Eromanga Basin (Burger 1968-bc). The Member was drilled in B.M.R. Bulloo No. 1 scout further to the west. Albian foraminifera were identified from the same samples that yielded K 1d and K 2a spores (Terpstra & Burger 1969). It is shown on p.11 that also in Talbalba No. 1 an Albian-K 2a age was established for cuttings from the same member.

The wireline log characteristics of zone E in the 1010-500 feet interval of Whyenbirra bear great resemblance to those in a number of oil wells in the Surat Sheet area from the Coreena and the overlying Surat Siltstone (Thomas & Reiser 1968). The Surat Siltstone (Reiser 1969 in prep.) is a locally developed rock unit which is not known in the Eromanga Basin, and according to Thomas & Reiser does not extend in subsurface north and west of the Balonne River in the Sheet area. If the resemblance of log characteristics is of correlative significance, then the sediments between 1010 feet and approximately 740 feet might be identified with the Coreena, while the overlying sediments could represent the southwestern correlate of the Surat Siltstone. Present regional mapping in the St. George, Dirranbandi and Homeboin Sheet areas will probably settle the possibility of a southwestern extension of the siltstone.

CONCLUSIONS

1. Upper Jurassic and Lower Cretaceous sediments are developed in the region between the Surat and Eromanga Basins at the border of Queensland and New South Wales overlying basement rocks in what appears to be an uninterrupted sequence. Although provisionally divided into lithological zones for the purpose of this investigation, they bear close affinity to the rock sequence mapped and logged further west and northwest in the Eromanga Basin.

2. Environments of deposition for the drilled sediments, briefly mentioned in Tables 1 and 2, suggest limits of marine deposition to the south for the Cretaceous strata. Thickness gradients of the Jurassic non-marine sediments suggest nearby southern limits of sedimentation for the area during the Upper Jurassic. The edge of the Basin must have moved southwards in Upper Jurassic and Lower Cretaceous times.

3. Results of faunal study from the Bulloo and Talbalba bores agree so far with Evans' and Burger's earlier datings of the Cretaceous spore units in the Queensland area. Present knowledge of the local sediments is insufficient to warrant any prognosis on time relationship of spore units to rock formations, established further north; however, initial pollen stratigraphic data from west of the Eulo Ridge suggest that this relationship might be a parallel one throughout the area of the Eromanga Basin.

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FIGURE 1 : TIME DISTRIBUTION OF PLANT MICROFOSSILS IN BELLFIELDS NOS. 1 & 1A

BORE	No. 1A								No. 1			
LITHOLOGICAL ZONE	C						D		E			
DEPTH OF SAMPLE	1200	1055	1000	875	850	700	525	400	325	200	175	150
PALYNOLOGICAL UNIT	K 1a			K 1b-c					K 1d		K 2a	
Kraeuselisporites linearis	?											
Murospora florida	x											
Coronatispora perforata	x											
Contignisporites multimuratus	x											
Dictyotosporites complex	x	x										
Foveotriletes parviretis	x	?	x									
Minerisporites sp.	x			?								
Ischyosporites punctatus	x	x	?	x		x		?				
Cyclosporites hughesi	x	x			x	x	x				x	
Biretisporites spectabilis	?	x	x	x	x		x	x			x	
Dictyophyllidites crenatus	x	x		x	x	x	x				x	
Contignisporites fornicatus	x					x					x	
Lycopodiumsporites circolumenus	x	x						x			?	
Classopollis spp.	x	x		x	x	x		x	x	x	x	x
Neoraistrickia truncata	x			x	x	x	x	x			x	x
Cicatricosisporites hughesi		x										
Couperisporites tabulatus		x										
Nevesisporites vallatus		x	x									
Crybelosporites stylosus		x			x	x						
Lycopodiumsporites nodosus		x		x	x	x	x	x		x		
Aequitriradites spinulosus		x									x	
A. verrucosus		x									x	
Klukisporites scaberis		x			x	x	x	x	x		x	
Sestrosporites pseudoalveolatus		x			x							x
Foraminisporis dailyi		?	x	x	x	x	x	x		?	x	x
Leptolepidites major			x				x	x			x	
Reticulatisporites pudens				x	x	x		x		x	x	x
Trilites cf. tuberculiformis				x		x		x	x			x
Pilosisporites notensis					x	x	?	x		x		
Dictyotosporites speciosus					x	x		x			x	
Leptolepidites verrucatus					x	x	x	x			x	
Cicatricosisporites australiensis					x	x	x	x	x		x	x
Cooksonites variabilis						x						
Foraminisporis asymmetricus								x			x	x
Pilosisporites parvispinosus									x	?	x	x
Crybelosporites striatus										x	x	x
Microfoveolatosporis canaliculatus											x	
Coptospora paradoxa											?	?
Cicatricosisporites sp.											?	x
Arcellites reticulatus												x
"Gen. et sp. A" Eis. & Cooks.		x										
Dingodinium cerviculum				x	x				x			
Cannosphaeropsis mirabilis					x							
Muderongia sp.					x			x				
Goniaulacysta edwardsi					x			x	x			
Muderongia tetracantha						?	x					
Diconodinium multispinum							x					x
Hystrichosphaeridium spp.							x	x	x	x		x
Muderongia mcwhaei								x				
Odontochitina operculata								?				?

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FIGURE 2 : TIME DISTRIBUTION OF PLANT MICROFOSSILS
IN WHYENBIRRA NO. 1 AND TALBALBA NOS. 1 & 2

BORE	Whyenbirra								Talbalba	
LITHOLOGICAL ZONE/FORMATION	B	C					E		Wallumbilla	
DEPTH OF SAMPLE	2200	2038	2000	1800	1600	1400	1000	600	952-56	280-90
PALYNOLOGICAL UNIT	J	K 1a				K 1b-c		K1d	K 1b-c	K 2a
Sestrosporites pseudoalveolatus	x									
Klukisporites scaberis	x	x		x						
Lycopodiumsporites circolumenus	x	x			x				x	
Foraminisporis dailyi	x	x		x	x					x
Ischyosporites punctatus	x		?			x			x	
Contignisporites multimuratus	x						x			
Leptolepidites verrucatus	x	x		x		x		x	x	
Classopollis spp.	x	x	x	x	x		x	x	x	
Crybelosporites stylosus		?								
Contignisporites fornicatus		x								
Murospora florida		x		x						
Nevesisporites vallatus		x	x		x					
Monoletes B.M.R. no. 824		x			x					
Lycopodiumsporites nodosus		x		x	x	x			x	
L. rosewoodensis		x			x			x	x	
Foveosporites canalis		x						x		
Dictyotosporites complex		x	x				x	x		
Neoraistrickia truncata		x	?	x	x	x			x	x
Biretisporites spectabilis		x	x	x	x	x	x	x		x
Leptolepidites major		x			x	x		x		
Matonisporites cooksonae		?		x				x		
Dictyophyllidites crenatus		?		x	?	x		x	x	
Crybelosporites punctatus		?						x		
Reticulatisporites pudens		?						?		x
Cooksonites variabilis			x							
Cicatricosisporites ludbrooki			x				x	?		
C. hughesi				x						
Rouseisporites reticulatus				x						
Contignisporites cooksonae				x						
Rouseisporites simplex				x	?					
Foveotriletes parviretis		x		x	?			?		
Cyclosporites hughesi		x		x	x	x		x	x	
Dictyotosporites speciosus			o?		x	x	x	?	x	x
Couperisporites tabulatus					x					
Aequitriradites verrucosus					x			?		
Pilosisporites notensis						x			x	
Trilites cf. tuberculiformis						x	x			x
Cicatricosisporites australiensis						x	x	x	x	x
Foraminisporis asymmetricus							x	x		x
Pilosisporites parvispinosus								x		
Crybelosporites striatus								x		x
Coptospora paradoxa										x
Pilosisporites grandis										x
Rouseisporites radiatus										?
"Gen. et sp. A" Eis. & Cooks.			o?	x						
Scriniodinium attadalense					?					
Dingodinium cerviculum						x	x			
Canningia colliveri						?	x			
Diconodinium multispinum							x			
Odontochitina operculata							x	x		
Goniaulacysta edwardsi							x	x		
Muderongia tetracantha							x	x	?	
Hystrichosphaeridium spp.							x	x	x	
Chlamydophorella nyei							x			x

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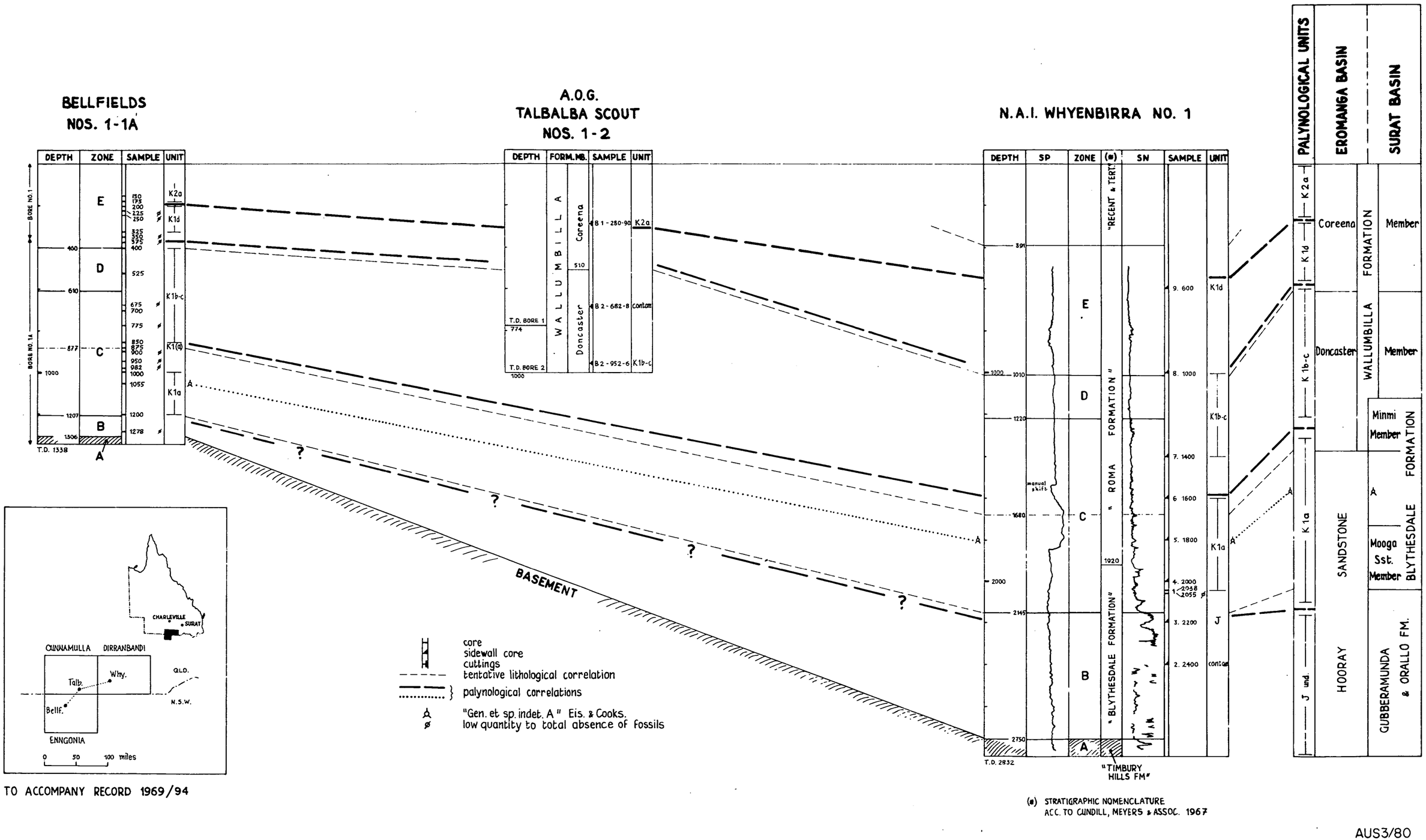
FIG. 3: CORRELATION CHART BELLFIELDS - TALBALBA - WHYENBIRRA



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