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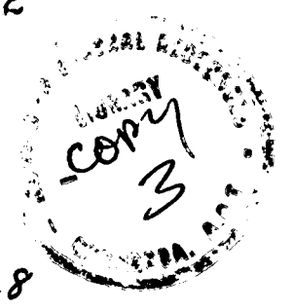

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NOTES ON THE CRETACEOUS-TERTIARY MEGAFAUNA OF THE NORTHWEST BASIN, WESTERN AUSTRALIA

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These preliminary notes deal with the sequence as it is found in the Giralia Structure. They do not include the Tertiary for example of the Rough Range and Cape Range, because systematic collecting of megafossils has to date not been done there.

The analysis of the Cretaceous-Tertiary megafauna from the Giralia area reveals that the sedimentary sequence begins with a transgression upon Palaeozoic rocks in Genomanian, or at the earliest in Albian time. The siliceous siltstones with radiolaria (formation P or Winning Siltstones of Raggatt, 1936) contain already in their lower beds ammonites of the family Acanthoceratidae, e.g. Acanthoceras (Mantelliceras) cf. vicinale Stol. (specimen found by Dr. C. Teichert), a characteristic form of the Cenomanian of Southern India (Ootatoor Group) and Madagascar as well as the Near East and Europe.

The Exact dating of the transgression is, however, not possible yet, because megafossils out of the basal glauconitic beds, i.e. greensands, have so far not been recorded. It may be, however, that a microfauna gives the necessary evidence for the time being. Besides rare ammonites the said siltstones contain quite commonly belemnites of the family Dimitobelidae and lamellibranchs, especially Pectinids, the affinities of which have not yet been worked out.

The next younger formation, conformable upon the siltstones is the more or less argillaceous "Inoceramus Limestone" (formation R) which consists in places almost entirely of shell fragments of a large Inoceramus species. The fauna found in this formation does so far not allow any definitive conclusion regarding the age. Ammonites have not yet been found and the abundant echinid spines, together with Ostreids, small brachiopods, Tubulostiids and Encrinids are not very conclusive, although certain affinities with the Santonian Gingin Chalk appear to be present.

The richest faunal assemblage in the Giralia Cretaceous is found in the so-called "Ammonite Marl" (formation S). According

to the ammonites this formation includes the Upper Campanian and Lower Maestrichtian. Of well known (Chile, Graham Land, New Zealand, Southern India, Madagascar) Campanian genera found here I mention Kossmaticeras and subgenus Gunnarites, Tetragonites, Pseudophyllites, Paraphylloceras and Phyllopachyceras. The Lower Maestrichtian genera, found in equal abundance here, are Diplomoceras, Eubaculites, Glyptoxoceras, Pachydiscus (P. egertoni Forbes, P. cf. gollevillensis d'Orb.), Brahmites (rare), Desmophyllites. Other ammonite genera, i.e. rather species, as well as the associated lamellibranchs, gastropods and echinids (rare) also suggest an Upper Campanian- Lower Maestrichtian age. The fauna as a whole is first, i.e. during the Campanian, closely related to that of Graham Land and Madagascar, but later, in the Lower Maestriehtian, develops strong affinities to the Aryaloor/Valudayoor fauna of Southern India. Fro the full understanding of this important fossil assemblage it is necessary, however, to obtain further information regarding the actual faunistic zoning. This must be done by careful excavation of a section in a suitable locality. At present only the general facts are known which leave many questions open, however conclusive they may be as regards the general position in time of the S-formation.

An important fact which has to be considered in the age determination of the overlying strata is the absence - within formation S - of the cosmopolitan Upper Maestrichtian zone ammonites (Sphenodiscus, Indoceras and c.). In other words the Sphenodiscan zone (Upper Maestrichtian) is either a) absent, b-) present in a non-ammonoid facies or c) present, but containing an ammonoid fauna different from that elsewhere. From the following explanations it will be seen that the Upper Maestrichtian is absent.

The "Ammonite Marl" is conformably overlain by a veritable greensand, i.e. formation T. Now T does not contain any ammonites and neither does any of the following younger formations. This rules out case c. But it also rules out b, because a greensand cannot be regarded as a non-ammonoid facies. On the contrary many greensands are known to have yielded the largest ammonite assemblages ever collected. Hence it cannot be assumed that for-

mation T represents the Upper Maestrichtian in a non-ammonoid facies. Another possible explanation, namely that the cosmopolitan forms such as Sphenodiscus (a fast swimmer!) should not have reached the shores of Western Australia seems also most unlikely. Considering the very close relationship between the West Australian and the South Indian Maestrichtian fauna it is hardly intelligible why Sphenodiscus , which is well represented in India, should be absent here, whereas benthonic crawlers (Eubaculites, Diplomoceras) and slow swimmers (Pachydiscus, Phyllopachyceras) are present in abundance in both localities. For all the mentioned reasons it must be assumed that during the Upper Maestrichtian marine sedimentation did not take place in that part of the Giralia area which is now exposed. It should, however, not be overlooked that this exposed area is very small and runs (unfortunately!) more or less parallel to the then shoreline. We know therefore nothing about the nature of the ammonite marl and the greensand in a more seaward area, i.e. to the west and north-west of the Giralia Range. Ly is quite possible and even probable that Upper Maestrichtian deposits would be found to the west of the present exposures underneath the coastal Tertiary formations. And these Upper Maestrichtian deposits would most certainly contain the fauna of the Sphenodiscan zone.

In the Giralia Range we cannot but assume therefore a break between the two otherwise quite conformable formations S and T. Formation T, the greensand, obviously marks the beginning of a new sedimentary cycle which is younger that Maestrichtian. It may be recalled that greensands are quite commonly known to be impotent marker beds as regards cyclic sedimentation. They are formed usually at the beginning of cycles and often after a non-depositional interval. In the Northwest Basin itself the great transgression of the Upper Cretaceous sets in with a greensand lying unconformably upon Palaeozoic rocks. The absence of an unconformity between S and T does, of course, not prove a continuous sedimentation. The area was according to all evidence a very gently sloping shelf upon which even minor fluctuations of sea-level would have affected comparatively large regions. Such

particular conditions may also account for the condensation of the Upper Campanian and Lower Maestrichtian into a bed only 7 to 10 feet thick (formation 8).

The problem arising now is: What age has the greensand, and what time is represented by the non-depositional interval? As said before the ammonites have gone - gone for ever - though the "greensand environment" was most suitable for them. There remains only one explanation; with the greensand we have entered post-ammonoid times, i.e. Danian and or later stages. However, as will be seen later, the greensand and the following limestone formations U, V and W are older than Ypresian. Thus forked in between Maestrichtian and Ypresian a Danian and or Paleocene, i.e. Montian - Thanetian - Landenian age results, and this is also born out by the fossil fauna.

Unfortunately the problems connected with the global correlation of all the Post-Maestrichtian but possibly and or certainly Pre-Ypresian formations seem still far from being solved. Under these circumstances we may examine also the possibility of establishing a local stage because strict contemporaneity with already known stages is doubtful. This is a correct procedure and has often been adopted, e.g. by the United States Geological Survey, who applied (and still applies) the stage name "Midway" (Midwayan) for American formations which are older than Ypresian and with certainity younger than Maestrichtian. It is also quite clear that "Midway" is and was always meant to be name created for local use. It is obviously not possible to correlate the American Midway strictly with the classical Montian and or Thanetian/Landenian because the positions in time of the respective boundaries do not coincide, i.e. these stages are not quite contemporaneous, although certain time-marking faunal zones may well be present on both sides of the Atlantic. They allow, however, only a correlation of part of the respective sequences, whereas the rest is not accounted for.

The same problem arises if we want to link up the Northwest Basin formations, T. U. V. and W (andX?) with either the European "Paleocene", the American Midway or other more or less contemporaneous sequences in New Zealand, Southern India, Belutschistan, Lybia and c. We will discover that certain Australian faunal zones can be

correlated, i.e. are contemporaneous with zones in one or more of the mentioned overseas sequences, whereas other zones seem to have no equivalents elsewhere.

The formations T-W are characterized by a rich non-ammonoid megafauna in which Echinoids, Brachiopods, Bryozoa and Ostreids predominate. Additional forms such as Nautilids (Deltoidonautilus, Hercoglossa) and lamellibranchs other than Ostreids are rather rare. The four formations are incidentally quite distinct as regards their respective faunas. In T, the greensand, we find as zone fossil the large Gryphaea cf. vesicularis Lam. together with small, fragile Rhynchonellids in great numbers, whereas in U the Gryphaea has disappeared completely and the Rhychonellids just linger with very rare specimens. The zone fossil in U is Echinocorys cf. ovalis Clark together with a smooth-shelled Terebratulid. In V Echinocorys has disappeared and the abundant zone form is another smooth-shelled Terebratulid, different from the one in U. Also in V a few and mostly irregular Echinids are found belonging to the family Ananchitidae. Formation W displays a magnificant fauna of Echinids and Bryozoa, whereas the smooth-shelled Terebratulids almost disappear. The Echinid fauna shows local differences as as regards the predominance of regular or irregular genera, but as a whole it contains a combination of Cretaceous with Tertiary forms of both regular and irregular genera. Among the Cretaceous forms there are for example Holaster and Cardiaster in abundance, and as a common Tertiary genus Schizaster may be mentioned.

The whole fauna, i.e. the combination of successive faunas has undoubtedly a unique aspect and correlation is difficult. The geographically nearest similar sequence is found in Southern India, i.e. the Niniyoor and Nerinea Beds, which have always been regarded as Danian. Although little is known about them it is clear enough that their fauna has a quite different facies. With the exception of the Nautilid Hercoglossa, found also in Australia, there are no common genera, not to mention species, but Hercoglossa is not a very reliable zone fossil. Another sequence of similar age then is found in Western India (Sind, Belutschistan). There we meet

Gryphaea vesicularis Lam. again in beds which are regarded as Danian in age. It will be noted that this may permit correlation of our greensand (formation T) only, whereas there again equivalents of our U-W faunas seem to be absent in Sind. On the other hand precisely these faunas - but not T - may be contemporaneous with the North and East European Danian where the prolificness of Echinids (also with Echinocorys and Holaster) is just as marked as in Australia. But there again an equivalent to our formation V with its scarceness of Echinids and abundance of smooth-shelled Terebratulids is unknown.

Approximately contemporaneous formations are also known from the Americas, particularly from Northern America. The Vincentown Sand of New Jersey for example contains Echinocorys ovalis Clark and Holaster and may therefore be compared with our formations U-W as well as with the North European Danian. The Midway of the Southern United States on the other hand contains a megafauna which has little in common with our T-W. It contains neither Echinocorys and other Ananchitids nor the Rhynchonellids and Terebratulids like the Australian formations. Oysters are certainly common in the Midway, but the species are different from Gryphaea vesicularis Lam. Hence strict contemporaneity with the Midway is also rather unlikely. The great and even striking similarity of the Midway microfauna with that of our T-W indicates, of course, that the two cannot be very far apart in time. If, however, and as it appears from the other mentioned correlations the Giralia T-W sequence is slightly older than the Midway, i.e. if it is Danian, then a comparison with America is impossible, because there the Danian is absent. The Midway is transgressive upon the Maestrichtian and nobody knows so far whether the microfauna of the Midway has not already existed during Danian time, as it is actually suggested by the evidence from Western Australia. It is in this regard really unfortunate that the faunal differences or similarities between the type sections of the European Danian, Montian and Thanetian are not very well known.

The following conclusions result therefore regarding our Giralia formations T-W (and X?).

1) They are younger than Maestrichtian and older than Ypresian.
2) They contain a Danian macrofauna together with a Midwayan microfauna.
3) Marine formations of similar age overseas are ranged either into Danian, Montian and Thanetian/Landenian (in Europe, North Africa and the Middle East) or into Jerseyan and or Midwayan in North America.
4) Strict contemporaneity of the Giralia sequence as a whole with one or more of those overseas cannot be proved and may even be unlikely. It can only be proved for individual zones which form but part of the whole sequence.

As mentioned above the Ypresian is absent and the Lutetian follows direct and conformable upon formation W. In the uppermost beds ot the latter indications for a break are apparent, especially in the northern part of the Giralia area. Micro- and Megapalaeontological investigations have proved the absence of the lower Eocene and the presence of the transgressive Lutetian, which contains Aturoidea, Hercoglassa (!), Ostreids and large Terebratulids as well as Gastropods such as Gisortia (Vicetia) depressa Sow. a well known form in the Lutetian of the Northern Hemisphere (for the first time recorded in the southern hemisphere). In the formations younger than Lutetian, which includes Y, no systematic collecting has been done and this preliminary and summarizing note ends herewith.

Canberra, 27th March, 1952.