

New Data Obtained with CT Scanning on *Platypeltoides cuervoae* (Corbacho & López-Soriano, 2012) Nileidae from the Lower Ordovician; Western Anti-Atlas, Morocco

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Abstract: The present study illustrates for the first time the ventral aspect and the hypostome of *Platypeltoides cuervoae* (Corbacho and López-Soriano, 2012) of the Upper part of the Lower Fezouata Formation (Lower Ordovician: Tremadocian) of the Guelmim area; Western Anti-Atlas, Morocco. Computed tomography of the holotype and paratype kept at the Natural History Museum in London (United Kingdom) for the conduct of a study on computed tomography and radiography as expert legal evidence in paleontology has revealed the hypotheses of the two previously cited specimens (Corbacho and López-Soriano, 2012) and another disarticulated specimen below, which was discovered during the computed tomography process. All CT Scanning images in this article have been obtained from a CT Scanned at the Natural History Museum, London, UK. By describing the ventral aspect and the hypostomes of the specimens studied in this article, any possible uncertainty and affiliation to Nileidae is stated and dissipated as suggested by Gutiérrez Marco, Sá, García Bellido and Chacaltana as belonging to Asaphidae, incorrectly suggesting that it is the species: *Asaphellus stubbsi* Fortey, 2009. Consequently, membership in the Nileidae family is reaffirmed and Asaphidae is ruled out. The genus *Platypeltoides* is also reaffirmed and *Asaphellus* is discarded. Being the correct species *Platypeltoides cuervoae* (Corbacho & López-Soriano, 2012).

Keywords: Tremadocian, Trilobita, Nileidae, *Platypeltoides*, Hypostome, CT Scanning, TAC

1. Introduction

Morocco has been a very important source of new trilobite species. In particular, the Fezouata Formation has provided large specimens often presented as monospecific assemblages. Since 2007, we have been studying new outcrops of trilobites and taxa of the Ordovician of Morocco, first with the research assistance projects of FOSILART (Spain) and later with those of the Association of Experts and Appraisers of Catalonia (Spain). The studies carried out in the Lower Ordovician and specifically in this formation are cited in references [1-13]. In this work we describe the ventral aspect and the hypostome of the species *Platypeltoides cuervoae* (Corbacho & López-Soriano, 2012) that was found in 2008, and subsequently

described 4 years later due to the scarcity of the material and the fact that most of the specimens have been reconstructed for the fossil market; see [14-16]. With the application of the CT Scanning technique we have been able to access the ventral features and hypostomes of the holotype and paratype and of a third disarticulated specimen that has appeared below them. These specimens are preserved in the NHM in London (UK) under the annotations NHMUK-it28944 for the holotype and NHMUK-it28945 for the paratype.

1.1. Historical Background

The Moroccan Ordovician was discovered by A. Bigot and J. Dubois in 1931, this led to several expeditions and studies by different geologists. G. Choubert in 1952 made a

summary of these expeditions [17] that gave the first classification of the chrono and lithostratigraphic set of this system. They distinguished four large lithological and morphological sets in the Moroccan Central Anti-Atlas: Outer Feijas (Tremadocian to upper Llandeilo), sandstones of the 1st Bani (Llandeilo), Ktaoua Shales (Upper Llandeilo-Lower Caradoc), sandstones of the 2nd Bani (Caradoc). It was J. Destombes in 1962, 1970 and 1971 [18-21] who described the stratigraphy of the Moroccan Anti-Atlas that is used practically up until today, being as follows: Outer Feijas (Tremadocian to upper Llandeilo), sandstones of the 1st Bani (Lower Caradoc), Ktaoua Shales (Middle - Middle Ashgill), sandstones of the 2nd Bani (Upper Ashgill).

1.2. Current Situation

Currently the deposits where *Platypeltoides cuervoae* appears are practically unknown to trilobite specialists due to their geographical location. Only J. Destombes in the 60's visited that area. In 2014, the first author (J. C.) visited the area and tabulated the coordinates, took photographs and studied the site. The purpose of this article is the study of hypostomes and ventral aspect of this species, unknown until now.

2. Materials and Methods

The ventral aspect and the hypostome are important subjects for the study of trilobites, but they are not always accessible. That is why techniques such as those mentioned by H. B. Whittington have been applied [22] "exoskeletons preserved by silicification, which may be freed from the limestone matrix by dissolving it away with acid, have given much knowledge of morphology and growth. Improved methods of casting, in latex or plastic compounds, have greatly facilitated study of exoskeletal molds". Currently with the application of CT Scanning, these limitations have virtually disappeared by being able to access these parts perfectly without having to damage the specimen, which has produced an important advance for the study of trilobites.

2.1. Materials

2.1.1. Specimens Studied

Three specimens of *Platypeltoides cuervoae*, two complete and one disarticulated, are presented in the same matrix. The complete ones are the holotype (NHMUK-it28944) and paratype (NHMUK-it28945) that are conserved in the Natural History Museum (NHM) of London (UK). All three specimens retain their hypostome, which are presented and described in this paper.

2.1.2. Complementary Video Material

https://youtu.be/H-pfQqT_Ms8

2.2. Geographical and Geological Settings

Origin of the specimens (Figure 1): The studied locality consists of grey-blue ferruginous sandstones which have been assigned to the Upper part of the Lower Fezouata

Formation, Lower Ordovician (Upper part of Tremadocian). The studied site is located approximately 710 km of the SW of Rabat, in the administrative area of Agadir and NW of Assa in Guelmim area; Western Anti-Atlas, Morocco. The coordinates of the site are N 28° 43' 31" and W 009° 36' 31" - Altitude 689 m.

2.3. Measurements

Table 1. Measurements in mm. TL= Total length.

number	NHMUK-it28944	NHMUK-it28945
T L	125	115

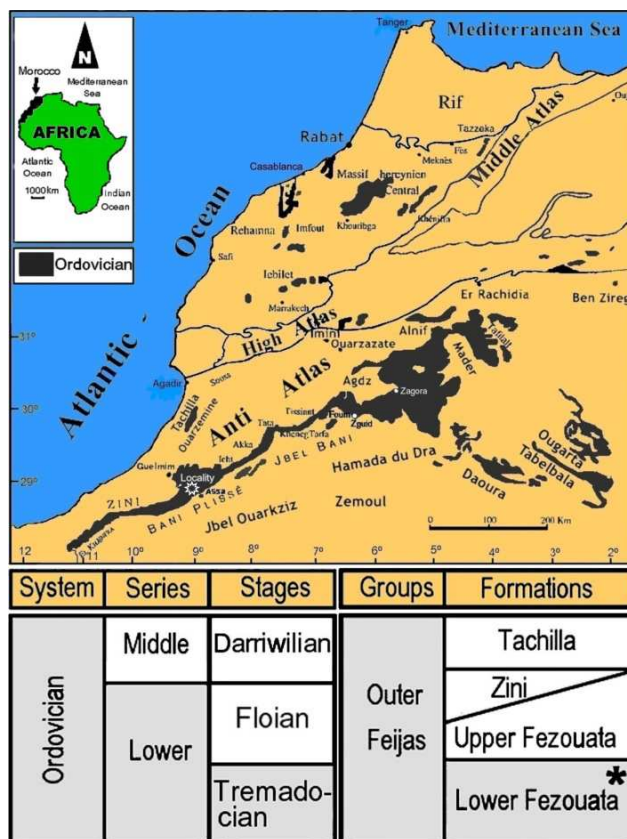


Figure 1. Map of Morocco and Stratigraphy of Lower Ordovician from the Anti-Atlas. * Indicates the type locality. After [13] and modified.

2.4. Systematic Paleontology

The specimens indicated under the entries NHMUK are housed in the collections of the Natural History Museum of London (UK).

Order ASAPHIDA Salter, 1864

Suborder ASAPHINA Salter, 1864 emend.

Fortey & Chatterton, 1988

Superfamily CYCLOPYGOIDEA Raymond, 1925

Family NILEIDAE Angelin, 1854

Genus *Platypeltoides* Pribyl in Prantl & Pribyl, 1949

Type species - *Platypeltis croftii* Callaway, 1877 from the Tremadocian of Shropshire (England, UK).

2.4.1. *Platypeltoides Cuervoae* (Corbacho & López-Soriano, 2012)

2012 – *Asaphellus cuervoae* Corbacho & López-Soriano [7], pag. 4, plates 1 – 3

2014 – *Asaphellus cuervoae* Corbacho & Calzada [23], pag. 22, plate 1

2016 – *Asaphellus?* *cuervoae* René [24], pag. 67

2017 – *Asaphellus stubssi* Gutierrez-Márco et al. [25], pag. 3

2018 – *Asaphellus cuervoae* Lebrun [26], pag. 83, figure D

2018 – *Platypeltoides cuervoae* Corbacho et al. [13], pag. 16, figure 5

2019 – *Platypeltoides cuervoae* Corbacho et al. [1], pag. 49, figure 4.



Figure 2. *Platypeltoides cuervoae*, view of the dorsal aspect of the holotype and paratype in its matrix. Image obtained from the 3D resin copy made with CT Scanning.

2.4.2. Diagnosis of the Species

Platypeltoides species of medium size, characterized by large eyes (approximately 30% of the glabellar length), with long and wide genal spines extending perpendicularly from the cephalon and making a 80° angle with the axis (sag.); the spines slightly towards their terminal.

2.4.3. Description of the Ventral Aspect

It has a very wide rostral plate (rp) sagittally (sag) and transversely (tr) forming an angle of 45° with the hypostome. Rostral suture (rs) is very limited

2.4.4. Hypostome Description

Hypostome of impendent condition, attached to anterior doublure but not aligned with the glabella. Nearly subquadrate shape, slightly wider in its posterior part, without either hypostomal furrows or borders, and hence, without differentiated lobes. Strong anterior wings projected upwards. Neither maculae nor other hypostomal associated structures are observed. No hypostomal sculpture, pits or terrace ridges are seen.

2.4.5. Discussion

A terraced lateral border of the hypostome is a common feature in the genus *Asaphellus*. In fact, terrace ridges are present in the full hypostome in several species of this genus, such as *A. acutulus*, *A. fezouataensis*, *A. tataensis* and *A. inflatus* (revised by Meroi-Arcerito et al., 2015) [27]. However, no terrace ridges are observed in the hypostome of these specimens.

2.5. Methods

All the images in this paper have been made utilizing a CT Scanner, CT scanning computer software and a 3D printer.

2.5.1. CT Scanning

CT Scanning of the NHM of London (UK) using a micro

CT-scan Nikon Metrology HMX ST 225 model in May 2019 for the holotype (NHMUK-it28944) and paratype (NHMUK-it28945) plus another disarticulated caparace that has appeared beneath them when scanning the type specimens of *Platypeltoides cuervoae* deposited at the NHM in London, (Figures 2 and 3), under the following parameters: 225 kV, 500 μ A, 1.6 mm silver filter, 3142 projections, 1415 ms exposure time and a voxel size of 0.107728 mm. The image process and 3D final models were carried out by using the software 3d slicer 4.10.2

2.5.2. Recovery of the Hypostomes

For the recovery and adjustment of the holotype hypostome the software 3d slicer 4.10.2 has been used

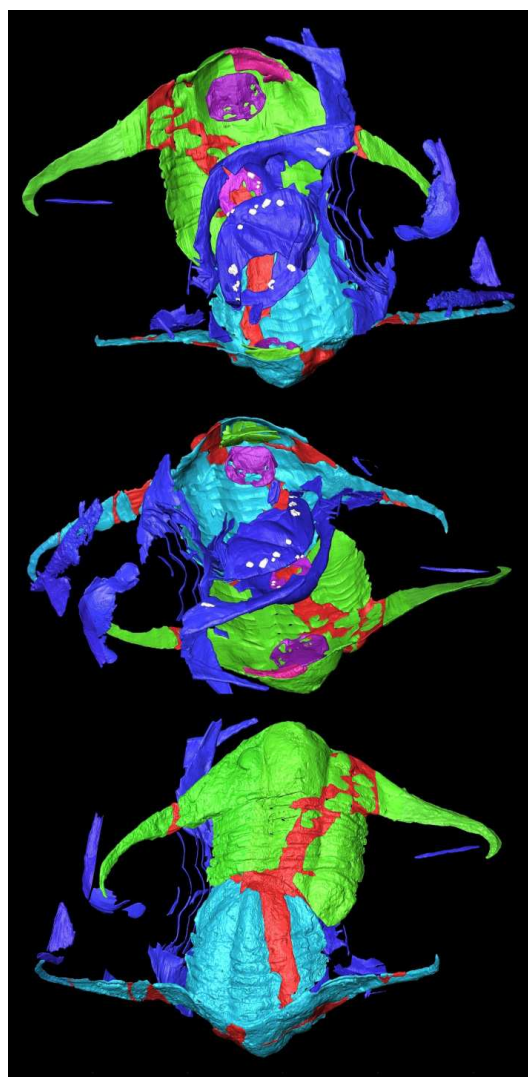


Figure 3. *Platypeltoides cuervoae*, (a) view of the ventral aspect (in its fossilized position) of the holotype (NHMUK-it28944) in green, the paratype (NHMUK-it28945) in blue and another disarticulated specimen in lilac. The hypostomes are indicated in pink those of the holotype and paratype with white indicating that of the disarticulated specimen and the part in red, repaired with resin; (b) ventral view of the holotype and the paratype with their hypostomes; (c) disarticulated specimen that is buried in the matrix, under the holotype and paratype with the hypostome.

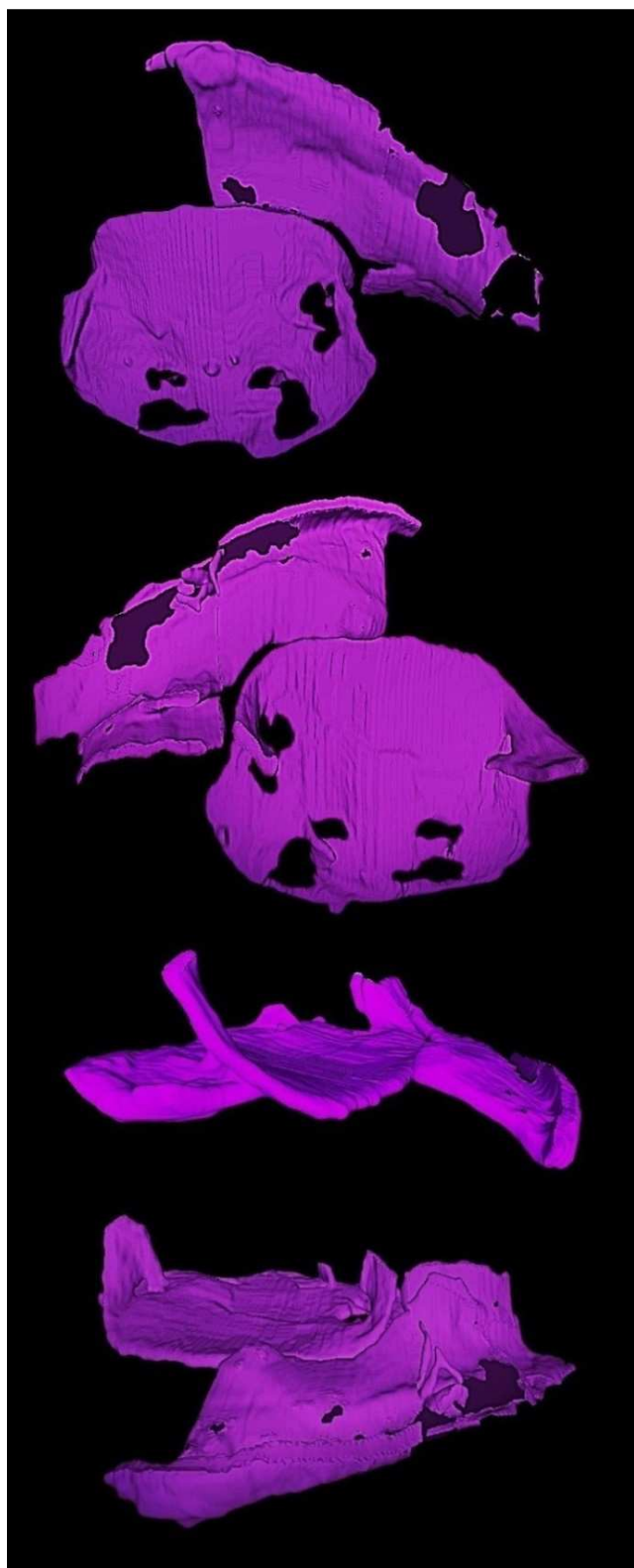


Figure 4. Hypostome of holotype (NHMUK-it28944) of *Platypeltoides cuervoae*. Hypostome assembly with rostral plate. 1 exterior ventral view, 2 interior dorsal view, 3 oblique interior view, 4 front interior view.

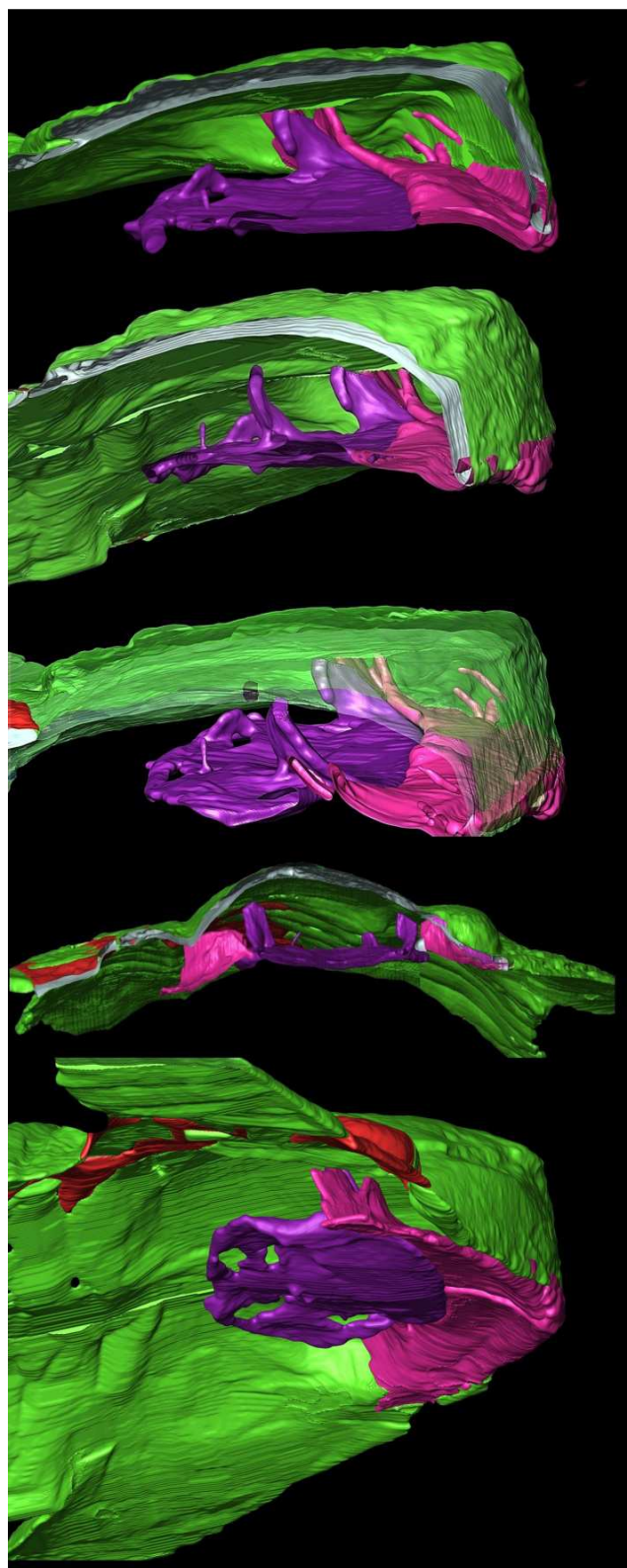


Figure 5. Hypostome of holotype (NHMUK-it28944) of *Platypeltoides cuervoae* with rostral plate attachment.

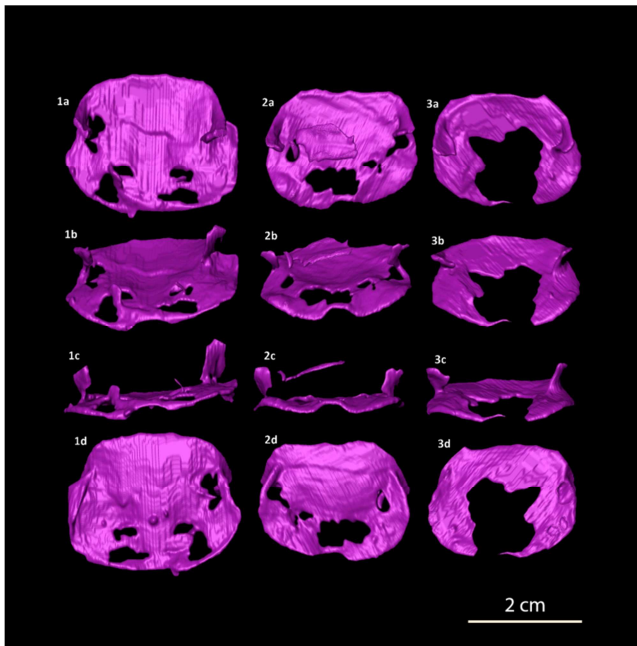


Figure 6. Hypostome of *Platypeltoides cuervoae*. (1a-1d) Hypostome of the holotype n° NHMUK-it28944; (2a-2d) hypostome of the paratype n° NHMUK-it28945; (3a-3d) Disarticulated specimen.

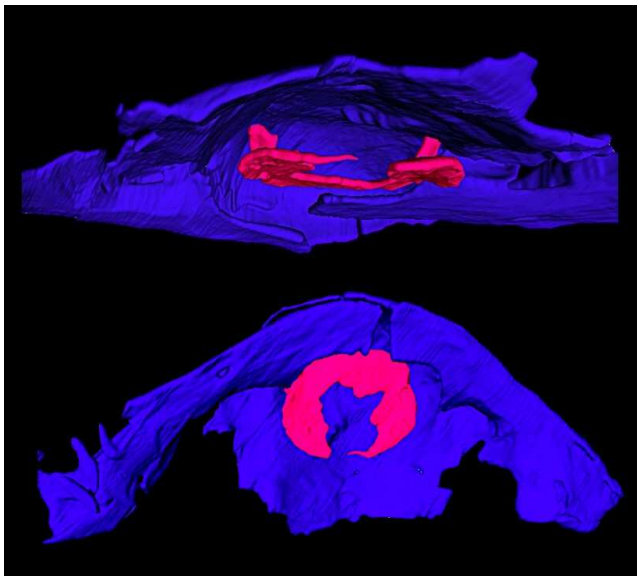


Figure 7. Cephalon of the disarticulated specimen of *Platypeltoides cuervoae*. a- Sagittal view with hypostome position, b- Dorsal view with hypostome and rostral plate.

3. Conclusions

With the description of the ventral aspect and the hypostomes of the specimens studied in this article, any possible uncertainty is dispelled and the affiliation to Nileidae is affirmed as proposed by Corbacho et al. [13] and not as stated by Gutiérrez Marco, Sá, García Bellido and Chacaltana as belonging to Asaphidae [in 25], incorrectly suggesting that it is the species: *Asaphellus stubssi* Fortey, 2009. Consequently, the genus change from *Asaphellus* to *Platypeltoides* is reaffirmed and the species *Platypeltoides*

cuervoae is affirmed.

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