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Preliminary notice *on the* Echinoids *from the* Upper Cretaceous System of Baluchistán, *by* Fritz Noetling, Ph.D., F.G.S., *Palæontologist, Geological Survey of India.*

The fine collection of fossils, which Messrs. Griesbach and Oldham have obtained from the cretaceous rocks of Baluchistán, contains, amongst others, numerous well-preserved *Echinoids*, several of which I recognised to belong to the genus *Hemipneustes* Agass. The occurrence of this genus seemed to indicate the existence of the étage *Danien* in Baluchistán—a fact which, if proved with certainty would be of considerable interest. The closer examination of the *Echinoids* has elicited some more interesting facts, which I publish now, because a considerable time must lapse before the examination of the whole fauna can be completed.

It is unfortunate that no figures of the new species can be given here, and, for the time being, the conclusions I base on the species mentioned below must be accepted in good faith, but I hope that the publication of the whole of the cretaceous fauna of Baluchistán will not be delayed much longer. On the other hand, I think that the results of the examination of the *Echinoids* will be of some assistance to the field geologists who are working now in Baluchistán, and it may be hoped that these notes will help to elucidate further facts concerning the development of the Upper Cretaceous system in Baluchistán.

From a paper in the "Records" [1] it appears that Mr. Oldham divides the strata below the Gházij beds (Eocene) into three groups, which in descending order are as follows:—

3. Dunghan group.
2. Belemnite beds.
1. Massive limestone.

An unconformable break is said to exist just above the Belemnite beds. It might then be expected that a considerable difference in the fauna of the Belemnite

[1] Geology of Thal Chotiali, Records, Geological Survey of India, Vol. XXV., P. 18.

beds and the Dunghan group would be met with, a view which had been fully borne out by the facts. However, Mr. Oldham, unfortunately, was led into a mistake, further elaborated in the 2nd Edition of the "Manual," p. 291, to assume that the Dunghan group contained an anomalous fauna, and that *Nummulites* were associated with cretaceous forms.

Mr. Oldham continues: "Under these circumstances it must remain an open question whether we are to regard the Dunghan group as oldest tertiary or newest secondary in age . . . If the top of the Dunghan group represents the lower limit of the tertiaries, we have to acknowledge an extreme abundance of the genus *Nummulina* in beds of cretaceous age; if the bottom, then the *Ammonoidea* are represented in beds of tertiary age by several genera and species. A third interpretation is open, and probably it will prove the true one, that the Dunghan group represents the gap between the Secondary and Tertiary period in Europe."

Supposing Mr. Oldham's observations were correct, they would contain nothing new, because true *Nummulites* have been discovered in the Eastern Pyrenees in strata which have been considered by Mr. Seunes[1] as belonging to the étage *Danien*. These strata are said to pass gradually into limestones which contain large *Nummulites* (*V. perforata*).

It is to be regretted that Mr. Oldham advanced such far-reaching theories on palæontological evidence which cannot be considered as conclusive. I have examined the "*Nummulina*" of the Dunghan group in Mr. Oldham's collection, and have found that Mr. Oldham had mistaken a species of the genus *Orbitolites* for *Nummulina*, and as the form is a typical cretaceous genus, the anomaly disappears.[2]

Mr. Griesbach has lately been over the sections described by Mr. Oldham in the paper quoted, and has found that there are three distinct series of rocks represented in that part of Baluchistán; the lowest (Mr. Oldham's "massive limestone") contains a number of fossils, which I am now engaged in working out. I found that they chiefly belong to the genera *Macrocephalites*, Zitt., and *Perisphinctes*, Waag., and that several forms from Kach, such as *M. transiens*, Waag., and *M. polyphemus*, Waag., are represented amongst them. The "massive limestone" is therefore of jurassic age, and represents probably the Kelloway group.

Above the massive limestone follows a series of beds, which are distinguished by an abundance of specimens of *Belemnites*. Locally the *Belemnite* beds may be divided into various horizons, but it seems doubtful whether such horizons could be traced over more than a very limited area. The examination of these forms has proved, that the Belemnite-beds must be considered to be of Neocomian age.

Above the *Belemnite* beds follow the calcareous beds (locally often sandstones) which contain a rich fauna, amongst which the genera *Sphenodiscus*, Zitt., and *Orbitolites*, must be specially mentioned. These beds are also characterised by the widely distributed *Cardita beaumonti*, D'Arch., which in Sind also occurs in the uppermost Cretaceous.

[1] Seunes, Observations sur le Crétacé supérieur des Pyréneés occidentales, Bull. de la Soc. Géol. de France, 3rd ser., vol. xvii, p. 803.

[2] I need not dwell here on the controversy that has been going on for a long time regarding the age of Leymerie's étage Garumnien. It is sufficient to say that Mr. Leymerie tried to explain the presence of cretaceous Echinoids in the calcaires à *Micraster tercensis* by the theory of colonies—a view which might also be applied to the Dunghan group supposing the anomalous fauna existed.

Above the dark-brown *Sphenodiscus* beds follows the white limestone of the Eocene formation with true *Nummulites*.

From the foregoing remarks it seems clear that the *Sphenodiscus* beds represent that part of Mr. Oldham's Dunghan group which contains the cretaceous fauna together with the so-called "*Nummulina*."

The Echinoids which have been described in the following pages have been collected by Messrs. Griesbach and Oldham in the *Sphenodiscus* beds; none come from the massive limestone or the *Belemnite* beds, nor from the nummulitic limestone above. We are therefore in a position to ascertain with great accuracy the age of the *Sphenodiscus* beds.

The Echinoid fauna here described consists of 11 genera with 16 species, of which 8 genera are represented by one, three genera by two, and one genus by three species, *viz.*:—

1. *Cidaris sulei mani*, spec. nov.
2. *Orthopsis perlata*, spec. nov.
3. *Cyphosoma sp.*
4. *Protechinus paucituberculatus*, gen. et spec. nov.
5. *Echinoconus gigas*, Cotteau.
6. *Holectypus baluchistanensis*, spec. nov.
7. *Pyrina ataxensis*, Cotteau.
8. „ *gigantea*,[1] spec. nov.
9. *Echinanthus griesbachi*,[1] spec. nov.
10. *Clypeolampas helios*,[1] spec. nov.
11. „ *vishnu*, spec. nov.
12. *Hemipneustes pyrenaicus*, Hébert.
13. „ *leymeriei*,[1] Hébert.
14. „ *compressus*, spec. nov.
15. *Hemiaster blanfordie*, spec. nov.
16. „ *oldhami*, spec. nov.

Out of the 16 species, 15 have been determined specifically, and only 1 generically; out of the 15 specifically determined species, 11 have been found to be new, but 4 could be identified with well-known species from Europe; these are—

Echinoconus gigas, Cotteau.
Pyrina ataxensis, Cotteau.
Hemipneustes pyrenaicus, Hébert.
„ *leymeriei*, Hébert.

I wish to say at once that among the 11 new species several show so close a relationship to other European species that it is quite probable that on actual comparison with the type specimens they may be found identical, and that the number of European species appearing in the cretaceous system of Baluchistán may in fact be much larger than stated above. However, the four species named have been recognised with great certainty, and we may therefore say that the Echinoid fauna of Baluchistán exhibits a most marked European character.

[1] The horizon of this species is not quite certain; Mr. Oldham, who has collected it, simply states from "Dunghan group"; from the state of preservation I think that it has been collected in argillaceous strata just above the *Belemnite* beds.

This feature appears still more remarkable if we take into consideration that these four species occur principally in the étage *Danien* of the Pyrenees. We are therefore fully justified in assuming, from the evidence of the Echinoids, that the cretaceous fauna of Baluchistán is of European type, and showing the closest relationship with the cretaceous fauna of the étage *Danien* of the Pyrenees. I admit that this is a somewhat startling result, and I must say that for some time I felt serious doubts as to its correctness, considering the great geographical separation; but after I noted down this fact, I came across Mr. Cotteau's note, "Sur un exemplaire du *Coraster Vilanovæ* provenant de Tersakhan (Turkestan)."[1] Mr. Cotteau, whose high authority on Echinoids will hardly be doubted by anyb ody describes in this a small echinoid, which had been presented to his brother by General Komaroff of the Russian Army. I quote here Mr. Cotteau's own words:—

"Cette espèce avait été dans l'origine considerée par M. Vilanova et par moi qui n'avais fait que suivre ses indications, comme éocène. De nouvelles observations ont demontré que la couche qui renferme le *Coraster Vilanovæ* doit se placer dans la Craie, à un niveau supérieur. La découverte de cette espèce faite récemment par M. Seunes dans la Craie supérieure des Pyrénées, ne laisse plus aucun doute sur l'horizon stratigraphique du *Coraster Vilanovæ*.

"La présence de ce petit Échinide, à une aussi grande distance des Pyrénées et de la province d'Alicante, est extrêmement intéressante et suffit pour établir que les dépôts de Tersakhan, dans lesquels il a été recueilli, font partie de la Craie supérieure, et que, suivant toute probabilité, les mers crétacés, qui recouvraient cette partie de la péninsule espagnol et des Pyrénées, se prolongeaient jusque dans le Turkestan."

There is other evidence of the probability that the cretaceous beds of Turkestán belong to the same area of deposition as those of Baluchistán, and if an Echinoid has been discovered in the former which is identical with a form which has hitherto only been found in the Upper Cretaceous system of the Pyrenees and Spain, it is by no means surprising that in Baluchistán several species have been found which are also identical with forms occurring in the cretaceous beds of the Pyrenees.

Mr. Cotteau's view that the sea in which the cretacous beds of the Pyrenees were deposited, extended to the Turkestán area, appears to be fully corroborated by the examination of the Echinoids from Baluchistán. In fact we might assume that the cretaceous sea in which this remarkable fauna lived had extended far to the south and certainly reached to Baluchistán.

If we turn our eyes further south-east and compare the Echinoids from the Arialoor group of Southern India with those from Baluchistán, we observe a most striking difference in the facies of the fauna and find that not a single species is common to both localities; in fact the whole composition of the Echinoid-fauna of Southern India differs greatly from that of Baluchistán, as will be seen from the following table. The following genera have been found in:—

	Baluchistán.	South-India.
Cidaris	X	X
Orthopsis	X	X
Cyphosoma	X	

[1] Bulletin de la Société Géologique de France, 3rd ser., Vol. XVII, p. 155.

	Baluchistán.	South India.
Pseudodiadema		X
Micropedina		X
Protechinus	X	
Salenia		X
Holectypus	X	X
Echinoconus	X	X
Nucleolites		X
Pyrina	X	
Cassidulus		X
Stigmatopygus		X
Botriopygus		X
Catopygus		X
Echinanthus	X	
Clypeolampas	X	
Hemipneustes	X	X
Holaster		?
Cardiaster		X
Epiaster		?
Hemiaster	X	X

We see, therefore, that out of a total of 22 genera which occur in the Arialoor group of Southern India and in the etáge *Danien* of Baluchistán, only five genera are common to both areas, namely,—

1. *Cidaris*,
2. *Orthopsis*,
3. *Holectypus*,
4. *Echinoconus*,
5. *Hemiaster*,

and probably also a sixth, the genus *Hemipneustes;* but the presence of the latter in Southern India is somewhat doubtful, because I base it on the supposition only that the ill-preserved *Cardiaster orientalis*, Stol., does not belong to that genus, but to *Hemipneustes*, as its poriferous zones indicate. Of the above-named five genera, four, *Cidaris*, *Hemiaster*, *Holectypus*, and *Echinoconus* are widely distributed genera, from which no conclusion can be drawn, and only *Orthopsis* may be said to be limited in its vertical distribution, and this genus, together with the probable *Hemipneustes*, would form the only connective links between Echinoid fauna of the upper cretaceous beds of Southern India and Baluchistán.

It may, however, be remarked that it would have first to be proved that the Arialoor group could be correlated with the *Sphenodiscus* beds in Baluchistán, before a comparison of their respective Echinoid fauna could be undertaken; in fact it might be assumed that such comparison is inadmissible if, as it is supposed, the Arialoor group represents the etáge *Senonien* in Southern India, whilst the *Sphenodiscus* beds can be correlated with the etáge *Danien*.

Mr. Lévillé,[1] however, has recognised the presence of the etáge *Danien* in Southern India, which he calls Ninyur group, and of which we must suppose that it was included in the Arialoor group, and therefore a comparison of the *Danien* in Baluchistán with the Arialoor group of Southern India may by no means be incompatible with the actual facts.

It must therefore be admitted that a large faunistic difference exists in the

[1] Bulletin, de la Société Géol. de France, 3rd ser., Vol. XVIII, 146.

Echinoid faunas of the upper cretaceous systems of Baluchistán and Southern India—a difference which not only concerns the species but also the genera. This fact is the more striking if we consider the faunistic similarity between the upper cretaceous systems of Baluchistán and the Pyrenees.

The only inference which we are able to draw from this fact is that a great faunistic province extended from South-Western Europe towards Central Asia and Baluchistán—the cretaceous Mediterranean Sea,—and that this same province was separated by a land barrier from the sea, in which were deposited the cretaceous beds of Southern India; a view which has already been expressed by other writers, amongst them the late Dr. Neumayr.

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