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Trinocladus? americanus n. sp., a new Dasycladale from the Upper Jurassic Smackover Formation of the Gulf Coast, United States of America

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ABSTRACT – A new Dasycladale (calcareous green alga) is tentatively described as *Trinocladus? americanus* n. sp. from the subsurface Upper Jurassic Smackover Formation of Alabama, United States of America. The generic uncertainties comprise the possibilities of either third order laterals or the presence of fertile ampullae between the first order laterals. The description of the new taxon increases the micropalaeontological inventory of the New World Mesozoic dasycladales.

RIASSUNTO – [*Trinocladus? americanus*, una nuova dasicladale dal Giurassico Superiore della Formazione di Smackover, Alabama, USA] – Una nuova specie di Dasicladale (alghe verdi calcaree) proveniente dal Giurassico Superiore della Smackover Formation dell'Alabama (Stati Uniti), è descritta come *Trinocladus? americanus* n. sp. Alcune incertezze rimangono sulla determinazione generica, date le possibilità di laterali del terzo ordine o di ampullae fertili tra i laterali di primo ordine. La descrizione di questa nuova specie incrementa il numero di dasicladali del Mesozoico onosciute nel Nuovo Mondo.

INTRODUCTION

Although Upper Jurassic to Lower Cretaceous Dasycladale green algae have been reported from many parts of the Tethyan region (e.g. Bassoullet *et al.*, 1978; Granier & Deloffre, 1993) there are only scarce informations on American occurrences of this group (e.g. Granier *et al.*, 1991). First data have been compiled by the famous palaeoalgaologist Johnson (1961, 1964) noting their occurrence in wells from Texas, Alabama and Arkansas and surface occurrences from west Texas. In the introduction to his work from 1964 Johnson remarks the "practical lack of fossils other than algae in some of the subsurface Jurassic of the Gulf Coast pointing up both the potential usefulness of these forms in solving stratigraphic problems and the need for additional information about them".

In the present paper, we describe a new dasycladale as *Trinocladus? americanus* n. sp. from the Upper Jurassic Smackover Formation from the subsurface of the Gulf Coast.

GEOLOGICAL SETTING

The shallow water limestones of the Smackover Formation are a major hydrocarbon-producing unit around the Gulf of Mexico rim. The name refers to the Smackover field in Arkansas drilled in the late 1930s (Bingham, 1937). Appleton oil field, where our material comes from, is located in Escambia County, Alabama, and was discovered in 1983 (Text-

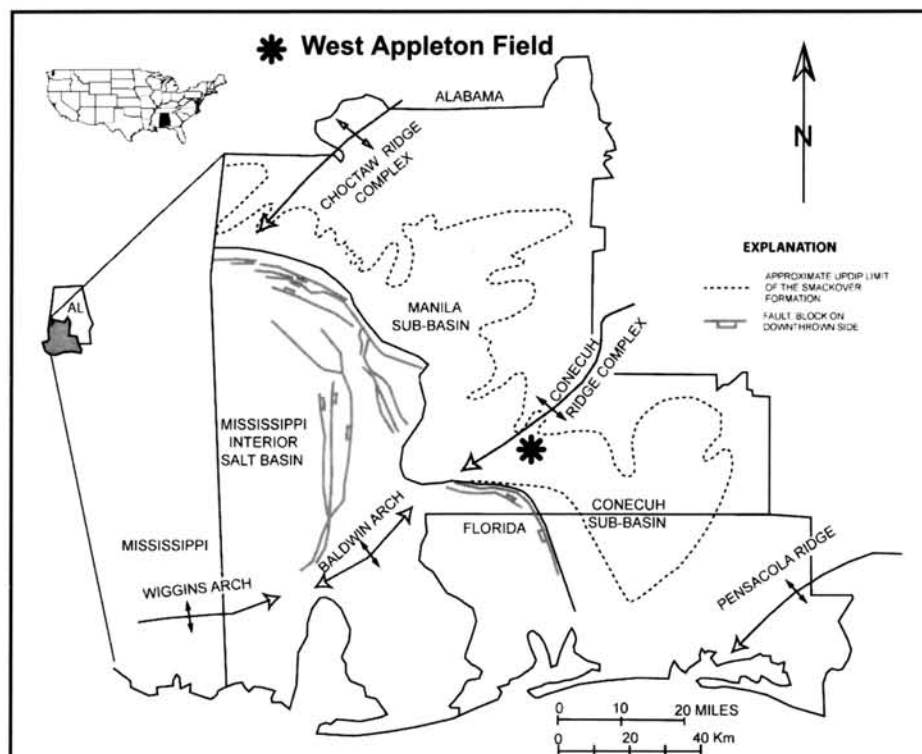
fig. 1) (Mancini *et al.*, 2000). One characteristic of the Smackover Formation is that it was dolomitized to various degrees postdating its deposition (e.g. Heydari, 2003). The stratigraphic age of the Smackover Formation is generally referred to the late early Oxfordian to early Kimmeridgian interval (Imlay & Herman, 1984).

The carbonate sediments of the Upper Jurassic Smackover Formation accumulated in a carbonate ramp setting during an overall rise in sea level (Mancini & Benson, 1980; Mancini *et al.*, 2000). The thickness and lithofacies distribution of the formation were affected by the configuration of antecedent paleotopography. In the northeastern Gulf of Mexico, the Smackover Formation generally consists of three informal members (Benson, 1988: lower, middle and upper) (Text-fig. 2). The basinal succession shows the complete development. The lower member, which overlies nonmarine to shoreface siliciclastic deposits, generally is thin, if present, and includes intertidal stromatolitic lime mudstone and intraclastic wackestone/packstone and subtidal oncoidal and peloidal packstone/wackestone. The middle member is characterized by subtidal laminated microbial lime mudstone interbedded with skeletal and peloidal wackestone. This member represents basinal deposits of approximately 100 m in thickness. The rate of sea level rise was greatest during the deposition of these beds, and the middle member represents maximum transgression of Smackover carbonates. Thrombolite dominated build-ups occur in the upper part of this unit. The

upper member includes a succession of shallowing-upward cycles. The cycles consist of lagoonal and intertidal lime mudstone/wackestone at the base and shoal and shoreface peloidal, oncoidal and ooid grainstones/packstones at the top. Individual cycle thickness ranges from less than 5 m to more than 15 m. This unit is overlain by lagoonal anhydrite beds.

For the West Appleton area being positioned on a basement paleohigh, Smackover stratigraphy is different (Mancini & Parcell, 2001) (Text-fig. 2). The lower member is not present and the facies of the middle member is essentially represented by the thrombolite facies on paleohighs and subtidal lime mudstone and wackestone off-structure seaward and lagoonal lime mudstone and wackestone off-structure landward, rather than the basinal microbial lime mudstone facies.

The material described here derives from a thrombolite interval of the middle member in the West Appleton area. Baria *et al.* (1982) describe several reef types of the Smackover Formation (see also Kopaska-Merkel & Schmid, 1999; Leinfelder *et al.*, 2002). These reefal buildups with a thickness of 3 to 45 m are mostly dominated by thrombolite boundstones, stromatolites and "*Tubiphytes*" *morronensis*, but locally important reef builders are corals as well as lithistid and hexactinellid sponges (Baria *et al.*, 1982; Parcell, 2003). Regarding the palaeoenvironment of *Trinocladus? americanus* n. sp., it can be noticed that this species must have grown within the photic zone under low to moderate energy conditions.

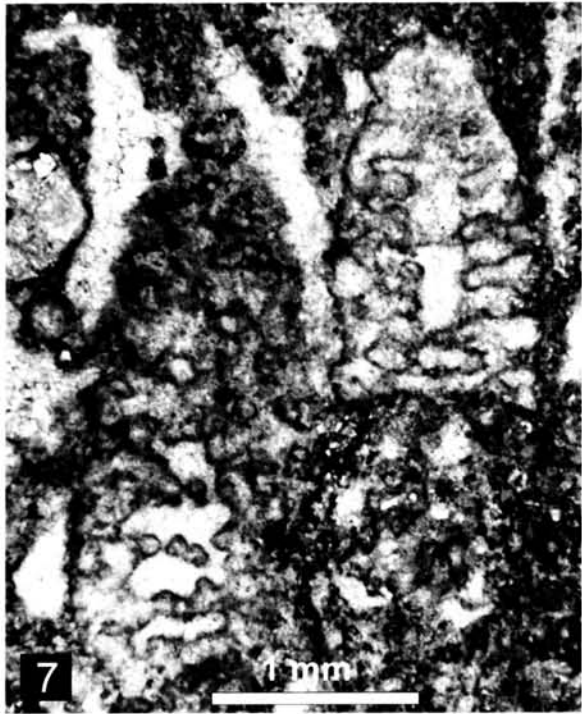
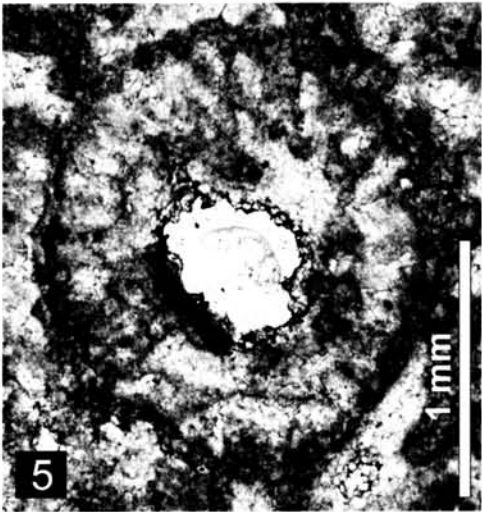
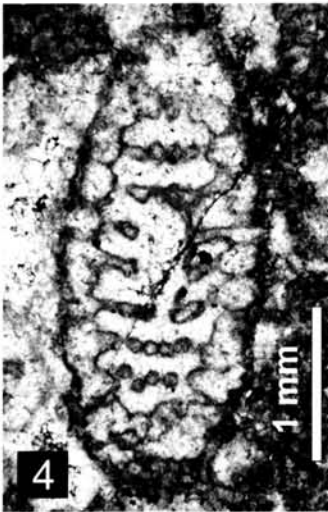
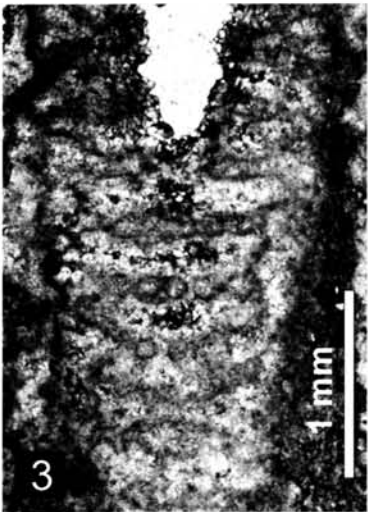
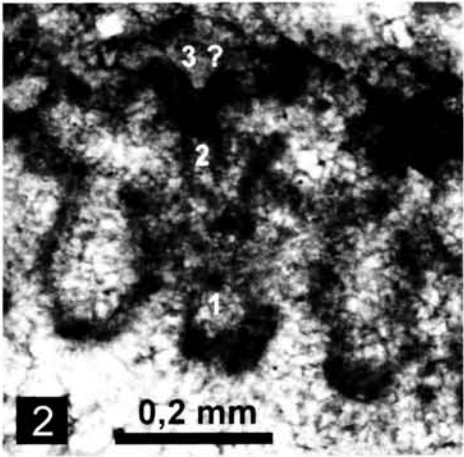
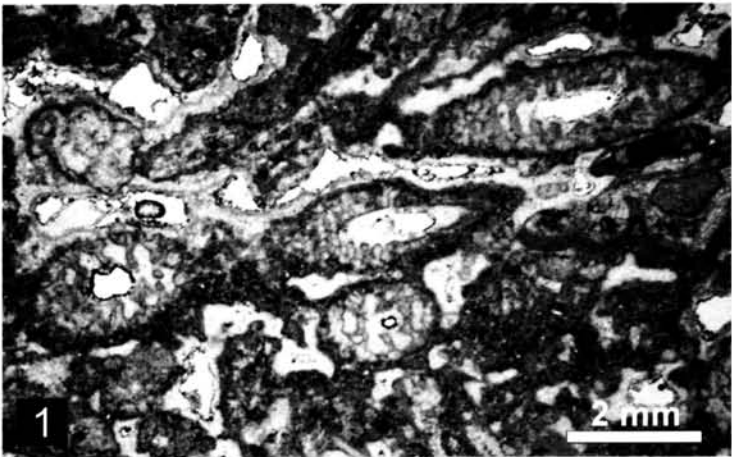


Text-fig. 1 – Location of West Appleton Field, Escambia County, Alabama.

EXPLANATION OF PLATE 1

Figs. 1-7 – *Trinocladus? americanus* n. sp., Upper Jurassic Smackover Formation of Alabama, USA.

- 1) Microfacies with abundant thalli, mostly oblique cutted; note the inter- and intraparticle porosity;
- 2) Detailed view of different orders of laterals (1-2, ?3);
- 3) Longitudinal-tangential section showing close-set primaries within a whorls. The latter are clearly separated from each others;
- 4) Oblique section, holotype;
- 5) Transverse section, slightly oblique. Note the porosity of the dasycladale main axis;
- 6) Various oriented sections;
- 7) Detail from 6. Tangential section (left) and longitudinal oblique section (right).



MICROPALAEONTOLOGICAL DESCRIPTION

Order DASYCLADALES Pascher, 1931
Genus TRINOCLADUS Raineri, 1922

TRINOCLADUS? AMERICANUS n. sp.
Pl. 1, figs 1-7

Derivatio nominis – The species name refers to the occurrence of the new species in North America.

Material – One thin-section containing more than 20 specimens, most of them cut longitudinal or oblique.

Holotype and depository – Tangential-oblique section, figured as plate 1, fig. 4, thin-section BSP 2002-I-25. The holotype (BSP 2002-I-25), together with the illustrated paratypes in the same slide, is stored at the „Bayerische Staatssammlung für Paläontologie und Geologie“, München.

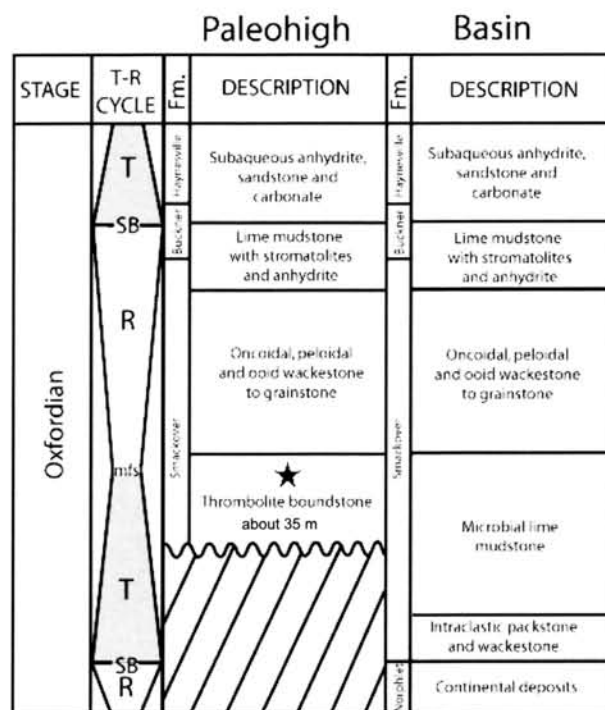
Type-locality – P.H. Gallagher 16-3 No. 1 Well (Permit No. 5757), West Appleton Field, Escambia County, Alabama (see Text-fig. 1).

Type-stratum – Dolomitized wacke- to packstone of the Smackover-Formation (middle member) containing abundant thalli of *Trinocladus? americanus* n. sp. Besides one gastropod section, no other microfossils have been detected.

Diagnosis – Comparably large dasycladale with small main axis and high number of thin elongated primaries perpendicular to the latter, bearing secondaries of comparable shape at their distal endings. The laterals are well separated from each others along the axis. The existence of third order laterals is possible.

Description – The strongly recrystallized thalli are cylindrical with a comparable small main axis. The numerous primaries arranged perpendicular to the latter, are elongated slightly swollen and well separated from each others in longitudinal sections (Pl. 1, figs 4, 7). Within a whorl, however, they are close-set accommodating adjacent to each others (Pl. 1, fig. 5). In some cases, individual laterals may occur slightly above or below the vertical plane (Pl. 1, fig. 4, lower part). Cross-sections of the primaries are circular in shape. In longitudinal section, it can be seen that two tubular secondaries arise at the distal end of the primaries. It seems that the secondaries are widening distally, another possibility would be the existence of third order laterals each again splitting into two tertiary (Pl. 1, fig. 2).

NE GULF OF MEXICO



Text-fig. 2 – Stratigraphy, facies development and Trans-/Regressive cycles ("T-R Cycle") of the Smackover Formation in the NE Gulf of Mexico. The approximate occurrence of *Trinocladus? americanus* n. sp. is marked with an asterisk.

Dimensions

Thallus diameter (D): 1.2 mm – 1.68 mm
(mean = 1.49 mm)
Main axis diameter (d): 0.28 mm – 0.76 mm
(mean = 0.54 mm)
Ratio d/D: 0.27 – 0.47 (mean = 0.4)
Verticil spacing (h): 0.48 mm – 0.52 mm
w: 15 – 20 (estimated)
w': at least 4 (maybe more)

Remarks – First of all it should be noted, that the material from the Upper Jurassic Smackover Formation is quite poorly preserved showing a Dasycladale with primary and secondary branches. The existence of tertiary branches in our specimens cannot be excluded pointing to the genus *Trinocladus* Raineri, 1922 indicated as follows: "*Trinocladus* is distinguished by the following features: cylindrical, club-shaped external form, primary, secondary and tertiary branches calcified, set in whorls, trichotomic partition, primary branches swollen and probably acting as sporangia" (Bassoulet *et al.*, 1978, p. 281). On the other side we also have to face the possibility that calcite crystals protruding from outside into the distal thallus wall only pretend the existence of higher order laterals. Another point to mention is the shape of the laterals of *T.? americanus* n. sp. being elongated and gradually widening and therefore not directly comparable to the definition provided by

Bassoullet *et al.* (1978). However, Dieni *et al.* (1985, pp. 23-24) remark certain differences in the branch morphology of *Trinocladus* at the species level.

Another possibility is the interpretation of the primaries of *T. americanus* n. sp. as sterile branches and the assumption of the existence of fertile laterals corresponding to the void spaces between the former (pers. comm. Prof. Ioan Bucur). Such an interpretation would, for example, be in conformity with the shape of the primaries of the American specimens, not showing a pronounced widening or swelling that can be expected in fertile laterals. This type of internal thallus organization is known from the genus *Conradella* Masse & Bucur. In the emendation of the type-species *Conradella bakalovae* (Conrad & Peybernes, 1978) from the Lower Cretaceous of the Carpatho-Balkan region, Masse & Bucur (2002) illustrated a specimen on plate 1, fig. 5 displaying a lack of calcification between the fertile ampullae showing a similar appearance to our recrystallized specimens. Thus, the strong recrystallization of the specimens from the Smackover Formation could mask the existence of these fertile ampullae. The genus *Conradella* is so far only known from the Lower Cretaceous.

In conclusion, we rather tentatively refer our specimens to the genus *Trinocladus* awaiting better preserved specimens either to validate our designation or to provide an emended diagnosis and description.

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