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PRELIMINARY REPORT ON PERMIAN BRACHIOPOD FAUNAS OF THE FITZROY BASIN

by

G.A. Thomas

CANBERRA.

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Records No. 1954/9.

The following report is a brief preliminary outline of the Permian brachiopod faunas of the Fitzroy Basin. The collections have all been made by the Kimberley geological survey party of the Bureau of Mineral Resources from 1948 to 1952. Unfortunately many of the specimens determined or discussed in this report have been destroyed or damaged in the fire at the Bureau offices. The determinations must be regarded as provisional for some forms, as sufficient work has not yet been done, and further collecting is necessary to deal satisfactorily with others, apart from the damage sustained in the fire. As will ensue below many forms are new. It is hoped to describe them systematically from the new collections made in 1953. Some will be passed over to outside specialists. Direct comparison has been mad with Carnarvon Basin collections. There is no attempt at scription in this report. The collections will be treated under formation names beginning with the lowest. A discussion of ecology is being reserved until later.

Grant Formation. No brachiopods or other marine fossils have been collected from this formation. The formation is correlated on general ground with the Lyons Group of the Carnarvon Basin, which has a small brachiopod fauna in several horizons. Further search might result in collections. The Lyons Group is of Sakmarian age.

Poole Sandstone. Fossiliferous beds are known from the lower part of this formation. At the base is the Nura-Nura Member, partly limestone and quite rich in fossils. This member has been known for some years. The Bureau officers have discovered another fossiliferous horizon not more than about 30 feet above the Nura-Nura Member. No other fossiliferous beds have been found.

The forms of the Nura-Nura Member are listed below by localities with brief notes. Some of the specimens are ferruginized. Others are calcareous and embedded in hard limestone.

W44. Chonetes nov. sp. A, a small form
Aulosteges cf. spinosus Hosking, a small form
Martiniopsis nov. sp. (Two small steinkerns have been provisionally referred to this genus. The outline is close to that of Martiniopsis subradiata var. branxtonensis Eth. from New South Wales, which is, however, much larger. A very similar form has been recognized from the Callytharra Formation of the Carnarvon Basin. Portion of the external surface was visible in one specimen of the latter. This indicates the presence of a very fine close ornament, resembling short close off-set spines.
Neospirifer nov. sp. A. (An alate form with a high flat area and up to about 96 mm. wide. A similar form occurs in the Callytharra but the area of the latter is curved.)

W40. cf. Taeniothaerus subquadratus Morris (Incomplete specimen provisionally referred to this species).

W36. Taeniothaerus cf. subquadratus Morris
Neospirifer nov. sp. A.

W34B. Neospirifer nov. sp. A.
Chonetes nov. sp. A.

W42C. Chonetes nov. sp. A.
Neospirifer nov. sp. A.
Brachiopod indeterminate; outline suggests Camerophoria

W33. Chonetes nov. sp. A.
Neospirifer nov. sp. A.

W42. Neospirifer nov. sp. A.

W44B11. Neospirifer nov. sp. A.
Chonetes cf. pratti Dav.

W43B. Neospirifer nov. sp. A.

Fossiliferous zone near base of Poole Sandstone in St. Georges Range.

All the specimens are in ferruginized sandstone.

SG120A. Small new spiriferid possibly belonging to Neospirifer (Single specimen only; it has a prominent fold and only slightly fasciculate ribbing
Chonetes cf. pratti Davidson
cf. Pseudosyrinx sp. nov. (A single broken specimen probably belongs to this genus; it appears to be close to the species in the Callytharra Limestone which has been named Syringothyris exsuperans de Kon. by Etheridge but is not this species. The Callytharra species should probably be referred to the genus Pseudosyrinx Weller.
Martiniopsis nov. sp. A. (The species is represented by a steinkern and an external impression and appears to be close to the form in the Nura-Nura Member, though larger; the very fine ornament of inversed spines is clearly visible).
Derbyia nov. sp. A. (A large new form, apparently fairly closely related to a very large new species from the Callytharra Limestone but which can be readily separated from it. Both have a general resemblance to D.grandis Waagen of the Salt Range, and the Poole form appears to be reasonably close to D. burlensis Reed of the Lower Productus Limestones but has finer ribbing.)
Neospirifer spp. indet. (2 species).
Dielasma sp. nov. (small form)

SG136A. cf. Pseudosyrinx sp.

There is no reason to doubt that the two horizons are of nearly the same age. Some forms appear to be common to both. The difference in environment will account for the difference in the lists for each. The brachiopods confirm a correlation of this fossiliferous part of the Poole Sandstone with the Callytharra Formation. Affinities with the Lower Productus Limestone of the Salt Range are evident. Therefore the brachiopods may be regarded as supporting an Artinskian age for the Poole Sandstone.

Noonkanbah Formation. This Formation is highly fossiliferous with an abundance of brachiopods, Bryozoa, corals, and crinoids, but comparatively few molluscs. Below are listed the forms from a measured section beginning with the lowest collection. The section was measured in the Brutens Yard area. The lithology is variable and comprises limestones, sandstone, and siltstone.

Brachiopods are not recorded from the basal 82 feet. In the next 65 feet in sample PR137C are bryozoa, orthotetid gen. et sp. indet., and Neospirifer sp. ind.

At 382 feet to 431 feet from base, in PR137F are recorded cf. Strophalosia sp. ind. and Streptorhynchus sp. ind.

Richer collections were obtained from 431 feet to 513 feet. PR137G contains:-

Neospirifer nov. sp. aff. hardmani Foord
Neospirifer spp. ind. (2 species)
Neospirifer sp. (cf. nov. sp. in SG120A of the Poole Sandstone)
Dictyclostus cf. callytharrensis Prend.
Streptorhynchus aff. luluigui Hosking
Strophalosia sp. (Small spinose form, possibly S. etheridgei Prend.)
Aulosteges sp., small form
Martinioid form gen. et. sp. indet.

From 513 feet to 595 feet brachiopods are rare. Taeniothaerus cf. subquadratus Morris is present.

The next brachiopods are from 660 to 668 : t. PR284T has Neospirifer sp. ind. only.

At 668 feet the following forms are recorded in sample PR284S:-

Cleiothyridina nov. sp. ? a small form
Streptorhynchus sp. aff. luluigui Hosking
Derbyia nov. sp.
Neospirifer nov. sp. aff. bryoensis Glauert
Neospirifer nov. sp. D (Small form with pronounced median fold)
Streptorhynchus nov. sp. (a larger form than S. luiluigui)
A very small adnate brachiopod is present.

PR284R was collected at 780 feet. Present are:-

Derbyia nov. sp. B (A medium-sized form, distinct from the species in Poole Sandstone)
Dielasma nov. sp., a small form
Chonetes cf. pratti Dav.
Neospirifer nov. sp. aff. hardmani Foord
Neospirifer cf. bryoensis Glauert
Neospirifer nov. sp. D.

At 800 feet sample PR284Q contains:-

Neospirifer cf. bryoensis Glauert
cf. Composita sp. ind.
Calceolispongia cf. hindei Etheridge

At 886 feet sample PR284N has:-

Strophalosia kimberleyensis Prend.
Neospirifer cf. bryoensis Glauert
Taeniothaerus sp.
Dielasma sp. prob. nov.
Indeterminate species of Neospirifer, Chonetes, orthotetid, and Cleiothyridina.

Sample PR284K is at 894 feet. It contains:-

Cleiothyridina macleayana Eth.
Strophalosia nov. sp. ? (larger and flatter than the usual S. kimberleyensis Prend.)

Chonetes cf. pratti Davidson
Neospirifer nov. sp.
Neospirifer cf. byroensis Glauert
Dielasma nov. sp. (small)
Strophalosia cf. etheridgei Prend.
martinioid gen. et sp. indet.
spiriferid nov. gen. et sp.
A probable new genus is present. This is a small externally "pseudo-punctate" form, hence probably spinose. It has about 12 lateral ribs and a divided fold on the dorsal valve. A similar form has been noted in one bed in the Wandagee Formation of the Carnarvon Basin.

Sample PR284L at 900 feet contains:-

Neospirifer cf. byroensis Glauert, a small form
Chonetes sp. ? pratti Dav.

Brachiopods are not recorded until 975 feet where PR284J contains:

Aulosteges nov. sp.
cf. Strophalosia nov. sp. ? (with a row of anterior spines in the fashion of Chonetes. (See PR284C)
cf. Krotovia sp., a spinose form
Streptorhynchus cf. luluigui Hoski
Hustedia nov. sp.
Camerophoria (Stenoschisma) nov. sp.
Cleiothyridina macleayana Eth.
Dielasma nov. sp., a small form
Strophalosia kimberleyensis Prend.
Neospirifer cf. byroensis Glauert
Neospirifer nov. sp. (with coarse fasciculation of ribs)
Neospirifer nov. sp. (with affinities to N. marcoui Waagen)
Brach. nov. gen. et sp. (As in PR284K.)

PR284H. at 995 feet has:-

Neospirifer nov. sp. Z of the N. marcoui group. (Close to a form in the Wandagee Formation).
Cleiothyridina macleayana Eth.
Neospirifer sp. ind.
Taeniothaerus cf. subquadratus Morris.
Streptorhynchus cf. luluigui Hosking
Strophalosia nov. sp. (large form cf. PR284D)
Strophalosia kimberleyensis Prend.

The next brachiopod-bearing horizon is at 1050 feet where PR284F contains:-

Taeniothaerus nov. sp. ? (cf. PR284D)
Strophalosia kimberleyensis Prend.
Aulosteges sp. ind.
cf. Krotovia sp. (cf. PR284D)
Cleiothyridina macleayana Eth., a variable collection

PR284D at 1100 feet is rich. Present are:-

Strophalosia kimberleyensis Prend., all smaller than usual
Krotovia cf. senticosa Hosking, larger than type form
Aulosteges sp. ind.
Strophalosia nov. sp. ?
Taeniothaerus nov. sp. ?, smaller form than T. subquadratus
Chonetes nov. sp. ?, larger than C. pratti Dav.
Calceolispongia cf. multiformis Teichert

PR284C at 1140 feet contains:-

Neospirifer sp. cf. musakheylensis Dav., very small
Cleiothyridina macleayana Eth.
Cleiothyridina aff. roysii l'Ev.
Linoproductus cf. cancriniformis Tschern.
Orthotetid indet. cf. Strepterhynchus beyrichi Rethpletz.
Chonetes cf. pratti Davidson.
Strophalosia kimberleyensis Prend.
?S. nov. sp. cf. sp. in PR284S
Neospirifer nov. sp. W., strongly fasciculate and deeply sulcate
Neospirifer nov. sp. Z.
Neospirifer sp. cf. byroensis Glauert

In PR284B at 1170 feet the following are present:-

Cleiothyridina nov. sp.? smaller than C.macleayana Eth.
Chonetes cf. pratti Dav.
Strophalesia kimberleyensis Prend.
orthotetid indet., much parasitized by fine worm tubes
Aulosteges sp. ind.

The topmost collection at 1240 feet is very rich. PR284A contains:-

Cleiothyridina macleayana Eth.
Cleiothyridina cf. roysii var. per Prend. (The Cleiothyridinae in this bed and also higher in the Liveringa are very variable in form. A further species might be separated here).
cf. Heterelasma nov. sp. (A small unique dielasmic which possibly is a representative of a new genus. This shows an extreme development of a sulcus on the ventral valve and corresponding plicae on either side. The form appears to be quite close to "Dielasma" julicum var. timorensis Broili from the Triassic of Timor. The genus Heterelasma shows "inversion" of fold and sulcus but never to the degree of this specimen. Heterelasma is mainly an Upper Permian form and its presence in this part of the section is apparently somewhat anomalous).
Cameropheria (Stenoschisma) nov. sp., close to specimen called C.purdoni Waagen form Timor but probably not belonging to that species)
Strepterhynchus cf. beyrichi Rethpletz (close to the Timor form)
Chonetes nov. sp. (small)
Linoproductus cancriniformis Tschern.
Phricodothyris sp.
cf. Krotovia sp. ind.
Strophalosia kimberleyensis Prend.
Neospirifer nov. sp. W.
Neospirifer nov. sp. Z
cf. Mustedia nov. sp.
Neospirifer cf. byroensis ? Glauert

The Noonkanbah forms listed above often show close resemblance to species in the Carnarvon Basin. The correlation of the base of the Formation cannot be precisely stated but the top of the Formation probably is not much younger than the Wandagee Formation and probably is not as young as the Coolkilya. The topmost beds are therefore upper Artinskian in age. Their ~~analogue~~ equivalent in the Salt Range is still the Lower Productus Limestone.

Collections were obtained from numerous other localities. The only ones listed below, however, are those which contain forms not recorded in the type section.

PR288NK20.

Pseudosyrinx nov. sp., smaller than the form from the Poole Sandstone.

Camerophoria (Stenoschisma) nov. sp. This is a different species to the one in PR284A.
Dielasma sp. nov., small
cf. Composita nov. sp. aff. elongata Dunbar & Condra.
Neospirifer spp.
cf. Phricodothyris sp.
Strophalosia nov. sp. large, spinose
Linoproductus cf. cancriniformis Tschern.
nov. gen. et sp. cf. form in PR284J & K.
Streptorhynchus cf. luluigui Hosking.
Neospirifer nov. sp. Z. This location is in the lower third of the section.

NK15 (PR281) contains Hustedia sp. cf. basedowi Eth. and other forms including:

Linoproductus cf. cancriniformis. This collection is near the level of PR284C.

NL177 (PR136).

Dictyoclostus cf. callytharensis var. wadei Prend. and forms.

NL172(PR250) contains better specimens of Derbyia nov. sp. than type section.

Liveringa Formation.

The Liveringa Formation has two brachiopod-bearing suites of beds, one near the base and the other near the top of the section. The formation is oolitic and ferruginous and partly sandy at the base and over 2,000 feet of mostly non-fossiliferous beds separate the two indubitably marine parts of the section. Plants are recorded from the middle sandy part of the section.

Brachiopods are numerically subordinate to pelecypods in the lower part. The localities not covering more than 200 feet of section are:-

SR1E Poorly preserved fossils include:

spiriferid sp. ind.
cf. Cleiothyridina sp. ind.
Chonetes cf. pratti Dav.

At Shore Range are found poor impressions of Chonetes cf. pratti Dav.

cf. Taeniothaerus sp.
cf. Aulosteges sp.

NK 152 SR6. In a soft friable rock are a number of poor impressions. They include:-

spiriferid ? cf. Choristitella nov. sp.
cf. Purdonella nov. sp.
Cleiothyridina nov. sp., small oval form
Neospirifer sp. ind.
cf. Martiniopsis nov. sp. The solitary steinkern specimen has a faint ventral septum and may belong to genus Mentzelia and apparently resembles somewhat M.punjabica Reed of the Middle Productus Limestone.
Dielasmid sp. ind.

The lamellibranchs do not suggest an age younger than that of the Coolkilya of the Carnarvon Basin.

The higher fossiliferous sequence is at the top of the

exposed Permian section. Numerous localities provided good collections. The order of thickness is a couple of hundred feet.

Mt. Hardman C. contains:

Waagenoconcha (Ruthenia) nov. sp. aff. purdoni Dav. - Numerous fairly good specimens of this species show the very fine spines peculiar to the Upper Productus limestone varieties of this species described by Cowper Reed (1944).
Dielasma sp. nov.
cf. Taeniothaerus sp.
Aulosteges nov. sp.
Cleiothyridina nov. sp., large round rather flat form
Neospirifer nov. sp., wide form with high area
Chonetes cf. pratti
Linoproductus nov. sp.?
?Strophalosia sp.
Serpulites sp.
spriferid cf. Choristitella nov. sp. aff. internatus Reed
Mid. Prod. Limestone
cf. Purdonella nov. sp. aff. conformis Reed Mid-Upper Productus Limestone.

At Location H3 there are:-

Waagenoconcha sp. cf. imperfecta Prend.
Aulosteges nov. sp.
Aulosteges dalhousi Davidson Several good specimens very close to the type of this are Salt Range and Himalayan form
Cleiothyridina nov. sp.?, very large round form.
Neospirifer nov. sp., alate form
Strophalosia nov. sp. ?, small

SP 98.

cf. Taeniothaerus nov. sp. possibly Juresania sp.
Waagenoconcha nov. sp. aff. purdoni Dav.
Dictyoclostus cf. indicus Waagen
Cleiothyridina nov. sp. P
Mt.Cedric Aulosteges sp. nov.
Waagenoconcha sp. ind.

H21. Derbyia nov. sp.
Cleiothyridina nov. sp. P
Neospirifer nov. sp., large prominently folded form
Cleiothyridina nov. sp., very variable form
cf. Mentzelia sp., steinkerns only

SP3. Cleiothyridina nov. sp.

FL109. Derbyia nov. sp.
Strepterhynchus sp.
Neospirifer nov. sp. cf. alate form in H3.
Taeniothaerus?
Waagenoconcha cf. imperfecta Prend.
W. cf. purdoni Dav.

FL 178. Waagenoconcha nov. sp. aff. purdoni Dav.
Streptorhynchus sp. ind.

SR 85. Aulosteges dalhousi Dav.

SP3. Waagenoconcha sp.
cf. Taeniothaerus sp.

RT11 Waagenoconcha sp.
Aulosteges sp.
cf. Spirigerella
Strept rhynchus nov. sp.? appears to be larger than S. luluigui Hosking
Serpulites sp.

Cal 2. Derbyia nov. sp.
Cleiothyridina spp., one aff. C. gerardi Diener
Dielasma nov. sp.
Waagenoconcha sp.

Tutu Bore.

Cleiothyridina nov. sp.
Streptorhynchus? sp.
cf. Taeniothaerus nov. sp.
Strophalosia sp., small form
Neospirifer nov. sp. M, large massive form, not strongly fasciculate.
Martiniopsis sp.
Waagenoconcha sp.

R510 Aulosteges sp.
Cleiothyridina sp.
Chonetes sp.

FL 192.

Dielasma (Heterelasma?) nov. sp. aff. latouchei Diener. A large form. This type is essentially an upper Permian one. H. latouchei occurs in the Zewan beds.
Derbyia nov. sp. This species may have affinities with D. hemisphaeria Waagen but the dorsal valve is less tumid.
Aulosteges dalhousi Dav.
Neospirifer nov. sp., M. strongly folded. This form may be a late development from the N. marcoui group of species.
Cleiothyridina nov. sp., large and rounded
C. nov. sp. aff. gerardi Diener.

This suite of the upper Liveringa is much younger than anything previously recorded from West Australia. There are very strong affinities with the Middle and Upper Productus Limestones and with the Upper Permian beds of the Himalayas. The affinities are Upper rather than Middle Productus. The most important forms in the upper Liveringa are Waagenoconcha nov. sp. cf. purdoni Dav. and Aulosteges dalhousi Dav.

Waagenoconcha nov. sp. cf. purdoni Dav. is very close to the Upper Productus varieties described by Cowper Reed. It would seem that the fine-spined forms occur only in these ~~beds~~ Upper Productus limestones, in the Salt Range sequence.

Aulosteges dalhousi Dav. is a somewhat rare form. Waagen and Cowper Reed (1944) list it as a Mid Productus form but Koken records it also from the Upper Productus Limestone beds or Chideru Group of Noetling. Upper Permian Himalayan affinities are suggested by Heterelasma? novl sp. aff. latouchei Diener and by Aulosteges dalhousi Dav. Other forms show advanced characteristics, e.g. Neospirifer nov. sp. M. and Derbyia nov. sp. Detailed work will no doubt provide other examples.

Appended is a correlation chart showing the stratigraphical position of the Productus Limestones. It will be seen that both Middle and Upper Productus Limestones, i.e. Chideru and Virgal Groups of Noetling, are Upper Permian. It may therefore be stated that the upper Liveringa is Tartarian in age, i.e. late Permian. It would appear that the upper Kungurian possibly to

lower Kazanian is missing in the Kimberleys. Though this may be covered by the plant-bearing beds of the Liveringa the likelihood of a disconformity should be borne in mind.

The strong affinities with the Salt Range have been pointed out in this report but there is not an identity. Many elements of the Salt Range and other Tethys beds in the Lower and Upper Permian are lacking. The lack of Lyttonia and other Oldhamiidae, and of Enteletinae and numerous other families, is noteworthy. The fauna is much less diverse than that of the Salt Range, which occurs in beds not exceeding about 1200 feet.

Close affinities exist with Timor but the stratigraphy of the latter is not properly worked out and the fossil descriptions are often inadequate and hence a detailed correlation cannot be attempted. Of interest is the record of Waagenoconcha purdoni Waagen from the Amarassi beds of upper Permian age.

Although there was evidently not much in common with the main Tethyan faunas, the Western Australian fauna has some elements derived from the western Tethys and from the Ural seas. Notable members of these elements are Linoproductus cf. cancriniformis and "Spiriferella" australasica Eth. and allies, none of which were well represented in the above collections but which are present in the Carnarvon Basi: The contribution from this source has not yet been worked ou

Some genera are very well represented in Western Australia. Notable is Neospirifer with many new species evidently evolving in parallel plexi; the species show many affinities with the Salt Range and Himalayas particularly in the Lower Permian notably with N. nitiensis Diener and N. marcoui Waagen and their allies. Other well-developed genera are Derbyia, not previously described from Western Australia, Streptorhynchus, Waagenoconcha, Linoproductus, Dictyoclostus, Aulosteges, Strophalosia, Heterelasma, Dielasma, Camerophoria, Pseudosyrinx, Hustedia, Cleiothyridina, Composita, etc. Two new genera and numerous new species are present.

The affinities with eastern Australia, except possibly Tasmania, are not close. The Strophalosiae have a general resemblance; Taeniothaerus occurs in both areas; Martiniopsis, abundant in New South Wales, is sparsely represented in Western Australia. The eastern Australian marine faunas are not as young as the upper Liveringa beds and most probably are not much younger than Artinskian. The eastern Australian area was glaciated for a longer period, evidently well into the Artinskian and perhaps later, in contrast to Western Australia, where the glaciation is Sakmarian. This may be a partial explanation for the difference in brachiopod faunas.

Appended are correlation tables showing I. the Western Australian inter-basin correlation, II. generalized sections, and III. the correlation of the Salt Range.

16th March, 1954.

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Fig. 21

	STAGES	IRWIN R. BASIN	CARNARVON BASIN	FITZROY BASIN	SALT RANGE INDIA
UPPER PERMIAN	TARTARIAN				CHIDERU BEDS (UPPER PRODUCTUS LIMESTONES)
				LIVERINGA (UPPER GROUP BEDS)	VIRGAL BEDS (MIDDLE PRODUCTUS LIMESTONES)
	KAZANIAN			? DISCONFORMITY	
LOWER PERMIAN	KUNGURIAN		COOLKILYA FM.	LIVERINGA (LOWER GROUP BEDS)	
	ARTINSKIAN	FOSSIL CLIFF	CALLYTHARRA FM.	NURA NURA MEMBER	LOWER PRODUCTUS LIMESTONES
	SAKMARIAN	HOLMWOOD SHALE			SPECKLED SANDSTONES

CARNARVON BASIN

(Adopted from Teichert 1952)

MUNGADAN ss

Chonetes, Streptorynchus

COOLKILYA ss

NALBIA ss SLS

WANDAGEE FM.

CARNARVON BASIN

(Adopted from Condon 1953)

KENNEDY GP.

BINTHALYA SUBGROUP

MUNGADAN ss.

COOLKILYA GW.

BAKER SLS

NORTON GW

WANDAGEE FM.

BYRO GROUP

QUINNANIE SHALE

CUNDLEGO FM.

BULGADOO SHALE.

MALLENS GW.

COYRIE FM.

LYONS GROUP

WOORAMEL ss

CORDALIA GW.

CALLYTHARRA FM.

LYONS GP.

2600' Approx.

Chonetes, Streptorynchus

1200' Approx.

5000' Approx.

4-6000' Approx.

FITZROY BASIN

(Adopted from Guppy et al 195

LIVERINGA GROUP

2420'

?

NOONKANBAH FM.

1200'

POOLE ss.

205'–1305'

NURA NURA MEMBER

GRANT ss.

3500'

Fig. 3

AMMONITE ZONES	SALT RANGE		GLASS MTS, TEXAS		URALS	FORAMINIFERAL ZONES
CYCLOLOBUS ZONE	UPPER PRODUCTUS LIMESTONES	CHIDERU BEDS	TESSEY LIMESTONES	OCHOAN	TARTARIAN	YABEINA ZONE
TIMORITES ZONE	MIDDLE PRODUCTUS LIMESTONES	VIRGAL BEDS	CAPITAN	GUADALUPIAN		POLYDIEXODINA ZONE (VERBEEKINA – NEOSCHWAGERINA ZONE, THOMPSON)
WAAGENOCERAS ZONE	?		WORD		KAZANIAN	PARAFUSULINA ZONE
PERRINITES ZONE	LOWER PRODUCTUS LIMESTONES		LEONARD	LEONARDIAN	KUNGURIAN ARTINSKIAN	
PROPERRINITES			WOLF CAMP	WOLFCAMPIAN	SAKMARIAN	PSEUDO – SCHWAGERINA ZONE