

Namurian Goniatite succession in the Coalfield of Djerada (Eastern Morocco),

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HISTORICAL INTRODUCTION.

Geological investigations lead in 1927 to the discovery of the Djerada Coalfield by J. HARROY and A. BRICHANT. Since 1927 an intensive research was conducted by A. BRICHANT and, from 1929 till 1931, another one by H. CASTADOT in the productive coalfield based on the tectonic framework established by BRICHANT.

The discovery by DEWANDRE of continuous marine bands permit the introduction of different divisions in the carboniferous formations. These marker horizons were mapped by DEWANDRE on a 1/20,000 scale.

One of us (B.O.) proceeds in 1936 with the establishment of a rigorous stratigraphical scale, sampling carefully and systematically the different fossils.

So he had the opportunity to discover goniatites in different levels, from the Upper Visean till in the Upper Westphalian.

The determinations of these goniatites were confined to Mgr DELÉPINE.

He recognized BISAT's *Eumorphoceras*, *Homoceras*, *Reticuloceras* and *Gastrioceras* zones and commented their correlation within the area and with foreign countries (1941).

In 1946 in his very important memoir on the coal basin of Djerada, B. OWODENKO mentioned DELÉPINE determinations in the descriptions of Namurian Strata.

During the last years, the study of the refinements of the zonal scheme for the Namurian based upon goniatites as stratigraphical indices enables very precise correlations to be effected over considerable distances.

This paper is concerned with the revision of the goniatite succession of Djerada from the point of view of modern stratigraphy.

GENERAL FEATURES OF THE NAMURIAN OF DJERADA.

The Namurian of Djerada is not very thick. The palaeozoic formation is visible through the jurassic covering along two parallel zones in a WSW-ENE orientation.

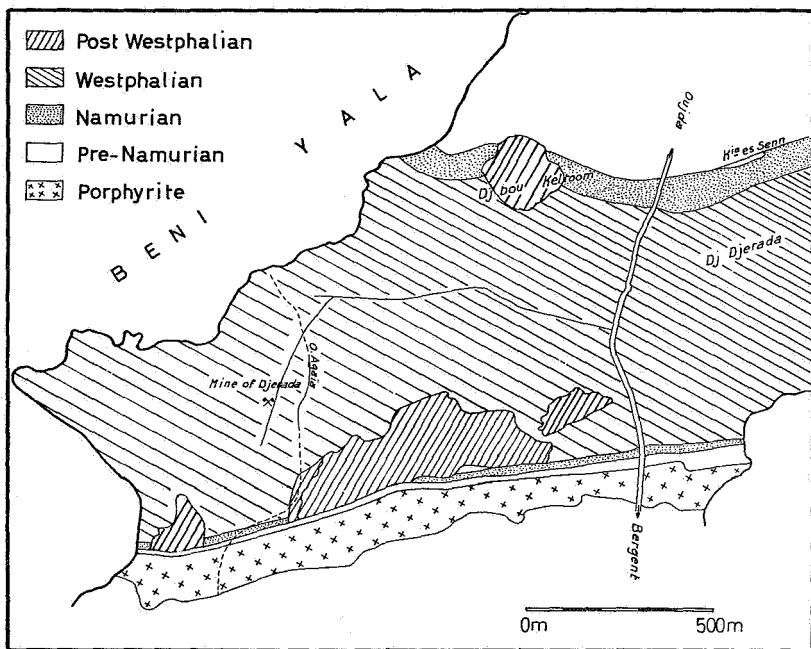


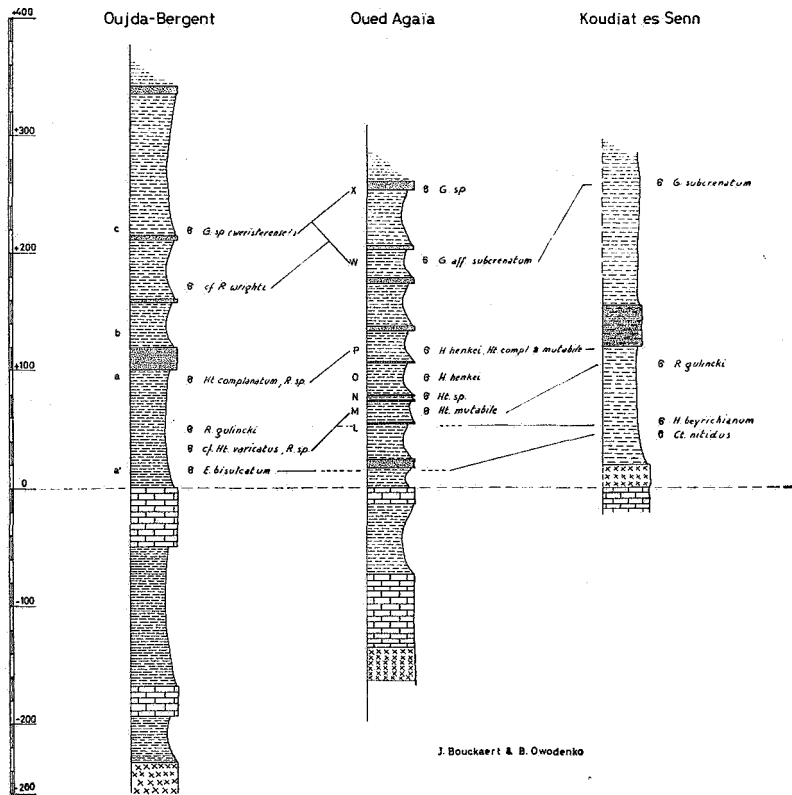
FIG. 1.

Visean, Namurian and Westphalian formations form a large syncline (see fig. 1).

The boundary between Visean and Namurian formations lays about 15 m above the last limestone in gray shales with Visean fauna.

Namurian is mostly composed of dark brown silicified shales, inserted with thin sandstone beds.

In order to study the goniatite succession of the Namurian formation, three sections, two on the North side and one on the South side of the syncline were examined.



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DESCRIPTION OF THE SECTIONS.

A. — SOUTH SIDE.

1. Section of the Oued Agaia.

From the South to the North the following strata may be observed :

Description.	Thickness in m.
Micaceous shales with plant remains and marine shales with Upper Viséan fauna (<i>Goniatites crenistria</i> and <i>Goniatites striatus</i> var. <i>crenistria</i>)	15,00
Blue green sandstone with plant remains	7,00

Description.	Thickness in m.
Dark shale with small limestone bed at the top. This bed is fossiliferous	30,00
Dark gray sandstone	1,20
Shale	15,00
Conglomerate	0,25
Brown micaceous shale with <i>Ht. mutabile</i> level M	8,00
Conglomerate	1,00
Fine shale, micaceous with <i>Ht. sp.</i> level N	2,50
Conglomerate with quartz pebbles	0,50
Sandy shale	5,00
Dark shale with bullions containing <i>H. henkei</i> , <i>Ht. varicatus</i> . level O	25,00
Sandstone and conglomerate bed.	0,50
Shale with <i>H. henkei</i> , <i>Ht. complanatum</i> , <i>Ht. mutabile</i> level P	0,50
Shale	24,50
Conglomerate	0,20
Fossiliferous shale level U	3,00
Black shale with concretions at the base	37,00
Gray-blue sandstone	6,00
Shale with bullions cf. <i>G. subcrenatum</i> level W	25,00
Sandstone and conglomerate	3,50
Shale with bullions at the top containing <i>Gastrioceras</i> sp. ... level X	46,00
Sandstone	6,00
Fossiliferous shale	50,00

2. Section of the main-road Oujda-Bergent.

Eastwards from the road cutting, above the carboniferous limestone, the section goes on as follows :

Description.	Thickness in m.
Black shale with cf. <i>Eumorphoceras bisulcatum</i> , cf. <i>Cravenocera-toides</i> sp. level a'	10,00
At about 20 m above level a', same black shale with <i>Reticuloceras</i> sp., cf. <i>Homoceratoides varicatus</i> (Km 47,870).	
10 m higher at Km 47,700 same black shale with <i>Reticuloceras gulincki</i> .	
About 40 m above this marine band, same black shale with <i>Reticulo-ceras</i> sp., <i>Dimorphoceras serratum</i> , <i>Ht. complanatum</i> level a	
The total thickness that can be allowed for the black shale is about 100 m.	
Alternating sandstones and shale beds	20,00
Green shale	40,00
Conglomerate	2,00
Just above the just mentioned layer, fine shale with <i>Reticuloceras</i> aff. <i>wrighti</i> .	
Fine sandy shale	50,00

Description.	Thickness in m.
Green sandstone	3,00
Green and gray micaceous shale with at the base <i>Gastrioceras</i> sp.	level c 120,00
Gray-green sandstone with shaly beds	6,00
Brown shale.	

B. — NORTH SIDE.

Koudiat es Senn (Thoot Hill).

About 100 m of shale are resting on a rhyolite flow. These shales contain two distinct levels with goniatite faune : the lower one is characterised by *Homoceras subglobosum* and *Homoceras beyrichianum* and the upper one by *Reticuloceras gulincki*. The shales are surmounted by about 35 m of sandstone beds alternating with sandy shales. Higher up the last mentioned strata are covered by shales and on the top of the hill some specimen of *Gastrioceras subcrenatum* were founded.

At the base, just below *H. beyrichianum* bed, DELÉPINE found *Ct. nitidus*.

Genus HOMOCERAS HYATT, 1883.

Genotype. — *Goniatites calyx* juv. PHILLIPS, 1836, p. 236, pl. XX, fig. 22 and 23.

Homoceras henkei SCHMIDT.

(Pl. 1, fig. 1 and 2.)

- 1933, *Homoceras henkei* SCHMIDT, p. 456 and text-fig. 70 and 71.
 1943, *Homoceras henkei* BISAT and HUDSON, p. 406, pl. XXV, fig. 4, 5 and 7; pl. XXX, fig. 2.
 1957, *Homoceras henkei* HODSON, pl. C, fig. 2; pl. E, fig. 4-6.
 1960, *Homoceras henkei* CHALARD, pl. D, fig. 5; pl. E.
 1960, *Homoceras henkei* BOUCKAERT, pl. II-V.
 1961, *Homoceras henkei* BOUCKAERT.

This species has been found at several localities in Western Europe associated with *Reticuloceras circumplacitile*. In the Djerada basin *Homoceras henkei* was only found in the level O from Oued Agaïa associated to *Homoceratoides mutabile* and *Homoceratoides complanatum* (R1a2).

Genus HOMOCERATOIDES BISAT, 1924.

Genotype. — *Homoceratoides prereticulatus* BISAT, 1924, p. 112, pl. I, fig. 3.

Homoceratoides mutabile BISAT and HUDSON.

(Pl. 1, fig. 3; pl. 2, fig. 1.)

1943, *Homoceratoides mutabile* BISAT and HUDSON, pl. XXV, fig. 2.

1946, *Reticuloceras reticulatum* OWODENKO, p. 51.

Description. — Closely allied to *Homoceratoides varicatus* SCHMIDT this species has in addition stronger plications at the umbilical edge with several striae between.

Horizon and locality. — This species occurs in the section from Oued Agaïa at the levels O and P. In Europe *Homoceratoides mutabile* is only known from the zone with *Reticuloceras circumplicatile*. It occurs also together with *Homoceratoides varicatus* and *Homoceras henkei*. So it may be established that the Levels P and O are of *R1a2* age.

Homoceratoides complanatum DELÉPINE.

(Pl. 2, fig. 2.)

1941, *Homoceratoides complanatum* DELÉPINE in parte.

1960, *Homoceratoides demaneti* CHALARD, pl. F, fig. 1 and 1 a.

1960, *Homoceratoides demaneti* BOUCKAERT, pl. II, niv. XV, fig. 6; pl. III, niv. 809, fig. 3 and niv. III, fig. 3-6.

1961, *Homoceratoides demaneti* BOUCKAERT.

DESCRIPTION. — The specimens are decorated by a small umbilical margin like *Homoceras henkei*. The striations dichotomising narrowly halfway up the flank show a slight tendency to bend forward and form a small lingua.

Remarks. — DELÉPINE's original description from *Homoceratoides complanatum*, is not complete. The figured holotypes do not show the typical ornamentation of the species. There may be also some confusion with the suture lines. So some of his determinations belong the species of *Homoceras* and not of *Homoceratoides*.

Horizon and locality. — In the Djerada basin, *Homoceratoides complanatum* occurs only in the O and P levels from Oued Agaïa, together with *Homoceratoides mutabile* and *Homoceras henkei*.

In Europe *Homoceratoides complanatum* was only found with *Reticuloceras circumplicatile* (R1a2).

Genus RETICULOCERAS BISAT, 1924.

Genotype. — *Goniatites reticulatus* PHILLIPS, 1836, p. 235, pl. XIX, fig. 26-32.

***Reticuloceras gulincki* BOUCKAERT.**

(Pl. 2, fig. 4.)

- 1941, *Homoceras diadema* var. *smithi* DELÉPINE, pl. VI, fig. 8 and 9.
 1941, *Reticuloceras inconstans* DELÉPINE, p. 85, pl. VII, fig. 1 and 2.
 1943, *Reticuloceras* sp. BISAT and HUDSON, p. 428, pl. XXIV, fig. 4.
 1959, *Reticuloceras* sp. BOUCKAERT, pl. 2, niv. XII, fig. 1, niv. XV, fig. 8; pl. 3 gis 813, niv. I, fig. 3 and 4; pl. 4, niv. II, fig. 1 and 2, niv. III, fig. 1 gis 3, niv. IV, fig. 3, 5, 6, 7 and 9.
 1960, *Reticuloceras gulincki* BOUCKAERT, p. 442, pl. 1, fig. 1-3.
 1961, *Reticuloceras gulincki* BOUCKAERT.

Description. — The specimens found in the Djerada coalfield show the characteristic features of the forms of the late *Reticuloceras circumplicatile* stock with a small lingua and with fewer striae inserted between the primary plications. The specimens are widely umbilicated and the ornament consist of widely spaced umbilical plications which branch rather irregularly into poorly crenulate, transverse striae. Subordinate spiral striae rarely spaced round the umbilical margin.

Horizon and locality. — *Reticuloceras gulincki* was founded at Koudiat es Senn about 20-25 m above *Homoceras beyrichianum* and in the road section Oujda-Bergent 40 m above the carboniferous limestone.

Genus *GASTRIOCERAS* HYATT, 1883-1884.

Genotype. — *Gastrioceras listeri* (MARTIN).

Gastrioceras subrenatum (SGHLOTHEIM).

(Pl. 2, fig. 3.)

1941 ?, *Gastrioceras stenlobum* DELÉPINE, p. 92.

1961, *Gastrioceras subrenatum* BOUCKAERT.

1962, *Gastrioceras subrenatum* RAMSBOTTOM and CALVER,
p. 574, pl. 15, fig. 4 and 5.

Description. — This species is mainly characterised by very faintly crenulate transverse striae and by poorly-developed umbilical nodes.

Discussion. — The specimens described by DELÉPINE are not well preserved and without any ornamentation. It is a matter of fact that the extended tubercules observed by the author may be the result of weathering. The stratigraphical position of *G. stenlobum* seems to be an indication that it may be attributed to *G. subrenatum*.

CONCLUSION.

Thanks to the recognition of the goniatite beds the zonal framework of the Namurian part of the Djerada Coalfield could be clearly established.

In comparison with Belgium the zone *E1* is not represented.

The presence of *Gastrioceras subrenatum* permits to trace the boundary between the Namurian and the Westphalian.

The presence of the sandstone and conglomerate beds explains the stratigraphical breaks between the different sections.

ACKNOWLEDGEMENTS.

The authors are indebted to the « Fonds National de la Recherche Scientifique » of Belgium for a research grant, and to the Director of the « Charbonnages Nord-Africains » for field assistance and sincere hospitality.

Brussels, December 1964.

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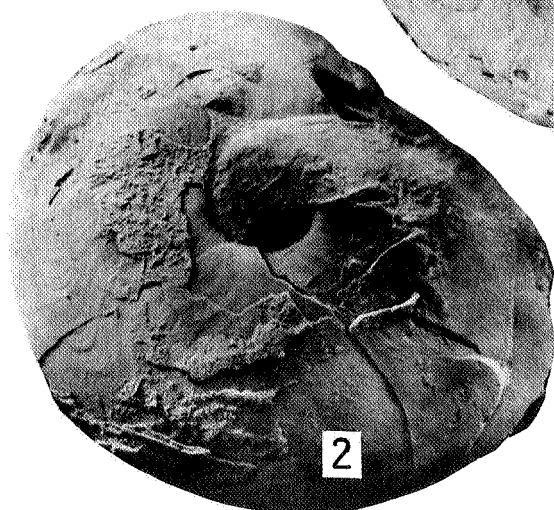
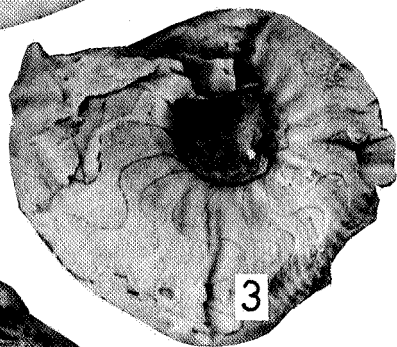
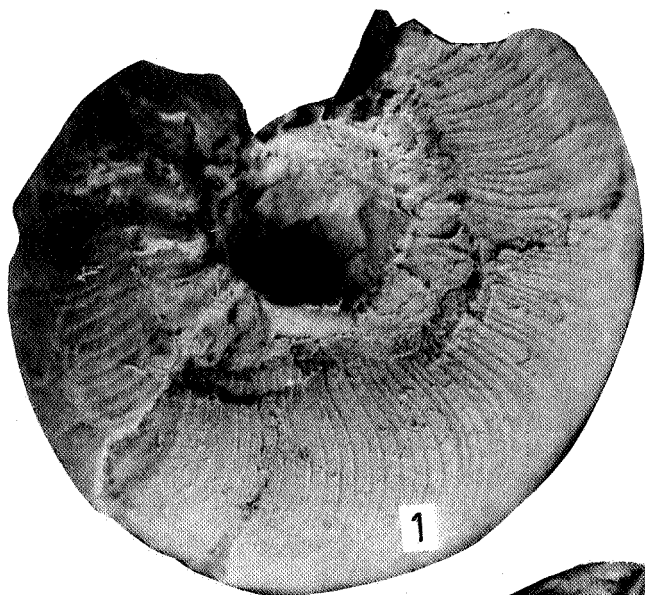
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PLATE I

EXPLANATION OF PLATE I.

1. *Homoceras henkei* SCHMIDT ($\times 8$).
Oued Agaïa, Level O.
 2. *Homoceras henkei* SCHMIDT ($\times 3$).
Adult form.
Oued Agaïa, Level O.
 3. *Homoceratoides mutabile* BISAT & HUDSON ($\times 3$).
Oued Agaïa, Level P.
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EXPLANATION OF PLATE II.

1. *Homoceratoides mutabile* BISAT & HUDSON ($\times 3$).
Oued Agaïa, Level P.
 2. *Homoceratoides complanatum* DELÉPINE ($\times 3$).
Oued Agaïa, Level P.
 3. *Gastrioceras subcrenatum* (SCHLOTHEIM) ($\times 3$).
 4. *Reticuloceras gulincki* BOUCKAERT ($\times 3$).
Main-road Oujda-Bergent, km 47.700.
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PLATE II

