

Géominpal Belgica
Découvertes géologiques, minéralogiques et paléontologiques
en Belgique.

4

(Supplement)

From *Apristurus*-like animals to *Raja*-like animals.

By

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Lower view of the anterior part of the skeleton of one female of *Scyliorhinus canicula* (LINNAEUS, 1758)

North Sea – Oostende fish-market – 23.12.1892 - Female specimen – Determination – Louis Giltay 1920

Collection of the Royal Institute of Natural Sciences of Belgium - Section Recent Vertebrates

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In remembrance of Mine-Engineer André Delmer

History of Sciences and Philosophy

André Delmer, the fourth Director of the Belgian Geological Survey, enjoyed telling with a discrete and enigmatic smile the following anecdote he had heard from the Belgian geologist explorer of the Congo, Jules Cornet, who had discovered this fascinating short story in the private correspondence of Michel Murlon, the first Director of the Belgian Geological Survey.

During a nocturnal banquet, after a tiresome Academic Palms distribution, the geologist Jules Cornet astonished His Majesty Léopold II of Belgium telling Him: *Sire, au contraire de ce que les Cassini osèrent faire* au Roi Louis XV, il m'est venu à l'idée que si Vous m'autorisez à déplier votre bonne Wallonie, la superficie de votre Royaume, pour le moins, triplée s'en trouverait, et cela, sans diminuer d'un pouce carré le territoire de nos puissants et belliqueux voisins.*

*Reduce, without battles, the French Kingdom by a good fifth of its national territory. Demonstration which received the following Royal sanction: *Messieurs, vous et votre famille m'avez coûté une fortune pour arriver à un résultat plus désastreux que celui que le moins doué de mes Maréchaux aurait pu m'annoncer. Coquins retournez sans tarder en votre pays de larrons et soyez heureux, qu'ami des Sciences et des Beaux-Arts, Nous vous laissons têtes sur épaules !*

Jules Cornet added, precisising his reflexion: *Si ce raisonnement est l'évidence même, comment faut-il concevoir la forme de notre Continent? La chose n'en est que plus étonnante car elle est valable pour toutes les terres connues.*

How could he have better explained the successive deformation of the Earth, when Alfred Wegener was not yet born?

To all the people passionate about Scientific Research.

Jacques Herman,

At Beigem,

28th December 2012

Jacques Herman

1.Summary

This *Notula* aims at making the suggested *modus operandi* transition process between the primitive populations of Scyliorhinomorphii and the primitive populations of Batomorphii, which apparently occurred during the Upper Jurassic, more comprehensive. (cf.: *Géominpal Belgica* 4, p.63).

2.Résumé

Cette *Notula* a pour but de rendre plus compréhensible le *modus operandi* suggéré de transition entre les populations primitives de Scyliorhinomorphii et les populations primitives de Batomorphii qui s'est, vraisemblablement, produit en Europe occidentale, au cours du Jurassique supérieur. (cf.: *Géominpal Belgica* 4, p.63).

3.Samenvatting

Deze *Notula* heeft als bedoeling de voorgestelde *modus operandi* van de transitie tussen de primitieve populaties van Scyliorhinomorphii en de primitieve populaties van Batomorphii, die zich waarschijnlijk in westelijk Europa voordeed, gedurende het Boven Jurassic, duidelijker te maken. (cf.: *Géominpal Belgica* 4, p.63).

4.Kurzfassung

Mit dieser ergänzenden Erläuterung wird beabsichtigt, den *modus operandi* des vermuteten Übergangs basaler Populationen von Scyliorhinomorphii zu basalen Populationen von Batomorphii verständlicher darzustellen, so wie er sich wahrscheinlich während des Oberen Jura in Westeuropa vollzogen hat. (cf.: *Géominpal Belgica* 4, p.63).

5.Introduction

The argumentation for a better comprehension of this singular suggestion repose on different biological data concerning the reproduction mode of these two taxa of very high systematic rank, such as the degree of evolution of their dentition, their capacity of detection of electricity sources, their own capacity to produce electricity and their favourite environments.

The last elements are furnished by diverse palaeontological data and diverse geological data, collected in different parts of the present world.

The enormous palaeogeographical differences existing between the ancient localisations of these fossiliferous places, resulting from the last 140 million years of continental drift, furnish the last arguments of this very complex hypothesis.

6.Introduction

L'argumentation destinée à apporter une meilleure compréhension de cette singulière suggestion repose sur différentes données biologiques concernant le mode de reproduction de ces deux taxa, de rang systématique très élevé, comme le degré d'évolution de leur dentition, leur capacité à détecter diverses sources d'électricité, leur propre capacité d'en produire et leur environnements favoris.

Les derniers éléments de cette argumentation sont fournis par différentes données paléontologiques et différentes données géologiques, collectées en différentes parties du monde actuel.

Les énormes différences paléogéographiques existant entre les anciennes localisations de ces sites fossilifères et leurs emplacements actuels, résultant des dernières 140 millions d'années de dérive continentale, fournissent les derniers arguments de cette hypothèse très complexe.

7.Introductie

De argumentatie nodig voor een beter begrip van deze originele suggestie berust op verschillende biologische data die de evolutie betreffen van hun dentitie, hun capaciteit de verschillende mogelijke elektriciteitsbronnen te detecteren, hun eigen capaciteit om elektriciteit te produceren en hun favoriete omgevingen.

De laatste elementen ter staving van deze hypothese berusten op verscheidene paleontologische en geologische gegevens, verzameld in verschillende delen van de huidige wereld.

De enorme paleografische verschillen vastgesteld tussen de oude lokalities van deze fossiel houdende lagen en hun huidige positie, veroorzaakt door de 140 miljoen jaren van continentale drift, verschaffen de laatste argumenten van deze zeer complexe hypothese.

8.Biological Evolution

The common reproduction mode of the most primitive Scyliorhiniformes and the most primitive Batoidei was oviparity, just like the living ones.

The eggs of their diverse populations present some diversifications in length and width, which seems of little signification. The thickness of the walls and their transparency seem to have been more significant, particularly for the Scyliorhinomorphii living in shallow waters.

A pluri-millimetric wall thickness makes the eggs more resistant, but the transparency of the wall considerably decreases the duration of the maturation.

9.Odontological Evolution

Their root structure and the connection of their dental crown with their dental root are also, by its similarity, very significant.

All the teeth of all the populations of their different species present the same type of dental-root and dental-crown structure.

9.1.Root Structure

Passing from an enhanced hemiaulacorhizy, valid definition for all the Scyliorhinomorphii, to a perfect holaulacorhizy, valid definition for all the Batoidei*. All the Scyliorhiniformes and all the Batoidei have also preserved a medial-intern protuberance, morphologically and structurally similar.

*Polyaulacorhizy results from a process of lateral fusion of holaulacorhizy elements.

9.2.Crown structure

Their fundamental relation crown-root junction is identical: the basal outer side of their dental crown overhangs the top of their dental root.

9.3.Electricity

Their living taxa have a similar ability to detect latent sources of electricity as well as the capacity to emit electricity themselves. Some of the Batoid taxa have increased their production of electricity to be able to produce brutal, sudden and repetitive electro-shocks, such as all the species of the Genus *Torpedo* HOUTTUYN, 1764.

The biological system of production of electricity*, its modus operandi, its decreasing repetitiveness and its power are remarkably described by Max Poll in 1947.

*For the species *Torpedo ocellata* RAFINESQUE, 1810 (See Bibliography: POLL, M. 1947: p. 82-83).

Other fishes have also developed, and augmented, this faculty. The most successful are members of the teleostean fishes of the Order Gymnotiformes comprising only the Family Electrophoridae*, represented by the two following Genera: *Gymnotus* LINNAEUS, 1758 and *Electrophorus* GILL, 1864.

*The author of this Family remains unknown, but it would not be surprising that he was the Prussian Scientist Alexander von Humboldt, who gave the best, and the most impressive, descriptions of the potential electricity production and their effects on horses and human people in his famous Memoirs: *Voyage fait aux Régions Equinoxiales du Nouveau Continent 1791-1804*.

It is difficult to suggest any phyletic relation between these two Orders. Such examples are useful to demonstrate that the acquisition and development of singular characteristics are possible for different zoological groups.

9.4.Bioluminescence

The numerous deep water populations of the Genus *Apristurus* GARMAN, 1913, (former Scyliorhinidae, Scyliorhiniformes, Scyliorhinomorphii, Neoselachii) have a similar degree of production of bioluminescence as the deep water populations of the Genus *Dipturus* RAFINESQUE, 1810 (Rajidae, Rajiformes, Batoidei).

All the living taxa of the Genus *Apristurus*, being deep to very deep water inhabitants, demonstrate that the separation between the *Apristurus* populations and the first Rajidae populations must logically have occurred before the first phases of the progressive colonisation of the lower part of the continental shelves, which means the end of the Upper Jurassic period.

The biological system of production of electricity*, its modus operandi, its decreasing repetitiveness and its power were remarkably described by Dominique Champiat et Jean Paul Larpent (See Bibliography: CHAMPIAT & LARPENT, 1952).

*A large variety of abyssal Teleostean fishes have also developed this faculty: consult the Wikipedia List concerning Bioluminescence.

9.5.Mode of life

The diverse populations of the diverse species of the Genus *Apristurus* and the diverse populations of all the different species of the Super-Order Batomorphii are benthic animals, living on, or near, the sea bottom.

This mode of life offers an ideal observation post to localise potential preys and the approach of eventual predators. A rapid camouflage is always realisable and these spots represent good places to lay and, sometimes, to anchor their eggs, and to assure the feeding of their young, when these emerge from their egg-case.

9.6. Geological and paleontological data

In the domain of the utilisation of diverse geological data, the geographical position of one fossiliferous locality, a strange *Fixism* remains. One problem is, practically, always forgotten. The utilisation or interpretation of palaeontological data (fossils) engender three questions: their determination, their age and where their discovering place was situated when they died (e.g.: this fossil is an anterior tooth of *Premontreia degremonti* CAPPETTA, 1992, its age is Middle Ypresian, its discovering place is Ampe Clay Pit, near Egem (Western Flanders, Belgium), but where was the Ampe Clay Pit 52 million years ago?

The answer is: approximately at a distance of 6.500 kilometres in the South East of its actual position, which means at a subequatorial latitude where, presently, the temple of Abu Simbel is situated. (See Bibliography: BLESS & FERNANDEZ-NARVAIZA 2000).

The apparition of the first populations of the Super Order Scyliorhinomorphii dates from the European Upper Jurassic. The apparition of the first populations of the Genus *Scyliorhinus* de BLAINVILLE, 1816 dates from the European Upper Cretaceous.

The apparition of the first populations of the Genus *Eotorpedo* WHITE, 1934 (Family Torpedinidae BONAPARTE, 1838) is dated from the Upper Palaeocene strata of North Africa.

In Central Europe, teeth of the same Genus *Eotorpedo* were rare, but regularly signalised from the Lower Eocene strata of the Parisian Basin. It is of course not sure that the *Eotorpedo* species emitted electricity.

The teeth of the oldest populations of the Genus *Raja* LINNAEUS, 1758 were discovered in Lower Oligocene strata, just after the Eocene-Oligocene Transition, in Germany (Chattian) and in Belgium (Rupelian).

This fact allows supposing that the possible ancestors of the Genus *Raja* are some populations of the former Scyliorhiniformes existing at this period, in the same areas where the Rajiformes appeared.

The only Genus of the Scyliorhiniformes which complies with this double request, phyletic (same period) and palaeoecological (same areas), is the Genus *Scyliorhinus* represented in this zone at this period by diverse taxa, themselves direct ancestors of the numerous living species of *Scyliorhinus* inhabitants* of zones comprised between the Caribbean Sea and the North Sea. *(See the following chapter).

A large part of the Bibliography, included in this Notula, is devoted to geological and tectonic references, some of these demonstrate the existence of some mini-continents and diverse Archipelagos having existed in the central and eastern Pacific, but which disappeared by successive subductions.

10. The Natural History of the Genus *Scyliorhinus* de BLAINVILLE, 1816

Contrarily to all the other Genera of the Super Order Scyliorhiniformes, the different successive populations of the diverse species of the Genus *Scyliorhinus* seem to have been perfectly satisfied with the diverse environmental places offered between* the eastern American coasts and the Lebanese coasts during the Upper Cretaceous period and the actual period.

*Before approximately the last 60 million years, the North Atlantic did not exist. This means that these coasts were separated by a maximum of 6.000 kilometres and not by the actual 13.000 to 14.000 kilometres. In fact, 6.000 kilometres between the same latitudes.

How they succeeded to survive more than 80 million years in the same environments is another question. This primitive Mediterranean Sea presented a multitude of very diversified types of coasts bordering shallow waters, which seem to have been their favourite diversification places.

During the Upper Cretaceous, the majority of the eastern coasts of America, but also these of the London Basin, the Paris Basin, the Mons Basin and the occidental part of the Limburg Basin were bordered by shallow warm waters.

The eastern coasts of the Limburg Basin offered deep continental slopes and the northern zones of western Germany were constituted of deep water chalky deposits. The dominant calcium-carbonate fraction (up to 98%) consists of accumulations of fragments of the thecae of Coccolithophoridales*, mass representing an incredibly long, slow and continuous sedimentation.

* Coccolithophoridales are micrometric Algae characterising the chalk deposits from the Lower Campanian to the uppermost Maastrichtian deposits of the entire world.

Such a diversity of environments was favourable for a very high diversification of the species of the Genus *Scyliorhinus*, explaining the existence of the different ancestral populations of the living species encountered from the Caribbean Sea to the Mediterranean Sea, and, most recently, in the North Sea from the Belgian coasts to the southern Norwegian coasts

After a careful reading of the FAO Fisheries Synopsis 125(10) devoted to the Gadiform fishes of the World, it is evident that it is possible to reconstitute the Natural History of this Order such as done for the former Scyliorhiniformes.

11. Similarities between the evolution of the Family Scyliorhinidae (Neoselachii) and the evolution of the Family Macrouridae (Teleostei)

Two Genera are sufficient to illustrate this suggestion: the Genus *Coryphaenoides* GUNNERUS, 1765 and the Genus *Nezumia* JORDAN, 1904.

All the populations of the different valid species of the Genus *Coryphaenoides* have a long tail and scales with, more or less, sophisticated spines (single and elongated to elongated and tricuspid), but all the populations of the different valid species of the Genus *Nezumia* have a long tail and elongated scales with moncuspid spines. Other Genera of the Family Macrouridae GILBERT & HUBBS, 1916, present other scales morphotypes allowing to reconstitute the evolution of the Family.

The majority of the specific taxa of these two Genera also colonised progressively the lower parts of the continental slopes, the abyssal bottoms and, finally, the hadal trenches.

This happened with a short geological time scale interval because the Macrouridae (Teleostei) are more evolved than the Scyliorhinidae (Neoselachii).

Like the Scyliorhinomorphii they could only colonise a Sea once it existed (e.g.: the Sea of Cortez), which allows to precise when certain taxa appeared.

12. Materials utilised for the revision of the former Order Carcharhiniformes

12.1. Recent material Quantitative aspect and Sources

The material utilised by the senior-author to propose all his considerations concerning the different taxa of the former Order Carcharhiniformes has the same national and foreign provenances as the material utilised for the revision of the former Order Scyliorhiniformes.

12.2. Fossil material

Quantitative aspect and Sources

In fact, in the English-French-Belgian Basin, the fossil teeth of the different taxa of the Order of the Carcharhiniformes*, being largely more frequent than those of the Scyliorhiniformes, it is difficult to precise the number of teeth collected by the different friends operating crews or their real frequency.

*The Carcharhiniformes, being larger predators than the Scyliorhiniformes, represent in different Belgian strata the top of the ecological pyramid. The largest predator (e.g.: *Cosmopolitodus hastalis*, *Megaselachus megalodon* or *Carcharodon carcharias*) are ecological curiosities and represented by a very low number of teeth in these strata.

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14. Bibliography

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14.1. Additional Bibliography

Geology and Tectonic

(See the comments following some references)

BLESS, M., J., M., L. & FERNANDEZ-NARVAIZA, M., C. 2000: L'odyssée de l'Euro-Meuse-Rhin. *Professional Paper of the Geological Survey of Belgium*. **291**: 86p., 38 fig., 32 cartes. (The most comprehensive large public approach of the Plates Tectonic, which many biologists, but also palaeontologists must read.)

BROWN, D., A., CAMPBELL, K., S., W. & CROOK, K., A., W. 1983: *The Geological Evolution of Australia and New Zealand*. Pergamon Press. 410 p. (View with a special attention: fig. 12.6 Drift structures of New Zealand).

BENNISSON, A., E. & WRIGHT, G., M. 1978: *The Geological History of the British Isles*. Edward Arnold Ltd. 406 p.

BRIGGS, J., C. 2003: The biogeographic and tectonic history of India. *Journal of Biogeography*. **30**: 381-388.

CHOUBERI, G. & MARCAIS, J. 1952: Géologie du Maroc. Fascicule 1. Aperçu structural. Histoire géologique du Massif de l'Anti-Atlas. *Notes et Mémoires du Service Géologique du Maroc*. **100**: 196p.

CLUZEL, D. 1991: Late Paleozoic to early Mesozoic geodynamic evolution of the Circum-Pacific orogenic belt in South Korea and Southwest Japan. *Earth and Planetary Sciences Letters*. **108**: 289-305.

COULMY, D. & PAGE, J.-P. 1974: *Les ressources de l'Océan*. Presses de la Cité. 294p. (View with a special attention: Pl.1: 2: -4.500 metres, off the Matapan Cape, Pl.2: A volcano emerges from the sea, off Iceland and

Pl.6: -5.000 metres, Pacific Ocean bottom: nodules (of manganese*) covering the bottom. *Precision of the senior-author.

DARMAN, H. & SIDI, H. Eds. 2000: An outline of the Geology of Indonesia. *Indonesian Geologists Association Publication*. **2000**: 192p. (The most recent overview of this subject).

FABRE, J. 2005: Géologie du Sahara occidental et central. *Tervueren Geoscience Collection*. **108**: 572p.

FAURE, M, CARIDROIT, M. & CHARVET, J. 1986: The late Jurassic oblique collisional orogen of southwest Japan: new structural data and synthesis. *Tectonics*. **5**: 1089-1114.

HASHIMOTO, M. Ed. 1990: *Geology of Japan. Developments in Earth and Planetary Sciences*. **8**: 250p.

HEEZEN, B., C., JOHSON, C., L. & HOLLISTER, C., D. 1969: The Northwest Atlantic Mid-Ocean Canyon. *Revue Canadienne des Sciences de la Terre*. **6(6)**: 1441-1458.

HIDE, T., W., C., UYEDA, S. & KROENKE, L. 1977: Evolution of the western Pacific and its margin. *Journal of Tectonophysics*. **38**: 145-165.

HSU, K., J. 1972: When the Mediterranean dried up. *Scientific American*. December 1972 (An interesting evocation of this often forgotten phenomenon).

KODAMA, K., TAIRA, A., OKAMURA, M. & SAITO, Y. 1983 : *Palaeomagnetism of the Shimanto Belt in Shikoku, Southwest Japan in Accretion Tectonics in the Circum-Pacific Regions*. Hashimoto & Uyeda Eds. Terra Scientific Publishing Company. **1983**: 231-241.

LIEGEOIS, J.-P., BENHALLOU, A., SEKKALA, A., Z., YAHIAHOI, R. & BONIN, B. 1952: *The Hoggar swell and volcanism, Tuareg shield, Central Sahara: intraplate reactivation of Precambrian structures as a result of Alpine convergences*. Library of Congress. Catalog to in Publishing data. **1952**: 379-481.

McGONIGAL, D. & WOODWORTH, L. 2002: *Antartica: the blue continent*. The Five Mile Press. 224p.

MEERT, J. G. & LIEBERMAN, R., S. 2004: *The Neoproterozoic assemblage of Gondwana*. On-line document since 2007.

MITCHELL-THOME, D., C. 1970: *Geology of the South Atlantic Islands*. Gebrüder Borntrage Ed. 367p.

SALVADOR, A. 1991 : Origin and development of the Gulf of Mexico Basin. *Geological Society of America*. **1991**: 389-444.

STONEHOUSE, B. 2002: *Encyclopedia of Antartica and the Southern Oceans*. John Wiley & Sons. 391p.

OTSUKI, K. 1992: Oblique subduction of mini-continentes and Subduction of oceanic ridges: Their implications on the Cretaceous tectonics of Japan. *Island Free*. **1**: 51-63.

UYEDA, S. & MIYASHIRO, S. 1974: Plate tectonics and the Japanese islands: a synthesis. *Journal of the Geological Society of America*. **85**: 1159-1170.

Palaeontology

MILAN, J., RASMUSSEN, B. & BONDE, N. 2012: Coprolithes with preys and traces from coprophagous organisms from the Lower Cretaceous (Berriasian), Jydegaard Formation of Bornholm, Denmark. *New Mexico Museum of Natural History and Science*. **57**: 235-239.

NOËL, D. 1970 : *Coccolithes crétaées. La craie campanienne du Bassin de Paris*. Eds. C.N.R.S. 130p., 23 fig., 48 pl.

SCHMID, W. Ed. 1982: Das Maastricht in Nordwestdeutschland, Fossilien aus der Schreibkreide. *Neues Jahrbuch, R. A.* **6**: 289 p.

14.2. Special References

Bioelectricity

POLL, M. 1947: Faune de Belgique. Poissons marins. Patrimoine du Musée royal d'Histoire naturelle de la Belgique. Bruxelles. 452 p., 267 fig. and 3 maps. (Read: p.: 82-83).

Bioluminescence

CHAMPIAT, D. & LARPENT, J. P. 1993: *Biochililuminescence. Principes et applications*. Eds. Masson. 531p.

Biodiversity

COHEN, D., M., INADA, T., IWAMOTO, T. & SCIALABBA, N. 1990: Gadiform Fishes of the World (Order Gadiformes). An annotated and illustrated Catalogue of Cods, Hakes, Grenadiers and other Gadiforms known to date. *FAO Fisheries Synopsis*. **125(10)**: 183-286.

NOUVIAN, C. 2008: *Abysses*. Text and photo-album. 258p. Presses de La Palina, Luçon, France. (This publication is in fact a wonderful compilation of the numerous abyssal water living forms).

SHIRIHAI, H. 2008: *The Complete Guide to Antarctic Wildlife*. Second ED. Princeton University Press. 544 p.

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