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**DISCOVERY OF A DERMOCHELYID TURTLE
IN THE MIOCENE OF SOUTH-CENTRAL ITALY
(EASTERN MATESE MOUNTAINS), BENEVENTO PROVINCE***

FRANCE DE BROIN and BERNARD PIRONON

I. - Introduction. Geology.

Fossil turtle fragments were found in the Langhian-Serravallian by one of the authors (B.P.) during research work on the geology of the Campano-Abruzzaise Platform of the Meta in the Matese mountains (southern Italy) (Clermonte and Pironon, 1979).

The Langhian-Serravallian crops out along the eastern edge of the Matese mountains and more precisely at the border of the Campobasso and Benevento Provinces within the town of Cusano-Mutri (Fig.1) (topographic sheet at 1/25,000 = Folio #162 III southwest Cusano-Mutri).

The road that heads down from the "Bocca della Selva" site to the village of Pietraroia winds on a vast monocline looking east. This Miocene limestone structural surface, dominated to the north by Mount Mutria, exposes on its southern edge a stratigraphic series going from Early Cretaceous to Serravallian-Tortonian (Selli, 1957; D'Argenio, 1962). Hundreds of meters to the north of "Civita di Cusano" crops out an Albian-Cenomanian bauxitic clay layer, a calcirudite series recrystallized with rudists (hippuritids, radiolitids) of the Turonian-Senonian. On this Cretaceous substratum the Miocene limestone crosses through a perfectly flat erosion surface. The latter starts off with three meters of biocalcirudite with lithothamnians, bryozoans, amphistegines, etc....corresponding to the Cusano Formation (Selli, 1957). A series rich in phosphatic granules succeeds it, reported in this region by D'Argenio (1962): Mr. Zalaffi, having been the first to study analogous sediments in the southern Lazio mountains, considered them an accumulation of coprolites. This level, in which the turtle remains were collected, and of which the thickness can reach two meters (a measurement never given in the consulted publications), presents itself in the form of a "grainstone" calcarenite. In this grainstone the phosphatic grains concentrate in irregular beds to give the rock a brown tint. Atop the phosphates and without a transition appear pelagic limestones with globigerines and orbulines of the Longano Formation (Selli, 1957) attributed to the Serravallian.

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II. - Description of the turtle fragments.

Order TESTUDINES Linnaeus, 1758
Suborder CRYPTODIRA Cope 1868
Superfamily *Chelonioidae* Baur, 1893
Family *Dermochelyidae* Gray, 1825
Genus *Psephophorus* H. v. Meyer, 1847

Psephophorus sp.

Pl. 59

LOCALITY AND STRATIGRAPHIC HORIZON. Pietrarroia, town of Cusano-Mutri, Benevento Province, eastern Matese mountains, south-central Italy, Miocene: Langhian-Serravallian.

MATERIAL. Fragments of a carapace reassembled on a limestone block (Pl. 59), coll. Pironon.

The limestone block, compacted with miniscule phosphatic grains, had been broken in two chunks that were separated from each other on the ground but fit together perfectly. The specimen includes a small portion of a large carapace of a dermochelyid, a family of sea turtles that appeared in the Early Eocene and are represented today by a single species, *Dermochelys coriacea*, the leatherback turtle, distributed in all oceans and seas except in polar regions.

MORPHOLOGY AND SIZE.

The fossil specimen constitutes an irregular mosaic of dermal plates, epithecal in nature, showing its dorsal face; it is arbitrarily arranged lengthwise on Plate 59. The main piece holds the remains of 66 plates connected by sutures. On the front left (Pl. 59) and below in the thick of the block appears an isolated partial plate. In the back right and above by a plate thickness a fragment made of seven partial plates is seen; a small piece of thin bone projects horizontally under the latter in the back. It may be a piece of rib, a thecal part of the carapace, distinct from the superficial epithecal carapace. On the block between the main piece and the seven-plate fragment are the remains of plates, probably corresponding to the thecal skeleton (neuro-pleural). Other isolated plates are situated inside the block and are visible on the vertical back edge. Finally, another one appears by virtue of the split of the limestone block just below a plate from the main piece. Obviously, the various elements belong to a single carapace, which was already fragmented, dislocated before fossilization: they represent only a weak part of the skeleton of the individual.

The carapace fragment measures 27 x 19 cm, going by its greatest dimensions. The surface is flat without any indication of the curvature of the carapace. That each element is almost flat and relatively smooth (some pitting and fine grooves) is irregular, a sign that they have been eroded: in extreme cases of erosion a center of radial growth in the middle of the plate is seen.

The complete carapace must have measured more than a meter in length. The thickness of most of the elements varies from 5 to 7 mm; some are 7 to 10 mm thick (anterior zone). The constituent plates are polygonal: seven or eight-sided and relatively large (2 to 4 cm in width or length); more often pentagonal or hexagonal, small to medium-sized (the smallest at 1.5 x 1.3 cm). They are connected by well-defined sutures, slightly jagged and easily separated. At the front and back of the block there are two zones with two irregular transverse rows of large plates (3.7 x 2.7 cm maximum), several of which have edges in a broken line (non-rectilinear). Between these two zones the majority of the fragment is made of relatively smaller plates by and large, almost all having rectilinear edges. There is a section of seven to eight of these plates between the anterior and posterior zones.

TAXONOMIC RELATIONSHIPS OF THE FOSSIL WITHIN DERMOCHELYIDAE.

The correct attribution of this type of carapace fragment to Dermochelyidae dates back to the second half of the 19th century. Previously, they had been attributed to the fishes or to edentates.

1) In 1839 M. de Serres, Dubreuil, and Jeanjean (Gervais, 1872) attributed a fossil fragment from the Pliocene molasse of Vendargues (Herault, France) to the fish, *Ostracion*. In 1849 Gervais recognized its true nature and gave it the name *Sphargis pseudostracion* (*Sphargis* Merrem, 1820, being a synonym of *Dermochelys* Blainville, 1816): he figured a specimen in 1859 then again in 1872 in a work devoted to the osteology of the leatherback turtle, "*Sphargis*" *coriacea*.

2) H. von Meyer (1846) considered a fragment from the Miocene of Neudorf an der March in Czechoslovakia near Austria (now Devinska Nova Ves) to be from a dasypodid (armadillo family); he christened it (1847) *Psephophorus polygonus*. It was only later that the chelonian nature of the fossil was recognized, after observations by Fuchs of a skeleton of the modern species, *coriacea*, kept at the Padoue Museum (Seeley, 1880; Van Beneden, 1883; Dollo, 1888). Finally, let it be said that such fragments of the Dermochelyidae could be confused with the remains of placodonts, such as *Psephoderma* of the Triassic of Europe (notably of Italy). Dollo (1888) placed the latter again among the Athecae, Sphargididae (= *Dermochelyidae*) next to *Sphargis*, *Psephophorus*, *Protostega*, and *Protosphargis* (the last two being, in fact, protostegid sea turtles). Later, several fossil specimens were correctly assigned to the family Dermochelyidae. It is possible, however, that in Italy and elsewhere, some paleontological collections may contain some without being recognized as such.

The taxonomic relationship of the Pietrarovia fossil within the family is shown here by a comparison with a portion of the dorsal carapace of *Dermochelys coriacea* (Linnaeus) (Pl. 60). Within this species of great sea turtles and unlike other turtles, the body is no longer protected by a dermal carapace of "thecal" character (fused to the vertebrae and ribs). This form of carapace is reduced to the nuchal plate and to a slight lateral extension of the ribs, which remain totally independent of each other (Gervais, 1872, pl. 6-8). The plastron elements of cryptodires are present and recognizable by their

morphology, reduced to narrow and thin strips bounding a large central fontanelle. Conversely, the body is protected by armor composed of a tough skin (leather) covering a carapace of a type called “epithecal.” It is made of bony polygonal plates connected by sutures and separate from the vertebro-pleural and plastral skeleton, in effect, “free” like that of the fossil edentate, *Glyptodon* of the Plio-Pleistocene of South America. Dorsally, seven longitudinal plate rows can be distinguished, thickened dorsally with seven keels in an irregular median bourrelet with tubercles. In these rows there is by and large an alternation of large hexagonal plates and slightly smaller quadrangular plates. Between these rows are large zones of polygonal plates in a mosaic, connected by sutures between them and streamlined plates, quite distinctly smaller than the latter. The sutures are slightly jagged and dorsally rectilinear but very finely serrate ventrally. Outside of the ventral plastron the epithecal covering is limited and discontinuous; it includes zones of small plates and five longitudinal rows of oval tubercles, forming keels (Gervais, 1872, pl. 9). There, where the plates are not developed themselves, their placement is marked by impressions in the skin (Gervais, 1872; Dollo, 1888, p. 68).

On Plate 60, fig. 2 shows a dorsal portion: through the dried skin, the mosaic of plates is visible. To the right part of the longitudinal row of large medially-keeled plates (clear zone) is represented. Fig. 1 shows the ventral view of a portion of the same carapace with a file of externally-keeled plates in the longitudinal axis of the figure. The thickness of the plates, varying according to its position on the carapace, is from 2 to 5 mm (tubercles of the keels put to one side) for a dorsal carapace 130 cm long and 100 cm wide.

The comparison of the fossil fragment from Italy with the modern species clearly shows the similarity between the two specimens and the taxonomic relationship of the former within Dermochelyidae. In addition, it indicates that it does not belong to the same species and probably no longer to the same genus. In the fossil the mosaic plates are clearly larger and thicker than the same non-keeled ones of the modern species.

A problem is posed: the position of the Italian fragment on the carapace—is it a part of the ventral plastron or the dorsal carapace? According to some authors (Seeley, 1880; Dollo, 1888; Palmer, 1909), the remains of the epithecal carapace of the dermochelyid fossils, placed in the genus *Psephophorus*, possessed a complete epithecal plastron, contrary to the modern *Dermochelys coriacea*, where it is reduced. The ventral plates would be, within *Psephophorus*, either thinner than the dorsals—and this would be the case of *P. rupeliensis* (Van Beneden, 1883) according to Dollo (1888, p. 69, note 4)—or thicker and not keeled—and this would be the case with *P. calvertensis* Palmer 1909. In our fossil the plates have the dimensions (length, width, thickness) of the dorsal plates of all *Psephophorus* and, in addition, those of the ventrals of *P. calvertensis*, but in comparison with certain fossil species, it would be a dorsal fragment instead.

Within *Psephophorus*, according to Palmer (1909) as in another dermochelyid with an epithecal carapace, *Cosmochelys* Andrews 1919, the central keel would be very strong, then from each side the keels would be progressively reduced towards the edges of the carapace.

a) *P. calvertensis* Palmer, 1909, from the Middle Miocene of Maryland, includes various fragments, of which the placement on the carapace was determined by Palmer. The one strongly keeled by a longitudinal ridge on a row of large plates is called dorsal

median; another one, very weakly keeled on the large plate row is called dorsal lateral. Both have keeled rows around plates in a little mosaic and Palmer indicates that on the lateral fragment, there is a tendency toward a parallel arrangement of the plates adjoining the keeled row; a final fragment, unkeeled with large plates surrounded by smaller ones without regular files, is called plastral.

b) *P. polygonus* H. von Meyer, 1847, figured by Seeley (1880); the figured specimen includes a longitudinal row of large plates with a strong ridge forming a keel and on both sides large zones of smaller plates in a mosaic; it is a median fragment.

c) *P. pseudostracion* (Gervais, 1849) from the Pliocene of Vendargues, figured by Gervais (1859, pl. 9, fig. 1 and 1872, pl. 9, fig. 4): the fragment from 1872 (coll. National Museum of Natural History, Paris, Paleontology, 1870-96) has a somewhat thick row of large plates in a slight longitudinal bulge and from each side some polygonal plates in a smaller mosaic: it is a lateral-dorsal fragment.

The Italian fragment compares best with a lateral-dorsal fragment and particularly the one from *P. pseudostracion*. In fact, we said that it includes at the front and rear (pl. 59) two narrow zones of large plates (edges along a broken line) and between them, smaller plates in a mosaic. The anterior zone, not being distinctly convex, includes conspicuously thick plates. It would be a row corresponding to a lateral keel. The posterior zone would be more lateral still and the front of the animal would have been situated to the right or to the left of the specimen as placed in Pl. 59.

Wherever the fragment placement was on the carapace from Pietraroia, it is sufficiently comparable to the remains of three fossil species cited for being placed in the same genus, *Psephophorus*. It is distinct from the modern *Dermochelys* by its much larger plates in a mosaic—thick and less numerous plates between the longitudinal rows. Note also that the keels are large continuous ridges and not narrower with high tubercles.

OTHER DERMOCHELYID FOSSILS.

1) *Psephophorus* group. In this genus are assigned the following:

— Plates of the carapace: *Psephophorus* sp. from the Miocene of Lagenfelde bei Altona (northern Germany), three isolated plates in addition to fragments of limb bones (Dames, 1894, pl. 2, fig. 2, 3), *Psephophorus* sp. of the Middle Eocene (Bracklesham) of Sussex (England) (Lydekker, 1889, p. 225): six connected plates.

— Isolated bones unaccompanied by plates but typically dermochelyid: *P. eocaenus* Andrews, 1901, humerus from the Middle or Late Eocene of Qasr El Sagha in the Fayum (Egypt) (Andrews, 1906) and in Belgium near Anvers, *P. scaldi* (Van Beneden, 1871), humerus from the Anversian-Bolderian (Miocene) black sand, species on which Dollo (1888) reported, in addition to a radius, a phalange, and a femur from the Scaldisian deposit (Pliocene) of Anvers.

— Pieces of the skeleton belonging to the skull, postcranial skeleton and the carapace: *P. rupeliensis* (Van Beneden, 1883) from the Boom clay, Rupelian (Oligocene) of Belgium; it is the most beautiful material of *Psephophorus* known, but only some elements were figured: by Van Beneden (1883), three large isolated polygonal

plates, some vertebrae, an ilium; then by Dollo (1888): three fragments of a humerus. Four other specimens were found in the same formation but have been neither figured nor described. Dollo (1888) gives only some observations on their morphology along with the complete inventory of the constituent elements of the skeletons. Since then, a reconstructed specimen was displayed in the Gallery of the Royal Institute of Natural Sciences of Belgium in Brussels. The carapace is remarkable for the large dimensions of the polygonal plates, comparable by their morphology to those of other species of *Psephophorus*. However, another reconstructed example, kept out of the exhibition, shows relatively smaller plates in general!

2) Close to the genus *Psephophorus* are assigned two species:

— *?Psephophorus oregonensis* Packard, 1940, from the Eocene of Oregon (U.S.A.) is based on fragments of carapace and skeleton (cranial).

— *Pseudosphargis ingens* (Koenen, 1891) described by Dames (1894) from the Late Oligocene of Doberg bei Bunde in Westphal (Germany), based on a skull fragment. The assignment of these two species to *Psephophorus* is possible (Nielson, 1959) but not confirmed as the skull of *P. polygonus* remains unknown. In fact, the description of *P. rupeliensis*, the only species of which nearly all the elements are preserved, is anxiously awaited. It would allow certain problems to be solved: confirm or deny the assignment of the species *oregonensis* and *ingens* to the same genus as *rupeliensis*; the attribution of the limb bones not accompanied by carapace remains (Fayum, Belgium) to this genus or to another.

Anyway, the lack of knowledge of the complete carapace, the skull, and limb bones (and particularly the humerus—very interesting in this family) of the type species, *Psephophorus polygonus*, allows for neither the definition of this genus nor the determination of which species must be assigned to it.

3) *Cosmochelys dolloi* Andrews, 1919, is based on epithecal carapace fragments from the Eocene of Nigeria. By the punctuated and tuberculated ornamentation of its plates, the relative sharpness of the keels, and the narrowness of the mosaic plate zones, *Cosmochelys* is at the same time distinct from *Dermochelys* and *Psephophorus*, which are closer to each other. With the humerus not being known a connection between the Nigerian genus and *P. eocaenus* of the Fayum is not foreseeable at present.

4) *Eosphargis* Lydekker, 1889, a dermochelyid of the Early Eocene of Europe: England (Lydekker, 1889), Belgium (Dollo, 1909), and Denmark (Nielson, 1959, 1963). A typical dermochelyid by its skull and postcranial skeleton, it is primitive by the absence of an epithecal skeleton and the retention of a thecal skeleton—true, it is already greatly reduced. This distinguishes it radically from *Psephophorus*, *Cosmochelys*, and *Dermochelys*.

III. Conclusion.

With our knowledge of the Dermochelyidae still very limited the Miocene fossil of Pietrarroia in the Matese mountains can only be placed in the genus *Psephophorus* in

the broad sense: including all the fossil specimens that are related to it in the literature at present; in the strict sense: including then only the fossils known from epithelial carapace fragments comparable to those of the type species, *P. polygonus*, such as *P. pseudostracion*—morphologically close to the Pietrarroia fossil.

Not knowing the evolutionary process that occurs within the genus or among the *Psephophorus* group, we cannot precisely determine the stratigraphic level of the discovery site of the Italian dermochelyid. *Psephophorus* was distributed, even in the strict sense, in the Miocene-Pliocene, largely in European seas (Germany, Belgium, France, and Italy) and to the United States (Maryland). It has existed since the Middle Eocene (England, Oregon?) to the Pliocene inclusive. It is not yet possible to precisely determine if the sole modern species, *Dermochelys coriacea*, directly descends from *Psephophorus*, which seems probable, nor if these two genera directly descend from *Eosphargis*. Recall that *Dermochelys* was found recently in the Mediterranean and it is even in Palermo, in Sicily, which constitutes the *terra typica restricta* of the type species *Testudo coriacea* Linnaeus, 1766.

In the past Italy has yielded numerous fossil turtle remains: terrestrial (Testudinidae), semi-aquatic (Pelomedusidae, Emydidae, Trionychidae), and marine (Cheloniidae or other now-extinct families). Despite its name, *Protosphargis vernonensis* Capellini, 1884 (northern Italy, Late Cretaceous) is not a dermochelyid—it would be a protostegid. Remains of sea turtles have been found as far as southern Italy: *Procolpochelys melii* (Misuri, 1910), Cheloniidae of the Miocene limestone of the Lecce region. Previously assigned to *Euclastes*, it was reassigned by Weems (1974) in a work on fossil turtles from the Calvert Formation of the eastern United States. It is interesting to note that *Procolpochelys* and *Psephophorus* were both present in this North American Miocene Formation, just as they were both present in the Miocene of Italy.

The *Psephophorus* specimen of the Matese mountains studied here is therefore the first recognized fossil dermochelyid remains from Italy. Its discovery richly deserved to be reported.

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Figure and Plate Captions

Fig. 1 – Location of the discovery site (indicated by the star). 1: Limestones with rudists; 2: Limestones with lithothamnians (Cusano Formation); 3: Layers with phosphatic grains; 4: Limestones with orbulines (Longano Formation).

PLATE 59

Psephophorus sp. of the Miocene of Pietraroria. Fragment of dorsal carapace in matrix. Dorsal surface; x 1/2. Pironon coll.

PLATE 60

Dermochelys coriacea (Linnaeus, 1766). Dorsal carapace detail, showing the dermal plates: large and aligned in place from a longitudinal keel in an irregular mosaic and three little ones between two keels; x 1. National Museum of Natural History coll., Paris (Comparative Anatomy) 1871-932.

Fig. 1 – Ventral face; detail focused on the plates of the central keel.

Fig. 2 – Dorsal face, the plates being visible through the dried skin (the leather); detail focused next to a lateral keel; the arrows show on the keel, from front to back, a tubercle of the keel and the attenuation of this one between two tubercles.