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CORRELATION CHART FOR THE CARBONIFEROUS SYSTEM OF AUSTRALIA

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SUMMARY

A brief synopsis of the evidence from the Carboniferous marine faunas of Australia has been used to draw a correlation chart for the Carboniferous System in the continent.

The Lower Carboniferous faunal sequence of the intracratonic basins of Western Australia is represented by the conodont and brachiopod zones established for the Bonaparte Gulf Basin. These are dated mainly in terms of biostratigraphic scales based on conodonts, foraminifers, and brachiopods established in the Lower Carboniferous of Britain and Belgium, i.e., mainly the Kohlenkalk facies. The Carboniferous brachiopod zones of the New England Geosyncline, recognizable only in eastern Australia, are dated in terms of the ammonoid and conodont zones of the German Lower Carboniferous i.e., the Kulm facies. Hence, in so far as it is possible to correlate the Kulm with the Kohlenkalk facies in western Europe, it is possible to make generalized correlations throughout the marine Carboniferous of the Australian continent.

Correlation of terrestrial sequences in Australia, and between them and those overseas, is based on plant and spore evidence. The sporadic nature of this evidence, however, renders such correlation highly tentative.

INTRODUCTION

The correlation chart for the Carboniferous System in Australia is divided into two sections, which represent two distinct regions of mainly marine sedimentation: a western region in the intracratonic basins of Western Australia; and an eastern region in the New England Geosyncline (= Tamworth and Yarrol Troughs, and the Gloucester-Myall Region, N.S.W.) and the north Queensland basins (= Burdekin Basin and the Broken River Embayment). Direct detailed correlations between these regions cannot be made at present, mainly because of the endemic nature of the respective faunas. A third region, of mainly terrestrial sedimentation, is characterized by the scarcity of fossils, and represented on the chart by the Drummond Basin.

The sequence of eastern Australian marine invertebrate zones shown on the chart is a combination of the brachiopod zones established by Roberts (1965) and Campbell & Roberts (1969) from New South Wales, and the faunas of McKellar (1967) from Queensland. It has been previously used by Campbell et al. (1969), and described in more detail by Campbell & McKellar (1969). The zones, recognizable in the eastern region only, are defined by brachiopods, and their positions in the various columns on the chart are indicated by the zone number (e.g., 4). Where ammonoids and conodonts are available, an attempt is made to date the eastern zones in terms of the ammonoid zones of the German Lower Carboniferous, i.e., the Kulm facies. During Westphalian times new and distinctly provincial faunas developed in eastern Australia, which show affinities no longer with those of the northern continents, but instead with Argentina.

The Western Australian zones, which are confined almost entirely to the Lower Carboniferous, are represented on the chart by those established for the Bonaparte Gulf Basin on the basis of conodonts (Druce, 1969) and brachiopods (Roberts, 1971). Their positions, as used in correlation, are indicated in the columns on the chart by letters, in upper case for brachiopods, and lower case for conodonts. The zones are dated in terms of the biostratigraphic scales based on conodonts, foraminifers, and brachiopods established in the Lower Carboniferous of Britain and Belgium, i.e., mainly the Kohlenkalk facies. Hence, insofar as it is possible to correlate the Kulm with the Kohlenkalk facies in western Europe, it is possible to make generalized correlations throughout the marine Carboniferous of the Australian continent.

Correlation within the mainly terrestrial regions, and between these and extra-Australian areas, is based on infrequent evidence from plants, and spores, and is highly tentative. For this reason, most terrestrial sequences are discussed at the end of the text, but not shown on the chart.

Both fossil identifications and opinions on the correlation of rock units, where unsupported by references, are the authors' work. Two sets of numbers are given at the base of the columns on the chart; those in bold face refer to the numbers shown on the locality map (Fig. 1), the others indicate the reference or references in the bibliography which are most useful as a starting point for further information on the areal geology of the column. Where practicable maximum thicknesses (in metres) have been shown.

Acknowledgments

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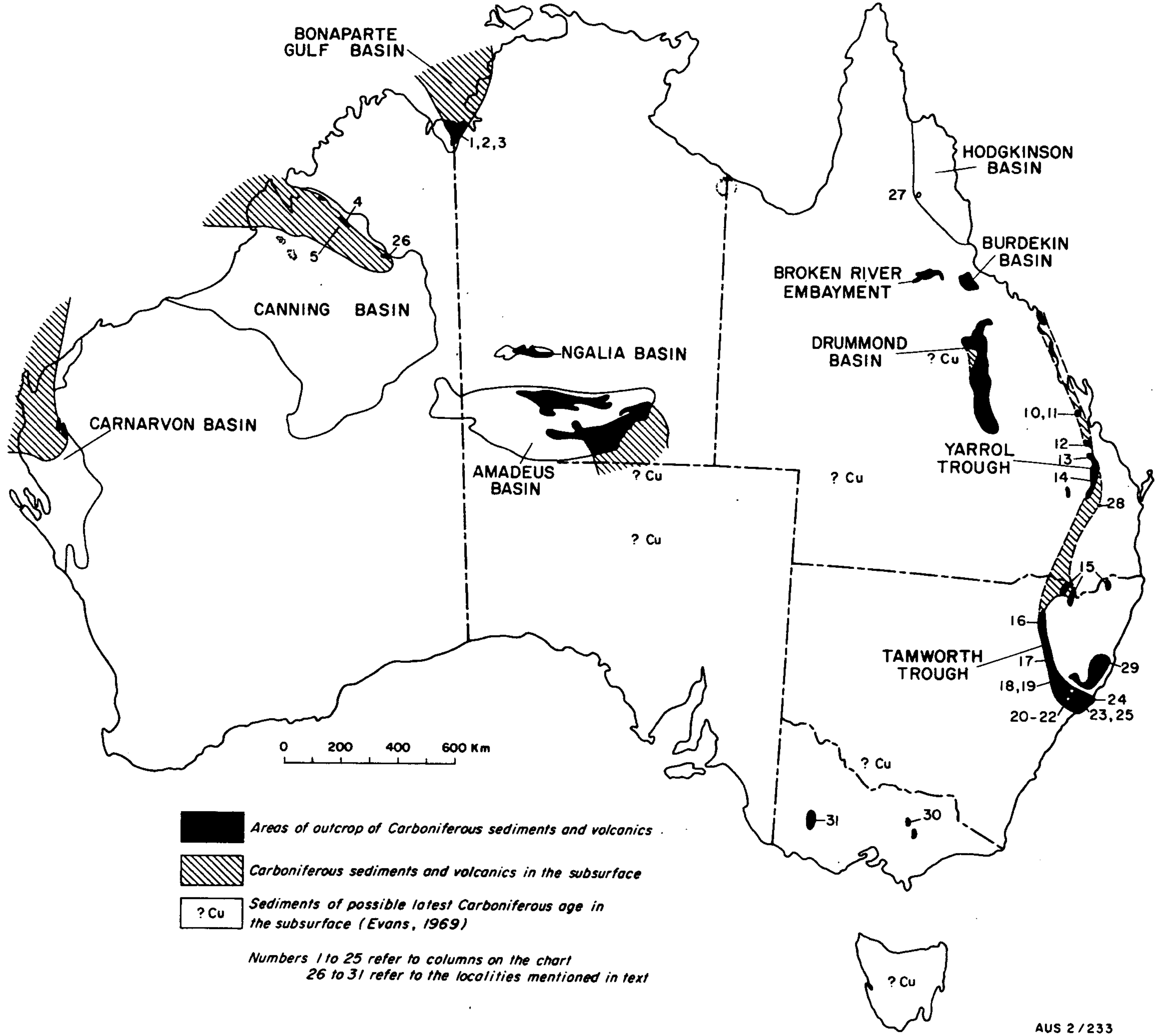
BONAPARTE GULF BASIN
1,2,3
4
5
26
CANNING BASIN
CARNARVON BASIN
NGALIA BASIN
AMADEUS BASIN
? Cu
? Cu
HODGKINSON BASIN
27
BURDEKIN BASIN
BROKEN RIVER EMBAYMENT
DRUMMOND BASIN
? Cu
? Cu
10,11
12
YARROL TROUGH
13
14
28
15
16
TAMWORTH TROUGH
17
18,19
20-22
29
24
23,25
? Cu
31
30
? Cu
0 200 400 600 Km
Areas of outcrop of Carboniferous sediments and volcanics
Carboniferous sediments and volcanics in the subsurface
? Cu
Sediments of possible latest Carboniferous age in the subsurface (Evans, 1969)
Numbers 1 to 25 refer to columns on the chart
26 to 31 refer to the localities mentioned in text
AUS 2/233

x?

Geology, University of Newcastle), Dr B.C. McKelvey (Department of Geology, University of New England), Dr G. Playford (Department of Geology, University of Queensland), and Dr E.C. Druce (Bureau of Mineral Resources), who provided unpublished information relevant to our studies.

THE STANDARD TIME SCALE

The base of the Carboniferous System has been taken as the base of the Gattendorfia Zone (CuI) and its equivalents, following the decision of successive Heerlen Congresses (1935, 1958). It should be noted, however, that this horizon does not correspond with the base of the Belgian Tournaisian, but approximately with the base of TnIb (Streel, 1969; Bouckaert et al., 1969, 1971; Paproth & Streel, 1970).

The base of the Belgian unit V1a, at the lowest bed of the Calcaires et Marbre Noir in the Assise de Dinant at Dinant (= base of the Mabre Noir de Deneé at Salet, and the base of the Calcaires et Dolomie de Sovet at Sovet), was taken as the base of the Viséan by the Sixth International Congress on Carboniferous Stratigraphy and Geology at Sheffield in 1967 (1969, p. 188-9). The basis for the recognition of this horizon is discussed below. It corresponds approximately with the base of the German goniatite zone CuIIγ.

The base of the Namurian is taken as the base of the range zone of Cravenoceras leion, following the Heerlen Congress decision of 1958. Horn (1960) has shown that this zone overlaps the upper part of the German goniatite zone CuIIIγ, viz. CuIIIγ_2, which had previously been considered as the latest unit in the Viséan. The extent of this overlap is so small that it is inconsequential for our present purposes.

The definitions of the Westphalian and Stephanian are of little significance for the chart because of the difficulty of making precise correlations at these levels in Australia.

The base of the Permian, which automatically defines the top of the Carboniferous, is taken at different levels by different workers. In western Europe it has been customary to take it as the base of the range zone of Callipteris conferta (though there are numerous problems associated with such a choice), whereas in Russia the base of the Asselian Stage is used. Neither of these horizons can be recognized with precision in any section in Australia, and for convenience the incoming of the Eurydesma fauna and/or the Glossopteris flora has been taken as marking the boundary. Recently it has been shown that Eurydesma appears in some sections before the Rhacopteris flora disappears or the Glossopteris flora appears (Runnegar, 1969). For the purpose of the present chart, therefore, we have chosen the base of Spore Zone 2 (Evans, 1969) as the base of the Permian.

THE GERMAN GONIATITE ZONES

In the chart presented to the Gondwana Symposium of 1967 in Buenos Aires the German goniatite sequence was used as a standard for the correlation of the Lower Carboniferous. The sequence was shown as continuous. Since then, particularly as a result of the work of Rhodes et al. (1969, 1971), Druce (1969), Matthews (1969a, b, 1970a, b) and Collinson et al. (1971) on conodonts, it has been found that the relatively thin sequences of Western Europe and North America contain several major disconformities. In addition, as Matthews (1970a, b) has pointed out, Schmidt's CuII zones were based on sections in widely separated areas, and there is no certainty that they are sequential and contiguous. In fact, Matthews has demonstrated, at least to our satisfaction, that the conodont zone of Siphonodella crenulata (Voges, 1960) is older than CuIIα but younger than CuI. This part of the sequence is therefore shown on his charts as a gap in the goniatite sequence (Matthews, 1969a, text-fig. 1; 1970a, text-fig. 2). We show the same gap on our chart.

The CuIIα and CuIIβ zones were defined by Schmidt (1925) in the Tn3c of Belgium and the lower part of the Carboniferous Limestone in Ireland respectively. Despite the absence of the nominate species of these zones in Germany, strata from the Rheinisches Schiefergebirge ~~in~~ and the Harz Mountains have been arbitrarily assigned to them, and this has caused confusion between ammonoid and conodont workers. The limits of CuIIβ are still so indefinite that we have not shown them on our chart. The possibility that the CuIIβ and CuIIα zones are time equivalents cannot be discounted.

Recent work by Krebs (1968) on the Erdbach limestone from which the zone fossil of CuIIγ, *Ammonellipsites kochi*, was described, has shown that its range zone covers the interval from the Erdbach Kalk II (about the middle of the conodont zone of *Scaliognathus anchoralis*) to the Erdbach Kalk III (approximately the top of the *anchoralis* - *bilineatus* interregnum). Austin & Rhodes (in Conil et al., 1969), who have studied the conodonts in the vicinity of the Tournaisian-Viséan boundary at Dinant in Belgium, report that the stratigraphically important *Polygnathus communis* and its sub-species *carinus* are restricted to the Tournaisian. *P. communis* along with *S. anchoralis* are recorded by Krebs in the lower of the two Erdbacher limestones referred to CuIIγ, and it therefore seems possible that this zone extends down to the Tn3c - that is, the latest Tournaisian. This is supported by the statement that *S. anchoralis* is restricted to Tn3c (Groessens, 1971), contrary to the claim of Austin & Rhodes (in Conil et al., 1969) that it extends into the Viséan of Belgium. The possibility of a spuriously early dating cannot be ignored however, because late Devonian conodonts have also been recovered from the Erdbacher limestones (Voges, 1960). The best estimate we can make at present is to approximate the base of CuIIγ with the Tournaisian-Viséan boundary. The top of CuIIγ is taken either at the top of V1b (Arbeitsgemeinschaft für Dinant-Stratigraphie, 1971) or within this zone(Weyer, 1972).

Weyer (1972) has recently shown that the CuIIδ (Entogonites nasutus) Zone may be correlated with early V3b of Belgium and the upper Beyrichoceras Stage (B2) of Britain. The base of this zone was shown to be separated from the top of the CuIIδ Zone by the kochi-nasutus Interregnum, a sequence which, in terms of the Belgian scale, corresponds to V2, V3a, and possibly part of V1b. In Britain, the kochi-nasutus Interregnum would approximately equate with the lower Beyrichoceras (B1) Stage. The association of Entogonites nasutus and Gnathodus bilineatus in Germany, shows that CuIIδ overlies the anchoralis-bilineatus Interregnum.

There is good reason to believe that CuIIδ and CuIIIα are contiguous (Nicolaus, 1963). The boundary between them is taken at the base of the conodont Apatognathus geminus - Cavusgnathus zone of the Avon Gorge sequence (Rhodes et al., 1969).

There is no known boundary problem between CuIIIα and CuIIIβ. The characteristic goniatites of the boundary subzones are known in apparently conformable sequences in Germany (Kulick, 1960; Nicolaus, 1963). Similarly the type goniatites of CuIIIβ and CuIIIγ are known in contact (Kulick, 1960). We have therefore shown the zones CuIIδ - CuIIIγ as forming a continuous sequence.

No post-Viséan Carboniferous goniatites are known in sequence from Australia and hence zones in this internal are not discussed.

FAUNAL ZONES IN WESTERN AUSTRALIA

Correlation of the Western Australian sequences has been effected by two main groups, brachiopods and conodonts, both of which are locally abundant. Foraminifera have been used on a more limited scale. Ammonoids are extremely rare. It is fortunate that at many localities all three major groups of fossils have been found either together or in sequence. In the following discussion the reasons for the dates shown on the chart are set out. The occurrences of the zones in the various columns are indicated by a lower case letter symbol on the left side for the conodonts and an upper case letter symbol on the right side for the brachiopods.

Brachiopod Zones

The Carboniferous brachiopod zones of Western Australia are based on work by Thomas (1971) and Roberts (1971). The zonal scheme used in the chart is that of Roberts (1971), which is based specifically on faunas from the Bonaparte Gulf Basin, and shows details of the definition of the zones and the ranges of the numerous species. Some of the zones can be identified in the Canning and Carnarvon Basins, but detailed work is required to differentiate between zones, and to determine whether all the zones can be applied throughout Western Australia. For example, in the Canning Basin elements of the *Unispirifer laurelensis*, *Grammorhynchus eganensis*, and *Septemirostellum amnicum* Zones are recognized in the upper part of the Laurel Formation; Thomas (1971) referred these to a broader *Unispirifer fluctuosus* zonal assemblage which may possibly be subdivided after more detailed work.

Spinocarinifera adunata Zone

An early Tournaisian age is indicated for this zone by the morphological similarity between *S. adunata* and *S. niger* (Gosselet) from the Etroeungt and early Tournaisian of Europe, *S. inflata* (Sokolskaya) from the early Tournaisian of the Kuznetsk Basin, Siberia, and possibly *S? arcuata* (Hall) from the Kinderhook of Missouri.

Acanthocosta teicherti Zone

A fauna from the teicherti Zone in the Ningbing Limestone is more diverse than elsewhere and contains Spirifer otwayi Roberts, which resembles S. chappelensis Carter from the Chappel Limestone of Texas, and S. tersiensis Rotai from the early Tournaisian Taidon and lower Netersinsky Beds of the Kuznetsk Basin; Brachythyris planulata Roberts, which is comparable to specimens of B. chouteauensis (Weller) from the Chappel Limestone; Rhytiophora sp.cf. R. calhounensis (Miller), which is compared with material from the Chouteau Limestone of Missouri; and Crassumbo? jonesi Roberts, which is possibly related to C. inornatus Carter from the Chappel Limestone.

Lomatiphora aquila Zone

The nominate species is unrelated to previously described productellidids, and the other characteristic species range into the overlying laurelensis Zone. Of these, Unispirifer laurelensis (Thomas) is morphologically close to U. platynotus (Weller) from the Kinderhook of Iowa, to 'Fusella' ussiensis (Tolmachoff) from the early Tournaisian Taidon and Netersinsky Beds of the Kuznetsk Basin, Siberia, to U. minnewankensis (Shimer) from the Rundle Formation of Canada, and possibly to Spirifer aff. clathratus M'Coy from the Z_1 of England. Septemirostellum simplex Roberts resembles S. mitcheldeanensis (Vaughan) from the Tournaisian K, Z, and basal C Zones in England, and the Tn1a, Tn1b, and Tn2a Zones of Belgium.

Unispirifer laurelensis Zone

The affinities of U. laurelensis and Septemirostellum simplex have been dealt with in the aquila Zone. Rhytiophora raricostata (Herrick), which is extremely close to a form ranging from the laurelensis to the amnicum

Zone, is recorded from the Kinderhookian Logan Formation of Ohio.

Grammorhynchus eganensis Zone

Prospira incerta Thomas, one of the distinctive species of the Zone, is morphologically close to P. prima Maxwell, which is present in the Schellwienella cf. burlingtonensis Zone of eastern Australia.

Septemirostellum amnicum Zone

Septemirostellum amnicum (Veevers) is close to S? acutirugatus (de Koninck) from the Tournaisian of Belgium and Russia. Eomartiniopsis costata Roberts has closest affinities with E. girtyi (Branson) from the Chouteau and Chappel Limestones of U.S.A.; Tylothyris transversa Roberts in some respects resembles T. laminosa (M'Coy) from the Tn2c and Tn3b of Belgium and the Z and C Zones of England; Marginatia mimica Roberts, which ranges from the amnicum to the spiritus Zones, is close to M. deruptoides Sarycheva from the Tournaisian of the Kuznetsk Basin; and Cranaena montana Roberts, which ranges from the amnicum to the langfieldensis Zones, resembles C. globosa Weller from the Burlington Limestone of Missouri.

Schellwienella australis Zone

Thomas (1971) has compared Schellwienella australis with Belgian specimens of S. crenistria (Phillips), and with S. burlingtonensis Weller from the Burlington Limestone of U.S.A. and the late Tournaisian of the Moscow Basin. He also compared Unispirifer septimus with Spirifer pentagonus Sokolskaya and S. ventricosus Sokolskaya from the Tournaisian of the Moscow Basin, and S. mediocris Tolmachoff and S. similis Tolmachoff from the Tournaisian Taidon and Netersinsky Beds in the Kuznetsk Basin, Siberia.

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Syringothyris langfieldensis Zone

Tangshanella? fasciculata bears an 'advanced' fasciculate ornament similar to that in younger spiriferaceans, but it is a distinctive species and cannot be closely compared with other taxa. Brachythyris peculiaris (Shumard) is from the Chouteau Limestone of U.S.A. Spirifer spiritus is compared by Thomas (1971) with S. attenuatus Sowerby, which is known from the late Tournaisian and early Viséan of Europe and the USSR.

Spirifer spiritus Zone

Thomas (1971) has compared S. spiritus with late Tournaisian and early Viséan species from Europe and the USSR, and has noted some resemblances between Punctospirifer mucronatus and P. transversus (McChesney) from the Chester of U.S.A. However, the continued occurrence of such species as Schellwienella australis, Unispirifer septimus, Septemirostellum septimum, and Prospira travesi from lower zones suggests that the zone is still of late Tournaisian or possibly early Viséan age.

Apart from the lowermost adunata Zone, which is early Tournaisian in age, the brachiopod zones dealt with so far are assigned only generally to the Tournaisian. There is a good deal of evidence favouring a broad correlation with the Chouteau and Chappel Limestones of U.S.A., but there are many conflicting relationships and it is not possible to determine a precise age for each of the zones. This may be due, in part, to the fact that faunas from important overseas sequences are inadequately described.

Faunal relationships of the Viséan zones are more precise, although this result may be slightly artificial because of hiatuses between zones, particularly on either side of the pauciplicatus Zone. This situation contrasts with the nearly continuously fossiliferous sequence in the Tournaisian.

Punctospirifer pauciplicatus Zone

The fauna of this zone is closely comparable with Viséan assemblages from the British Isles and Europe: Productina margaritacea (Phillips) is characteristic of the D Zone of Great Britain, and the Viséan of Belgium, Germany, and USSR; Serratocrista Brunton, 1968, has previously been recorded from the lower part of the D Zone in Ireland; Delepinea uttingi is comparable with D. destinezi (Vaughan) from the C_2S_1 Zone of Britain and the early Viséan of Belgium, and with D. carinata (Garwood) from the C_2 Zone of England and the early Viséan of Belgium; Megachonetes zimmermanni is common in the Viséan of Poland, Belgium, France and USSR, although it has been recorded also from the Tournaisian of the Kuznetsk Basin; two species of Rugosochonetes are remarkably close to species from the Viséan of Great Britain - R. macgregori bears a close resemblance to R. silleesi Brunton from the lower D Zone of Ireland, and to the fine-ribbed holotype group of R. celticus Muir-Wood from North Wales, and R. ustulatus is close to R. transversalis Brunton, also from the low D Zone of Ireland; both Podtsheremia? humilicostata and P? thomasi have affinities with the Spirifer duplicostatus Phillips group of species from the Viséan of Great Britain and Belgium, and with Anthracospirifer shoshonensis (Branson & Greger) from the early Meremecian (lower or middle Salem) of U.S.A. The bulk of evidence favours correlation with the lower D Zone of Great Britain.

Anthracospirifer milliganensis Zone

Thomas (1971) determined the age of the zone as late Viséan to possibly Namurian on the affinities of Anthracospirifer milliganensis with the A. bisulcatus (Sowerby) group of species of these ages in Britain and Belgium, with Spirifer parabisulcatus Semichatova from the late Viséan of the Moscow Basin, and with S. nox Bell from the Upper Windsor of Nova Scotia.

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Echinoconchus gradatus Fauna

The Echinoconchus gradatus Fauna is the youngest marine Carboniferous fauna known in the onshore part of the Bonaparte Gulf Basin. The commonest species, Echinoconchus gradatus, Ovatia sp.B, and Punctospirifer sp., are recorded in the milliganensis Zone. The age of the gradatus fauna is probably Namurian because of its position above the milliganensis Zone. However, the possibility of an uppermost Viséan age has not been eliminated. In eastern Australia Echinoconchus gradatus is recorded from the Viséan Delepinea aspinosa and Rhipidomella fortimuscula Zones.

Conodont Zones

In Western Australia, the conodont zones established by Druce (1969) for the Bonaparte Gulf Basin cover the lowest parts of the Carboniferous of Europe (lower and middle Tournaisian) and of the Mississippian of the U.S.A. (Kinderhookian). They appear to be intermediate between the spathognathodid-polygnathid-pseudopolygnathid zonation of Great Britain (Rhodes et al., 1969), and the siphonodellid-gnathodid zones of Germany (Bischoff, 1957; Voges, 1959, 1960) and North America (Collinson et al., 1962, 1971; Klapper, 1966; Sandberg & Klapper, 1967; Thompson & Fellows, 1969). Such differences in the world-wide distribution of conodont genera in the lowest Carboniferous are controlled, according to Druce (1969, p. 34), by environmental influences.

Seddon (1970) demonstrated, from his study of Frasnian conodonts from the Canning Basin, the presence of two contemporaneous but disparate conodont sequences (the Palmatolepis sequence and the Icriodus sequence), which were presumed to represent different environments (=biofacies). This concept was developed by Druce (1970, p. 386), who suggested that in Early

Carboniferous times the simple morphological types (= Biofacies II; Druce, 1973) represented by the Spathognathodus-Polygnathus-Clydagnathus assemblage (the British Avonian aspect), predominate in shallow-water deposits, and complex morphological types such as Siphonodella and Pseudopolygnathus of the triangulus group (the German and American aspect) in deep-water deposits (= Biofacies III; Druce, 1973). The more ornate genera (Dinodus, Dolignathus, Dollymae, Scaliognathus, and Staurognathus) of Biofacies III are thought to be confined to deep-water faunas. Zones based solely on deep-water forms are difficult to correlate with those based mainly on shallow-water forms. Shallow and deep-water genera, however, are not mutually exclusive, and for correlation to be accurate, it is important that descriptions of zonal faunas based dominantly on deep-water genera should include the shallow-water forms as well. Early correlations may therefore require some modification.

In ascending order the Western Australian conodont zones, as established for the carbonate succession on the southeastern platform of the Bonaparte Gulf Basin, are as follows.

Spathognathodus plumulus Assemblage Zone

This zone is correlated by Druce (1969) with the lower part of the Patrognathus variabilis - Spathognathodus plumulus Assemblage Zone of Britain, viz., the S. plumulus nodosus Subzone - lower K in terms of the Avonian coral-brachiopod zones established by Vaughan (1905). According to Druce (1969, p. 37), it is equivalent, in part at least, to the Gnathodus n.sp.B - G. kockeli Assemblage Zone of Collinson et al., (1962), now known as the Protognathodus kuehni - P. kockeli Zone (Collinson et al., 1971), of the Upper Mississippi Valley; and the lower part of the Protognathodus kockeli - Pseudopolygnathus dentilineatus Zone, now known as the Siphonodella sulcata - Protognathodus kockeli Zone (Ziegler, 1969), of Germany. Druce (1969, p. 29) does not discount the possibility that the

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lowermost 15 m of the S. plumulus Assemblage Zone, which contains only two species - Spathognathodus cf.S. tridentatus (E.R. Branson, 1934) and Polygnathus sp. B. Druce, 1969 (= Siphonodella praesulcata Sandberg, 1972) - may belong to the uppermost Devonian. For our purposes, however, we equate the base of the Spathognathodus plumulus Zone with the base of the Mississippian (viz., the base of the Kinderhookian Series - the 'Glen Park' Formation, and the base of the Carboniferous (viz., the base of CuI). The presence of Siphonodella praesulcata in association with S. sulcata, Protognathodus kuehni, P. kockeli, Pseudopolygnathus dentilineatus and Spathognathodus aculeatus in the 'Glen Park' fauna (Sandberg et al., 1972) supports this view.

Siphonodella sulcata - Polygnathus parapetus Assemblage Zone

Druce (1969) equates this zone with the upper part of the Patrognathus variabilis - Spathognathodus plumulus Assemblage Zone of Britain (the Clydagnathus sp. A. subzone), and the Siphonodella sulcata Assemblage Zone of the Upper Mississippi Valley. Although it cannot be correlated directly with the German succession, Sandberg & Klapper (1967) report S. sulcata in the upper part of the Protognathodus kockeli - Pseudopolygnathus dentilineatus Zone of the type section of CuI. The same authors have found Patrognathus variabilis within, but no younger than, the Siphonodella sulcata Zone in Wyoming. This suggests that both the Spathognathodus plumulus and the Siphonodella sulcata - Polygnathus parapetus Zones of Western Australia are equivalent to the Patrognathus variabilis - Spathognathodus plumulus Zone of Britain, and indirectly (by correlation with U.S.A.) to the Protognathodus kockeli - Pseodopolygnathus dentilineatus Zone of the basal CuI of Germany.

Siphonodella isosticha - Polygnathus inornatus nodulatus Assemblage Zone

The base of this zone is correlated by Druce (1969, p. 37) with the base of the British Siphonodella - Polygnathus inornatus Assemblage Zone of Rhodes et al., (1969, p. 38). Both are drawn at about the first occurrence of Siphonodella isosticha (Cooper) and the Polygnathus inornatus group. As a whole, the Australian zone corresponds to the lower part of the British zone. The incoming of Siphonodella quadruplicata marks the upper limit of the zone in Australia, which indicates a correlation with the Siphonodella duplicata Assemblage Zone of the Upper Mississippi Valley. No direct correlation is possible with the German succession. However, because it is older than quadruplicata, Druce considers that the S. isosticha - P. inornatus nodulatus Zone is probably equivalent to the Siphonodella-Pseudopolygnathus triangulus inaequalis and Siphonodella - P. triangulus triangulus Zones established by Voges (1959, p. 268) in the type CuI section. Indirect support for this correlation comes from the report of Sandberg & Klapper (1967), who on the basis of samples collected from this section have correlated their Siphonodella sandbergi - S. duplicata Zone (a correlate of the S. duplicata Assemblage Zone of Collinson et al., 1962) with both of Voges's zones.

Siphonodella quadruplicata - S. cooperi Assemblage Zone

This zone is correlated by Druce (1969, p. 31) with the middle part of the British Siphonodella - Polygnathus inornatus Assemblage Zone - a conclusion based on the presence of Siphonodella isosticha, Polygnathus inornatus, P. inornatus rostratus, and Pseudopolygnathus vogesi in both zones. The presence of Siphonodella quadruplicata in the lower part and S. cooperi in the upper part of the Siphonodella quadruplicata - S. cooperi Zone suggests to Druce (1969, p. 38) 'a firm correlation with the American Siphonodella quadruplicata - S. crenulata and the overlying S. isosticha - S. cooperi Assemblage Zones of the Mississippi Valley'. This correlation, based on the assumption that the upper limits of the siphonodellids in the Bonaparte Gulf Basin and in the Upper Mississippi Valley are isochronic, may have to be revised in the light of the new concept of conodont biofacies (Seddon, 1970; Druce, 1970; Seddon & Sweet, 1971). There seems little age difference between the base of the Siphonodella quadruplicata - S. cooperi Zone, the base of the American Siphonodella quadruplicata - S. crenulata Zone, and the base of the German Siphonodella crenulata Zone (= base of Tn2a; Conil & Paproth, 1968; Paproth 1964, 1969; and others). However, the later Australian zones of Clydagnathus nodosus, Spathognathodus tridentatus, and S. costatus (Biofacies II) may be time equivalents of the siphonodellid zones (Biofacies III) of America and Germany. In the present state of knowledge, attempts to correlate these two facies would be highly speculative.

Clydagnathus nodosus Assemblage Zone

This zone contains species not represented in the Avonian of Britain (apart from Spathognathodus cyrius cyrius); however, because its upper limit is marked by the first local occurrence of Spathognathodus tridentatus it is probably equivalent to the pre-tridentatus upper part of the Siphonodella - Polygnathus inornatus Assemblage Zone in Britain.

Spathognathodus tridentatus Assemblage Zone

The Spathognathodus tridentatus Assemblage Zone is correlated by Druce (1969, p. 38) with the Spathognathodus cf. S. robustus - S. tridentatus Assemblage Zone of the British Avon Gorge section. The lower limits of both zones are marked by the first occurrence of S. tridentatus and the upper at the first appearance of S. costatus costatus (E.R. Branson) (sensu Rhodes et al., 1969, non Ziegler, 1962).

Spathognathodus costatus Assemblage Zone (non sensu Ziegler, 1962)

This zone is equivalent to the lower two-thirds of the Spathognathodus costatus - Gnathodus delicatus Assemblage Zone of the British Avonian (Druce, 1969, p. 33), the lower part of which includes the

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boundary between the K and Z zones of Vaughan (1905). The Avonian conodont zone represents the first appearance of Gnathodus delicatus; in Belgium the earliest known record of this species is in Tn2c, together with the final appearance of the siphonodellids (Austin & Rhodes, in Conil et al., 1969; Groessens, 1971). Independent and indirect support for this correlation is based on foraminiferal evidence from the Septimus Limestone, which Mamet & Belford (1968, p. 345) regard as no younger than middle Tournaisian (Zone 7); Mamet (in Sando, Mamet, & Dutro, 1969) shows that his Zone 7 is represented in the Dinantian by Tn2b and Tn2c.

The Spathognathodus costatus Assemblage Zone lacks siphonodellids and gnathodids, which makes it difficult to correlate this zone with those based on 'deep-water' assemblages in North America and Germany. Indirect correlation via the Avonian Spathognathodus costatus - Gnathodus delicatus Zone, however, suggests that it may be equivalent to either the Siphonodella isosticha - S. cooperi Zone of the Upper Mississippi Valley (Scheme A of Rhodes et al., 1969 - based on the distribution of gnathodids), or alternatively to part of the unconformity below the Meppen Formation (Scheme B of Rhodes et al., 1969 - based on the distribution of the siphonodellids).

Pseudopolygnathus nodomarginatus Assemblage Zone

This zone is correlated by Druce (1969, p. 34) with the upper part of the British Spathognathodus costatus costatus - Gnathodus delicatus Assemblage Zone, viz., the upper subzone (Clydagnathus unicornis Subzone) of the North Crop of the South Wales Coalfield. The presence of the Spathognathodus costatus group and the absence of the Polygnathus lacinatus group in the Australian Zone suggest that it is slightly older than the British Polygnathus lacinatus Assemblage Zone. No direct correlation with the U.S.A. and Germany is possible. If the zone is slightly older than the Avonian Polygnathus lacinatus Zone, an indirect correlation based on the first appearance of Gnathodus semiglaber would suggest that it is no younger than the middle Tournaisian (Tn2c) of Belgium, the latest Kinderhookian of southwestern Missouri, and the upper part of the Lower Siphonodella crenulata Zone (= without G. semiglaber) of Germany. For the appearance of G. semiglaber marks the base of the Polygnathus lacinatus Zone in Britain, and the base of the G. semiglaber - P. communis carinus Zone (basal Osagean) of Missouri (Thompson, 1967); furthermore, both G. semiglaber and P. communis carinus characterize the Tn3a of Belgium (Groessens, 1971).

To summarize, the entire sequence of conodont zones established by Druce (1969) for the Bonaparte Gulf Basin is older than the Scaliognathus anchoralis Zone (of Voges, 1959), and is probably equivalent to the K and Z_1 Zones of the British Avonian, the CuI and Lower Siphonodella crenulata Zone (= without Gnathodus semiglaber) of Germany, the Tn1b to Tn2c of Belgium, and the entire Kinderhookian of the U.S.A.

Conodont faunas younger than the Pseudopolygnathus nodomarginatus Assemblage Zone are present in the Bonaparte Gulf Basin, but as they are not in a continuous sequence, no zones were defined; Druce (1969, p. 38) used the undefined term 'Gnathodus texanus Assemblage Zone' to refer to the conodonts of the Utting Calcarenite, in a loose sense, because he clearly excluded this fauna from his zonal scheme (op.cit. p. 22).

FAUNAL ZONES IN EASTERN AUSTRALIA

The correlation of the eastern Australian zones with the world time scale has been attempted mainly by the use of goniatites and conodonts, and secondarily by brachiopods. The most significant points are as follows.

Tulcumbella tenuistriata Zone

This zone is correlated with CuI because in the Mt Morgan area it conformably overlies beds containing the Upper Devonian species Tenticospirifer grandis Maxwell, which most closely resembles T. julii (Dehée) from the Zone d'Étroeungt in France (Maxwell, 1954; Dear, 1968); and in the Werrie Syncline it conformably underlies the Spirifer sol Zone, which has been placed in the gap between CuI and CuIIα (see below).

Spirifer sol Zone

Rhodes et al., (1969, p. 60) report a conodont fauna associated with Protocanites and Muensteroceras from the 'Berwick Formation' of Australia. They compare the conodont assemblage with a similar 'Z' Zone fauna of the Avonian, and report that the 'pseudopolygnathids are identical to Z_1 and lower Z_2 specimens. Associated with the pseudopolygnathids are many gnathodids most of which are new species, although a few are similar to G. punctatus, a species characteristic of the upper part of Z_2.' We put most weight on the evidence of the pseudopolygnathids. In America G. punctatus is restricted to the S. cooperi hassi - G. punctatus Zone of latest Kinderhookian age (post-Chouteau) (Collinson et al., 1971), and this with the evidence of the pseudopolygnathids is taken by us to indicate a position within the Z_1 Zone of the Avon Gorge. In terms of the German goniatite zones the conodonts correspond to the middle part of the gap between CuI and CuIIα of Matthews (see above). Dr T.B.H. Jenkins, who provided the specimens and stratigraphic information for Rhodes et al., indicates that the 'Berwick Formation' is in fact the Rangari Limestone, which outcrops on 'Carellan' (or 'Croydon' in Campbell & Engel, 1963, fig. 1) the property of Mr Barwick, 13 km south of Rangari. This locality is within the S. sol Zone.

Associated with the S. sol Zone in the upper part of the Tulcumba Sandstone and the lower part of the Namoi Formation in the Werrie and Belvue Synclines are Protocanites lyoni (Meek & Worthen), P. australis Delépine, Muensteroceras sp. cf. M. oweni (Hall), and Prionoceras (Imitoceras) werriense Campbell & Engel. These were originally interpreted as indicating a CuII age or slightly older (Campbell & Engel, 1963, p. 62): at that time CuI was thought to lie immediately below CuIIα. Some of these ammonoids have long been known to be closely related to the Chouteau and Rockford Limestones of U.S.A., and these are now known to belong to the Siphonodella isosticha - S. cooperi and Gnathodus semiglaber - Pseudopolygnathus multistriatus Zones of Collinson et al. (1962) (see Matthews, 1970b). According to Rhodes & Austin (1971, p. 333) the nominate species of the semiglaber - multistriatus Zone are very similar to forms from the Polygnathus lacinatus - Pseudopolygnathus cf. P. longiposticus Zone (upper Z_2) of the Avon Gorge. The goniatite evidence would therefore be consistent with an age equivalent to the upper half of the gap between CuI and CuIIα.

Finally, the Brushy Hill Limestone at Glenbawn, which probably belongs to this zone though it lacks the diagnostic species, contains a conodont, Patrognathus sp. (Branagan et al., 1970), similar to P. andersoni Klapper (Jenkins, pers.comm.). Klapper (1971) described this species from Kansas in association with Siphonodella quadruplicata, S. cooperi, and S. obsoleta. Sandberg et al. (1972) also noted it in association with S. sandbergi in the upper part of the S. sandbergi - S. duplicata Zone in Wyoming. In terms of the German conodont zonation, these American occurrences therefore indicate that Patrognathus andersoni probably ranges from the Siphonodella duplicata - Polygnathus triangula triangula Zone of Voges (1960) into the lower part of the Siphonodella crenulata Zone (without Gnathodus semiglaber) - i.e. uppermost CuI to the lower part of the CuI - CuIIα gap.

In summary, the *Spirifer sol* Zone seems to be approximately equivalent to the CuI - CuIIα gap of Matthews.

Schellwienella cf. *S. burlingtonensis* Zone

As reported by Campbell & McKellar (1969), *Protocanites* sp. and *Ammonellipsites* sp. have been found in this zone in the Belvue and northern Werrie synclines, and *Merocanites* sp. cf. *M. houghtoni* (Winchell) occurs high in the zone on the eastern side of the Werrie Syncline. *Protocanites* is not known above CuIIα anywhere in the world, and no sections are known in which *Merocanites* occurs with or below *Protocanites*. Although there are some overseas occurrences of *Merocanites* difficult to date, for example in the Marshall Formation of Ohio (Miller & Garner, 1955) and the Coddon Hill Chert and Bampton Limestone of Devon (Prentice & Thomas, 1965), the genus is not likely to range below CuIIγ. Its main occurrences are in the CuIIγ and CuIIδ.

In the Glenbawn area Branagan et al. (1970) have listed a large conodont fauna below the Isismurra Formation from a unit now defined and named the Dangarfield Formation (Roberts & Oversby, in press). Dr T.B.H. Jenkins informs us that he regards the presence of abundant pseudopolygnathids and *Polygnathus communis* in this fauna as indicative of a late Tournaisian age. He also reports a specimen of *Protocanites* from a similar horizon nearby. On approximately the same horizon in this vicinity brachiopods of the S. cf. *burlingtonensis* Zone occur together with a goniatite, *Muensteroceras* sp., of the *M. oweni* group, though quite different from the form referred to *M.* cf. *oweni* in the *S. sol* Zone (Roberts, in prep.). These data suggest that in this area the *S.* cf. *burlingtonensis* Zone is CuIIα in age.

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In summary taking the above information in conjunction with that from the underlying zone, the S. cf. S. burlingtonensis Zone covers some or all of CuIIα and the lower part of CuIIγ.

Orthotetes australis Zone

Roberts & Oversby (in press) have shown from work in the Rouchel district that the australis Zone requires revision. The zone is present in the lower part of the Woolooma Formation at Rouchel, and in the Bonnington Formation at Gresford. Faunas from Lewinsbrook and Trevallyn, in the Gresford district, which belong to the australis Zone are now known to come from the Bonnington Formation (Hall, 1972, unpubl.; J.R.), not the Bingleburra Formation as originally suggested by Roberts (1961). The australis Zone is characterized by an influx of new species. These include Schuchertella concentrica Roberts, Streptorhynchus spinigera (M'Coy), Eomarginifera tenuimontis Roberts, Krotovia sp., Acuminothyris triangularis Roberts, Brachythyris elliptica Roberts, Asyrinxia lata (M'Coy), Cleiothyridina australis Maxwell, Coledium laevis (Roberts), and Dielasma picketti Roberts. At Rouchel, Orthotetes australis (Campbell) and Fluctuaria campbelli Roberts are present in a fauna transitional with an older zone. Species characteristic of the later part of the zone include Rugosochonetes auriculus Roberts, Plicochonetes sexifidus Cvancara, Waagenoconcha delicatula Campbell, and Voiseyella anterosa (Campbell).

Beyrichoceras trevallynense Brown, Campbell, & Roberts, and Prolecanites sp. are associated with a fauna of brachiopods from the australis Zone in the Bonnington Formation at Trevallyn. Brown, Campbell, & Roberts (1965) compared B. trevallynense with the B. micronotum group of ammonoids which characterize subzones 3 and 4 of the Beyrichoceras Zone, and particularly with B. submicronotum Bisat, which is found in probable equivalents of subzone 3. The genus Prolecanites first appears in subzone 2 and persists beyond the end of the Viséan. In

Derbyshire B. submicronotum is associated with P. discoides in beds which underlie those with a subzone 4 assemblage. This suggests an age equivalent to Bisat's subzone 3 or perhaps 4 of the Beyrichoceras Zone. We see no reason for altering the suggestion of Brown, Campbell, & Roberts (1965) that the middle to upper part of the Beyrichoceras Zone (subzones 3 & 4) is equivalent to the upper part of CuIIδ and the lower part of CuIIIα of Germany.

Delepinea aspinosa Zone

Recent work by Roberts in the Salisbury district, north of Gresford, has clarified the concept of the aspinosa Zone. The lower part of the zone is characterized by the incoming of Delepinea aspinosa (Dun), Productina margaritacea (Phillips), Echinoconchus gradatus Campbell, Spirifer osbornei Roberts, Inflatia elegans Roberts, and Inflatia simplex (Campbell). These species are associated with longer-ranging forms from the australis Zone such as Streptorhynchus spinigera (M'Coy), Waagenoconcha delicatula Campbell, Voiseyella anterosa (Campbell), and Asyrinxia lata (M'Coy). The upper part of the zone is dominated by the occurrence of Gigantoproductus tenuirugosus Roberts. In sequences in the northern Hunter Valley region species such as Schuchertella pseudoseptata Campbell, Rotaia sp.cf. R. subtrigona (Meek & Worthen), Eumetria mona Campbell, and Ectochoristites wattsi Campbell, which are present in the uppermost beds of the Namoi Formation at Babbinboon (Campbell, 1957), occur with or stratigraphically close to G. tenuirugosus; we have therefore revised the zone present in the upper part of the Namoi Formation from australis to aspinosa Zone. Few brachiopods from the aspinosa Zone give precise ages in terms of the European sequence. Productina margaritacea Phillips, which is also recorded from the Utting Calcarenite in the Bonaparte Gulf Basin (Roberts, 1971), is known from the D_1 of Ireland (Brunton, 1966); and Gigantoproductus dentifer (Prentice), which is morphologically closely related to G. tenuirugosus, is known from the C_2S_1 to D_2 of Britain.

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Foraminifers from the upper and lower parts of the zone have been identified by B.L. Mamet (pers.comm.). Those from the lower part of the zone at Rouchel are of late-early or middle Viséan age (Mamet's zones 11 to 12 or perhaps younger), and those from limestones at about the same stratigraphic level as Gigantoproductus tenuirugosus at Salisbury are late middle to middle late Viséan (Mamet's zones 13 to 15) in age.

Rhipidomella fortimuscula Zone

As reported by Campbell & McKellar (1969, p. 85), the Beyrichoceras sp. described by Cvancara (1958) from this zone is now identified as Girtyoceras sp. nov.. Specimens of Beyrichoceras cf. B. obtusum (Phillips) are known from the zone in the Yarrol Basin of Queensland. A correlation with the British P_1a or P_1b subzones and the German upper CuIIIα or CuIIIβ is suggested.

More recently the goniatite Sudeticeras has been collected from this zone in the upper part of the Dakiel Formation in the Monto district of Queensland (Geol. Surv. Queensland locality K31; see McKellar, 1967). This genus is characteristic of the British P_2 Subzone (Moore, 1950), which is the approximate equivalent of the German CuIIIγ, though it first appears in CuIIIβ (Moore & Hodson, 1958; Kullmann, 1961). It seems clear, then, that the R. fortimuscula Zone should be mainly correlated with CuIIIβ, though it may extend a little above or below this zone.

Marginirugus barringtonensis Zone

A reliable lower limit is placed on this zone at two localities by the dating of the zone below as CuIIIβ. In the area south of Forster, N.S.W., in rocks mapped as Wootton Beds, a smooth beyrichoceratoid ammonoid with sutures like those of Beyrichoceratoides and an almost smooth sub-globose conch, has been found about 30 m above a thin layer of this zone. Ammonoids of this type are not known to occur above CuIIIγ. From the zone in the Monto area of Queensland, Dear (in Hill & Woods, 1964) has figured a specimen he refers to as *Beyrichoceras* sp. Further preparation of this specimen shows it to be virtually unidentifiable, but it is unlikely to be a species of *Beyrichoceras*.

At numerous localities in the Gloucester - Myall region of N.S.W., the upper parts of the zone contain abundant specimens of *Lissochonetes*, a genus not reliably recorded in pre-Namurian rocks overseas. We conclude that the zone spans the interval CuIIIγ to early Namurian.

Levipustula levis Zone

This has been widely regarded as a Westphalian unit (see Campbell & McKellar, 1969, for summary); the evidence is dependent almost entirely on the brachiopods.

The same zone has been recognized in Argentina (Amos & Sabattini, 1969), where Pennsylvanian (Des Moinesian) goniatites have been found with brachiopods and trilobites. However, there is doubt about their provenance (Amos, Campbell, & Goldring, 1960). The Des Moines Stage in North America is correlated with the late Westphalian of Europe (Wanless, 1969).

Syringothyris bifida Zone

This zone cannot be directly dated with precision. On the basis of some weak brachiopod evidence and its stratigraphic position, it was originally said to be Westphalian or 'possibly as young as the Stephanian' (Campbell, 1961). No further faunal evidence of its age has since become available.

FLORAL EVIDENCE

The eastern Australian floras shown on the chart are provided by Mrs Noreen Morris (pers. comm.). Her plant correlations are consistent with those based on marine invertebrate evidence. She notes a distinctive floral assemblage within the Joe Joe Formation, the upper part of the Currabubula Formation, the bottom of the Seaham Formation, the top of the Mt Johnstone Formation, and the top of the Isaacs Formation. She considers that the plants above and below the Paterson Volcanics belong to the same assemblage, and sees no reason for the hiatus above the Volcanics shown on our chart. We have shown this discontinuity in order to accommodate recent evidence from Helby (pers. comm.), who has modified his previous work (Helby, 1969a). He recognizes a microflora in the Isaacs Formation which he believes to be older than the Potonieisporites Microflora of the Seaham Formation, but younger than the Grandispora Microflora described by Playford & Helby (1968) from the Italia Road Formation.

PHYSICAL DATING

(a) The Martins Creek Andesite and Hudsons Peak Andesite of the Gilmore Volcanics (Dungog-Paterson Column) was first dated by Evernden & Richards (1962). Their results were recalculated by Francis (*in* Harland et al., 1964, pp. 316-7) giving ages of 326 and 328 m.y. Recent work by Amdel Laboratories, Adelaide, on an unnamed andesite about 1600 m above the base of the Isismurra Formation (Waverley-Rouchel Column), thought on stratigraphical grounds to be the equivalent of the lower part of the Gilmore Volcanics, has produced an age of 319 $\pm$ 9 m.y., and a somewhat altered ignimbrite 600 m lower in the same formation gave a date of 309 $\pm$ 6 m.y.

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If we ignore the last-mentioned date because of the nature of the sample, these results indicate a stratigraphic position near the Viséan - Namurian boundary, and are thus consistent with the suggested palaeontological correlations.

(b) The Paterson Toscanite (Dungog-Paterson Column) was also dated by Evernden & Richards (1962) but the result is now regarded as unsatisfactory (Francis & Woodland in Harland et al., 1964).

(c) The reversal of magnetic polarity that takes place at the level of the Paterson Toscanite (the Paterson Reversal) gives some evidence of the age of this part of the sequence. McElhinny (1969) has reviewed all information available to that date. In our view the area of best control overseas is Colorado, where the reversal is near the top of the Des Moinesian Stage. The situation in the USSR is not so clear. McElhinny's interpretation places the reversal near the end of the Moscovian, though there are other reversals that complicate the issue. For example, it is not clear why the Paterson Reversal cannot be related to the Orenbergian rather than the Moscovian reversal. It is unfortunate that the reversal has not yet been recognized in the type Westphalian-Stephanian sections.

NOTES ON THE COLUMNS

The numbers at the bottom of each column indicate items in the numbered reference list at the end of the notes. Only the latest and most significant references have been listed. Where the column is interpreted as in the publication(s) listed we have offered no further comment. However, in some instances, the interpretations we offer differ somewhat from those given in the publications listed. Where this has happened we

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give our reasons below. Further, data in some of the columns have been made available only in semi-official publications or in an informal way. In such cases we are appending a summary of the relevant information.

Bonaparte Gulf Basin

Minor modifications in the correlation of the various zonal schemes in this basin are discussed in earlier sections of this work. This previous discussion deals largely with the sequences in the southeastern platform, where most of the zones were established, rather than with those of the northwestern platform and the basinal area. The following notes are given in order to present a more balanced account.

Northwestern Platform

The brachiopods, foraminifers, and conodonts from the Utting Calcarenite can only be equated with overseas sections within broad limits. On balance, the brachiopod evidence (see notes on the *Punctospirifer pauciplicatus* Zone, p. 12) appears to favour a correlation with the D1 Zone of Britain (= V3b of Belgium; CuIIδ and part of CuIIIα of Germany). Conodonts in the Utting Calcarenite indicate a slightly older age (not younger; Roberts, 1971, p. 21 - proof error) than that suggested by some of the brachiopods (Druce, 1969). In terms of the Upper Mississippi Valley sequence, the conodonts as described by Druce (1969) correspond to a position somewhere between the upper part of the *Bactrognathus*-*Taphrognathus* Assemblage Zone and the *Apatognathus scalenus* - *Cavusgnathus* Assemblage Zone of Collinson et al. (1971); that is, between the upper Burlington and the upper St Louis formations. After reviewing the evidence, Druce (1969, p. 26) considers that 'the absence of the *Gnathodus girtyi* and *G. commutatus* groups and *G. bilineatus* and the abundance of *G. texanus* indicate a lower Viséan age, possibly CuIIδ'. This statement should now be modified in the light of Weyer's (1972) work on the German ammonoid zone *Entogonites nasutus* (CuIIδ). The conodonts indicate an age equivalent to a position within the *kochi-nasutus* Interregnum (= V3a, V2, V1b pars); in terms of the German conodont zones this broadly corresponds to the *anchoralis-bilineatus* Interregnum. Foraminifers identified by Mamet & Belford (1968) belong to Mamet's foraminifer zones 14 or 15, equivalent to the V3a and V3b Zones of Belgium. Therefore, the evidence from all three fossil groups from the Utting Calcarenite - brachiopods, foraminifers, and conodonts - tends to favour a position within the upper part of the *anchoralis-bilineatus* Interregnum (V3a or V2).

The Burvill Beds contain the conodont *Gnathodus girtyi simplex* (identified by Druce, 1969), which in Britain is reported by Rhodes et al. (1969) from rocks (D2 Zone) no older than the *Gnathodus monodosus* Assemblage Zone (equivalent to the CuIIIβ Zone of Germany). Mamet & Belford (1968, p. 344; fig. 2) have reported that the foraminifers from the Burvill Beds indicate Zone 16, possibly lower 16 (of Mamet), which suggests an age equivalent to either late CuIIIα or CuIIIβ in Germany.

The lower beds of the Point Spring Sandstone conformably overlie the Burvill Beds, and both contain the same brachiopod fauna (the *Anthracospirifer milliganensis* Zone), thought to be late Viséan to Namurian in age (Thomas, 1971). The *Echinoconchus gradatus* Fauna, from the top of the Point Spring Sandstone, is probably Namurian (Roberts, 1971).

The Border Creek Formation in the type area cannot be dated precisely. Rocks referred to this formation in Bonaparte No. 2 Well by Veevers & Roberts (1968) are said by Helby (pers.comm.) to contain members of a microfloral assemblage, which elsewhere is thought to be restricted to the Tournaisian and Viséan (Balme, 1964, Playford, 1971). This is in conflict with the marine invertebrate fossil ages, because the Border Creek Formation overlies, with erosional disconformity, the Point Spring Sandstone, which is dated as late Viséan or early Namurian. It is possible that the spores in the Border Creek Formation of Bonaparte No. 2 have been reworked, because rocks in Pelican Island No. 1, also referred to this formation, contain the Potonieisporites Assemblage (Helby, 1970), of possible Stephanian age. In the light of these conflicting pieces of information the position of the Border Creek Formation is shown in a noncommital position on the chart, about the Westphalian-Stephanian boundary.

An unnamed unit at the base of the Kulshill Formation in Kulshill No. 1 Well (5965-6175 ft) is regarded by Duchemin & Creevey (1966, p. 28) as Lower Permian. According to these authors, it contains a mixture of Lower Permian spores and reworked spores of Upper Carboniferous (Autunian - Stephanian) and Lower Carboniferous ages, together with reworked late Visean to early Namurian foraminifers and ostracods (Dickins, Roberts, & Veevers, 1972). On this basis, the Kulshill Formation belongs to the Lower Permian.

Basinal area

The Bonaparte Beds are represented in our chart by the type section penetrated by Bonaparte No. 1 Well. Below about 7500 feet the Bonaparte Beds contain the spore species Hymenozonotriletes lepidophytus Kedo, 1957, which indicates an uppermost Devonian (latest toVI = Tn1a, Strunian) age (Playford, 1971, p. 59). Mamet & Belford (1968) and Belford (1970) have studied the Carboniferous part of the Bonaparte Beds, and report Zone 9 foraminifers in the interval between 6616 feet and 6620 feet, equivalent to the upper Tournaisian Tn3c of Belgium - the type locality of the CuIIα Zone. The interval between 2407 feet and 1840 feet contains a fauna slightly younger than that of the Utting Calcarenite, ranging in age from V3b (Zone 15) to possibly lower V3c (lower Zone 16); in terms of the German goniatite zones this is CuIIδ to possibly CuIIIβ. The opinion of Veevers & Roberts (1968, p. 118; fig. 65), based on foraminiferal and ostracod occurrences, that 'the interval between cores 6 and 8 (1840 - 2410 feet) in Bonaparte No. 1 is equivalent to core 11 (4920 feet) in Bonaparte No. 2', is no longer valid. This view, challenged on palynological grounds (Playford, 1971, p. 56), has been outdated by subsequent detailed investigations of cores and cuttings in Bonaparte No. 1, below core 14 (4340 - 4358 feet). Many of the foraminifer and ostracod species that are present in this well in the upper interval have been found in core 16 (4810 - 4818 feet). This means that core 11 in Bonaparte No. 2 may be correlated with a level in Bonaparte No. 1 at least as low as core 16. Therefore this apparent conflict between the correlations based on microfloral data on the one hand, and foraminiferal and ostracod data on the other, is now resolved.

The type section of the Tanmurra Formation contains the youngest foraminiferal faunas reported so far (Mamet & Belford, 1968) between 638 feet and 724 feet in Bonaparte No. 1 Well. The uppermost Viséan - lower Namurian boundary, that is the boundary between Mamet's Zones 16 and 17, is located between 679 feet and 670 feet. From palynological data, Playford (1971) considered that the rocks referred to the Tanmurra Formation in Bonaparte No. 2 Well by Veevers & Roberts (1968) are probably older than the type Tanmurra.

Canning Basin

Lennard Shelf

Playford & Lowry (1966) unite the Fairfield Beds of Guppy et al. (1958) and the overlying Laurel Formation of Thomas (1957, 1959) into a single formation, the 'Fairfield Formation', because they considered the two formations were conformable and lithologically similar. Thomas (1971), Roberts (1971), and Jones (in Roberts et al., 1972) retain both the names Fairfield and Laurel for the Late Devonian and Early Carboniferous sediments respectively; these authors state that the field relationships, rocks, and fossils of these two units are in need of definitive study. This problem is under current investigation by a joint team from the Bureau of Mineral Resources and Geological Survey of Western Australia. A review of the current biostratigraphic evidence bearing on this problem has been compiled by Jones (op. cit.). There is little to add to this review except that Jones' suggestion that the conodont provisionally cited as ? Scaphignathus velifer by Glenister & Klapper (1966, pl. 94, fig. 3, WAPET DF 10-3 and Table 9, GSWA 3240) is probably referable to Clydagnathus cavusformis, is confirmed by Beinert et al. (1971, p. 83). These authors also state that C. cavusformis occurs with Spathognathodus plumulus plumulus (misidentified as S. aculeatus by Glenister & Klapper) in GSWA 3240 and 150 feet below that subspecies in WAPET DF10-3'.

Fitzroy Trough

The Fitzroy Trough is represented on our chart mainly by the section penetrated by Yulleroo No. 1 Well (Bischoff, 1968, unpubl.). The lowest part of the marine Carboniferous Unit C, between 12 630 feet and

12 160 feet, is assigned to the lower Tournaisian (CuI) because of the presence of the Spathognathodus costatus Zone (sensu Ziegler) below, and the presence of conodonts (Polygnathus communis carinus and Siphonodella cf. S. quadruplicata) equivalent in age to the Siphonodella crenulata Zone above. The presence of the Spathognathodus costatus Assemblage Zone (Druce, 1969; non sensu Ziegler) is suggested by the occurrence of the nominate species at 11 456 feet, and indicates a middle Tournaisian age at this depth. Above 10 500 feet, the upper two-thirds of the section of Carboniferous Unit C yielded Viséan microfossils (mainly ostracods).

Carboniferous Unit B, a continental sequence (6138 feet to 3478 feet), consists of non-fossiliferous sandstone with intercalated red and green mottled shale; no internal evidence of age is available.

Bischoff reports Cavusgnathus unicornis and Spathognathodus scitulus in Carboniferous Unit A between 2840 feet and 2890 feet - a combination which suggests a Viséan age, no older than the Cavusgnathus unicornis - Apatognathus libratus Assemblage Zone of Rhodes et al. (1969); in the Bonaparte Gulf Basin these species occur together in the Utting Calcarenite. The upper beds of Carboniferous Unit A encountered in Barlee No. 1 Well are dated on conodont evidence (Bischoff, pers. comm.) as late Visean (CuIIIγ) to early Namurian (E_1).

Bischoff recognized his Carboniferous Units A and B and the upper part of Unit C in Grant Range No. 1 and Fraser River No. 1 Wells, in the sequence originally defined as Anderson Formation (McWhae et al., 1958). In these wells, and in Barlee No. 1, Carboniferous Unit A contains the 'Lycosporoid' Microflora of Balme (1964).

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Evidence for the age of the oldest part of Grant Formation comes from Blackstone No. 1 Well, where Balme (in Johnstone, 1968) reported a microflora tentatively correlated with the one described by Playford & Helby (1968) from the Italia Road Formation of New South Wales. Accepting that the base of the Grant Formation has been correctly identified in this Well, the lowest beds are possibly as old as Westphalian.

Carnarvon Basin

Thomas (1971) has summarized the evidence available on the correlation of the Lower Carboniferous part of the Carnarvon Basin column. Brachiopods from several levels in the Moogooree Limestone are indicative of a Tournaisian age, but just how much of that epoch is represented is unknown. The middle part of the formation is correlated with the upper part of the Laurel Formation of the Canning Basin, and this in turn is equated with the interval between CuI and CuIIα. The Yindagindy Formation has few brachiopods which can be dated only as ? Viséan.

The position of the Harris Sandstone is indefinite. Work by Kräusel (1961) on plants suggest that it is Late Carboniferous.

Broken River Embayment

The Bundock Creek Formation and the Clarke River Formation both contain a probable S. sol fauna. The former unit extends down into the Famennian, but the latter is apparently entirely Carboniferous.

The Sybil Group lies unconformably on the Clarke River Formation, and is in part equivalent to the Tareela Volcanics and in part younger. In its upper parts it contains palaeoniscid fish and a Rhacopteris flora, but these are insufficient evidence to assign a precise age (Wyatt et al., 1970).

Burdekin Basin

The age of the Lollypop Formation is determined from its conformable relations with the Famennian Myrtlevale Formation below and the Hardwick Formation above. In its upper third (Wyatt et al., 1970) the latter unit contains a fauna with elements of both the T. microstriata and S. sol Zones, though it contains diagnostic fossils of neither. The Piccadilly Formation conformably overlies the Hardwick Formation. Stratigraphic considerations suggest that it is equivalent to the upper parts of the Clarke River Formation and the Star Beds (Wyatt et al., 1970). The Star Beds have stronger evidence of the presence of the S. sol Zone, including Prospira typa Maxwell, towards the top of the unit, though the base extends down into the Famennian (McKellar, 1970).

There is no control on the age of the Tareela Volcanics. They are possibly disconformable on the underlying rocks (Wyatt, 1968).

Drummond Basin

Dating of the units is at present very imprecise. No marine faunas are known, but the presence of the Lepidodendron veltheimianum flora in the Telemon Formation and higher units suggests a Carboniferous age. White (in Olgers, 1969) notes that no Upper Carboniferous plants are present in the Ducabrook Formation or older rocks. The Joe Joe Formation, which lies with angular unconformity on the Ducabrook (Mollan et al., 1969), contains the Potonieisporites Microflora (Evans, 1969).

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Yarrol Trough

Rockhampton

The sequence is as given by Fleming (1969). Druce (1970, p. 93) reports the presence of the conodonts Polygnathus communis dentatus Druce, 1969, P. sp., and Siphonodella sp. from the Gudman Oolite, at the base of the Rockhampton Group. The first species occurs in the Bonaparte Gulf Basin, where it ranges from the middle of the Siphonodella sulcata - Polygnathus parapetus Assemblage Zone into the base of the Siphonodella quadruplicata - S. cooperi Assemblage Zone. In terms of the German goniatite zones this corresponds to late CuI or the earliest part of the gap between CuI and CuIIα of Matthews. Thus the base of the Rockhampton Group may be as old as the lower part of the Cania Formation (Units a and b of Dear, 1968), which contains the Spirifer sol Zone.

The Cargoogie Oolite Member, about 650 m above the base of the formation, contains Taphrognathus capricornicus Druce, which is known elsewhere from the Utting Calcarenite and the Milligans Beds of the Bonaparte Gulf. The same species is recorded by Druce (1970) from the Kolonga Creek Limestone Member in the lower part of the Splinter Creek Formation of the Cannindah Creek Section.

The Lion Creek Limestone is equated with the M. barringtonensis Zone on the coral evidence of Jull (1969). From near the top of the Neerkol Formation, Fleming (1969) has described a faunal association not known elsewhere in Australia. He is unable to choose between a Stephanian and a Sakmarian age for the fauna, but we are inclined to the view that it is Stephanian because of the number of polyzoans it has in common with the Levipustula levis Zone.

Mount Morgan & Cania

The Turner Creek and Youlambie Conglomerates contain Eurydesma, but from the latter at least, Dear (1969) records Cardiopteris overlying the Eurydesma-bearing beds. Similar plants occur in the Joe Joe Formation associated with the Potonieisporites Microflora. We have therefore partly equated these units.

Cannindah Creek - Yarrol

The date of the boundary between the Rands and Burnett Formations is still indefinite. The occurrence of Eurydesma near the base of the Burnett Formation may indicate a correlation only with the Youlambie Conglomerate and its equivalents. None of the fossils from the Rands Formation are similar to those in basal Permian rocks elsewhere. We have therefore tentatively placed the boundary within the latest Carboniferous, despite the fact that no representatives of the Syringothyris bifida Fauna are found in it.

Warwick - Goondiwindi

The Texas Beds (= the Beacon Mudstone of Lucas, 1959 in part) are structurally complex. They contain coralline limestones, apparently on several horizons. From these, Strusz (in Olgers & Flood, 1970) has recognized species of the rugosans Lithostrotion, Amygdalophyllum, ? Naoides, and ? Merlewoodia, which are suggestive of rocks as low as the Rangari Limestone (Spirifer sol Zone) and as high as the Lion Creek Limestone (late Viséan). The presence of Polypora neerkolensis Crockford, Fenestella sp. cf. F. osbornei Crockford, and Fenestella sp. cf. F. loganensis Wass indicates the presence of the Levipustula levis Zone at one locality.

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The Mt Barney Beds and the Emu Creek Formation on the eastern side of the Texas High contain the L. levis Zone, but complete sequences are unknown owing to structural complications.

Tamworth Trough

Werrie - Belvue Syncline

The Hill 60 Member of the Merlewood Formation contains late Visean corals (Pickett, 1966); a spiriferoid from a similar stratigraphic level on the eastern limb of the Werrie Syncline is known elsewhere only from the Rhipidomella fortimuscula Zone.

The upper part of the Currabubula Formation contains a macroflora found elsewhere only in the upper part of the Mt Johnstone Formation, the base of the Seaham Formation, and the top of the Isaacs Formation, as has been indicated above (p. 27). The lower part (Carey, 1937) contains elements of the Rhacopteris Flora, but none of the Lepidodendron Flora.

Rocky Creek Syncline

In the Horton district the base of the Luton Formation contains a late Famennian (toVI) conodont fauna (Pedder, 1967; Philip & Jackson, 1971). The formation rests with apparent conformity on the Mandowa Mudstone.

In the area south of Gravesend, where the Luton Formation probably lies unconformably on the Noumea Beds, Tulcumbella microstriata has been noted in collections made by McKelvey, and Roberts has recognized elements of the Spirifer sol Zone, including Protocanites lyoni and Imitoceras werriense. About the middle of the unit, a fauna doubtfully referred to the Schellwienella cf. burlingtonensis Zone occurs. This zone is definitely represented in the lower parts of the overlying Namoi Formation.

The age of the Spion Kop Conglomerate and younger rocks in this column cannot be precisely determined. The Spion Kop contains glacial rocks (White, 1968) and it may therefore be younger than has been shown previously. It is correlated lithologically with the Coefpolly Conglomerate of the Werrie Syncline.

Glenbawn

The sequence at Glenbawn was briefly described by Branagan et al. (1970) and has been recently studied by Roberts & Oversby (in press.). The Kingsfield Beds at the base of the sequence consist of undated volcanics, purple shale, ironstone, and lithic sandstone of continental origin. They are overlain by the Dangarfield Formation, a marine unit containing, near the base, the Brushy Hill Limestone Member. The brachiopod fauna from the Brushy Hill Limestone is suggestive of the *Spirifer sol* Zone. It also contains Tournaisian conodonts, details of which are given on p. 21. Hence the underlying continental sequence may be older than Carboniferous. Within the Dangarfield Formation crinoidal limestones from approximately 520 m above the Brushy Hill Limestone contain brachiopods of the *Schellwienella* cf. *burlingtonensis* Zone, as well as a goniatite of the *Muensteroceras oweni* group (p. 22). We have no palaeontological control of the age of the Rossmore Formation, apart from the occurrence of *Rhacopteris* (Branagan et al., 1970).

Waverley - Rouchel

The Glenlawn Formation and Martindale Formation of Manser (1968) are unfossiliferous and cannot be accurately dated. Faunal evidence from bracketing formations indicates a range in age from Late Devonian

(Famennian; younger than toV) to Early Carboniferous (Tournaisian). Cymaclymenia boorahensis Pickett, from the Kiah Limestone Member of the underlying Lincount Mudstone, indicates an age of late Famennian (toV) (Roberts et al., 1972). Brachiopods of the Schellwienella cf. burlingtonensis Zone are recorded from the overlying Waverley Formation in the Rouchel district (Roberts & Oversby, in press). The Woolooma Formation, a marine intercalation in the Isismurra Formation, contains representatives of the Orthotetes australis and Delepinea aspinosa Zones. Isotopic dates on volcanics in the Isismurra Formation are given on p. 27. We have no palaeontological control on the age of the Rossmore Formation in this column.

Gresford and Dungog - Paterson

The sequence from the Gresford district was described by Roberts (1961). Subsequent biostratigraphical work in the Rouchel district (Roberts & Oversby, in press) indicates that the faunal sequence and correlations in the Gresford - Dungog region require modification. A preliminary revision by Roberts shows that the Bingleburra Formation in the Lewinsbrook Syncline contains representatives of the Schellwienella cf. burlingtonensis Zone. The Orthotetes australis Zone is present in the Bonnington Siltstone. New information from the Rouchel district indicates that the fauna from Lewinsbrook formerly assigned to the ?Thomasaria voiseyi Zone by Roberts (1965) and to the Spirifer sol Zone by Campbell et al. (in Banks, 1969) belongs to the Orthotetes australis Zone. The Delepinea aspinosa Zone is represented in the Flagstaff Sandstone, and in sediments termed Wiragulla Beds. The association of Gigantoproductus tenuirugosus Roberts with Delepinea aspinosa (Dun) in the Wiragulla Beds of the Wallarobba Syncline indicates a correlation with an horizon near the top of the Flagstaff Sandstone at Brownmore. In that area, the Delepinea aspinosa Zone is present throughout about 1700 m of the Flagstaff Sandstone. Overlying the Flagstaff Sandstone is an unnamed unit which consists of mudstone containing lenticular bodies of conglomerate, ignimbrite, and sandstone; brachiopods, ammonoids, and corals in the mudstone belong to the Rhipidomella fortimuscula Zone. The succeeding unnamed sandstone unit is unfossiliferous except for indeterminate plant debris and is interpreted as non-marine (McDonald, 1972, unpubl.). It is overlain by siltstone, identified by McDonald as the Booral Formation, containing the Levipustula levis Zone.

The only palaeontological control on the age of the Gilmore Volcanics and the Mt Johnstone Formation is from the Grandispora Microflora (Playford & Helby, 1968) and the macrofloras of Morris. There may be undiscovered breaks in the section.

Gloucester - Myall Region

Booral

Recent work by Kisi (1970, unpubl.) has resulted in the discovery of abundant specimens of the Glossopteris flora probably low in the Alum Mountain Volcanics. We have therefore slightly raised the boundary of this unit, and the related Gloucester Rhylites, in comparison with its position on the previous chart.

Myall

Recent work by Suters (1973, unpubl.) has proved the presence of the Spirifer sol Zone low in the Wootton Beds in this region. Interbedded with brachiopods of this zone are well preserved specimens of Leptophloeum australe.

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Columns not shown on the chart

Northeastern Canning Basin

In the northeastern Canning Basin, near Red Bluffs (Fig. 1, locality 26), sandstone beds previously mapped as Lower Permian Grant Formation (Playford & Lowry, 1966), contain the plant Leptophloeum australe (Veevers et al., 1967). Its known range in Australia is Upper Devonian to Lower Carboniferous, but Veevers et al. dated the sandstone as probable Lower Carboniferous because it overlies late Upper Devonian strata of the late Famennian proteus Zone (of Veevers, 1959) with a marked erosional disconformity. The previous misidentification of this probable Lower Carboniferous sandstone as the Lower Permian Grant Formation shows that all the isolated sandstone outcrops, now mapped as Grant Formation, that unconformably overlie the Devonian sequence must be critically examined.

Hodgkinson Basin, Queensland

In the Hodgkinson Basin (Fig. 1) there are various occurrences of conglomerate, sandstone, and shale that because of their field relations have been placed in the Carboniferous (de Keyser & Lucas, 1968). The Hodgkinson Formation itself is mainly Devonian, and may extend into the Lower Carboniferous.

In the Nychum district (Atherton 1:250 000 Geological Series Sheet; Fig. 1, locality 27), a mixed Glossopteris-Cardiopteris flora identified in the Nychum Volcanics has been dated by Rb/Sr measurements as possibly latest Carboniferous, 294 $\pm$ 9 m.y. (Black, Morgan, & White, 1972). This conclusion has been challenged by Balme (1973, p.103), who stated that the real interest of this plant fossil assemblage is not that it is "mixed", but that it provides the first clear Australian record of cardiopterid fronds in association with diverse elements of the Glossopteris-flora'. Such an association is known from India, South Africa, and Brazil, in strata which most Australian palaeontologists and stratigraphers regard as Early Permian (see full discussion by Balme, op.cit.).

Murgon, Queensland

In the Murgon area, 160 km north-west of Brisbane (Fig. 1, locality 28), limestones of the 'Wondai Series' are exposed in a faulted block (the Yarraman Block). They represent only a small part of the Carboniferous sequence and their stratigraphical relations are unknown. For these reasons, they are not shown on our chart. Palmieri (1969) has described a Lower Pennsylvanian conodont fauna from them. The presence of Idiognathoides corrugatus (Harris & Hollingsworth, 1933), I. attenuatus (Harris & Hollingsworth, 1933), I. cf. I. delicatus Gunnell, 1931, I. cf. I. sinuatus Harris & Hollingsworth, 1933, and Streptognathodus noduliferus (Ellison & Graves, 1941) suggests an Early Pennsylvanian (Morrowan - Atokan) age, possibly no older than the Gnathodus bassleri symmetricus Assemblage Zone of Arkansas (Lane, 1967), or, in European terms, no older than the late (but not latest) Namurian Marsdenian (R2) Stage in Belgium (Higgins & Bouckaert, 1968; Bouckaert & Higgins, 1970). If Idiognathus is present, as Palmieri suggests, then part of the sequence is probably at least as young as the basal stage of the Westphalian (G2) (Meischner, 1970).

Macleay Valley, N.S.W.

Lindsay (1969) has reinterpreted the stratigraphy of this region (Fig. 1, locality 29). The Carboniferous section in descending order is:

	Thickness
Kullatine Formation	640 - 1370 m.
Majors Creek Formation	up to 2000 m.
Boonanghi Beds	> 1600 m.

The only fossils from the Boonanghi Beds are too fragmentary to permit assignment to a zone. Fossils of the L. levis Zone have been recorded by Lindsay in both the Majors Creek and the Kullatine Formations. Campbell (1962) had previously recorded Cravenoceras kullatinense, a Namurian species, from an horizon considered to be low in the Kullatine Formation. In view of these conflicting results Lindsay and ourselves are at a loss to know how to correlate the sequence.

Victoria

Terrestrial Lower Carboniferous rocks dated on the basis of fish remains are known from near Mansfield (Fig. 1, locality 30), and probably also from the Grampians Mountains (Fig. 1, locality 31), in Victoria (Hills, 1958; Talent & Spencer-Jones, 1963).

South Australia

Beds just above basement in several prospecting wells in the northern part of South Australia, the southern part of the Northern Territory, and parts of the Murray Basin (Ludbrook, 1961; Evans, 1969) as well as the basal unit of the Wynyard Tillite of the Quamby Group in Tasmania, contain the Lower Nuskoisporites Microflora (= Potonieisporites Microflora). They begin sequences that become much more extensive in the Permian, and hence they are dealt with on the Permian chart.

Amadeus Basin, N.T.

The dating of the Pertnjara Group is imprecise (Wells et al., 1970). The basal formation, the Parke Siltstone, on fossil evidence is probably entirely Upper Devonian (Jones, in Roberts et al., 1972). The age of the youngest unit of the Pertnjara Group - the Brewer Conglomerate - in the absence of fossil evidence, depends on the isotopic dating of tectonic events during its deposition, i.e., the Alice Springs Orogeny (Forman et al., 1967; Jones, 1972). This is dated by Stewart (1971), using K/Ar measurements on muscovite from the Heavitree Quartzite in the Arltunga Nappe Complex, as 358 - 322 m.y. According to Harland et al. (1964), these ages span Late Devonian and Early Carboniferous time. Therefore, as the Parke Siltstone was deposited during the Late Devonian, the age of the Brewer Conglomerate is probably Early Carboniferous. The middle unit of the Pertnjara Group, the Hermannsburg Sandstone, contains indeterminate plant remains of little stratigraphical value. However, its age by interpolation is either latest Devonian or earliest Carboniferous.

The Finke Group, in the southeastern part of the basin, is about the same age as the Pertnjara Group. Rocks of both groups interfinger in the area between the Charlotte Range and the Finke River (Wells et al., 1970).

Ngalia Basin, N.T.

The Mount Eclipse Sandstone contains the plant fossils *Cardiopteris polymorpha* and *Lepidodendron veltheimianum* (White, in Wells, Evans, & Nicholas, 1968), an association indicative of a Carboniferous, possibly Late Carboniferous, age.

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CORRELATION CHART FOR THE CARBONIFEROUS SYSTEM IN AUSTRALIA

—— Boundaries known on the ground, conformity, correlation well known ---- Boundaries known on the ground, conformity, but correlation indefinite —?— Formation boundaries poorly known and poorly correlated | | | Gap in sequence