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Pediastrum Species and Others Coccal Green Algae from Butmah Formation in Borehole Kand-1 Northern Iraq

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ABSTRACT

The coccal green algae of Butmah Formation in borehole Kand-1 northern Iraq were studied from spore and pollen slides as NPP(Non pollen palynomorphs) by analyzing three samples. Three varieties of the common species *Pediastrum simplex* and the species *Coelastrum reticulatum* were identified and described for the first time from the Triassic rocks in Iraq. The paleoecological value of the genera *Pediastrum* and *Coelastrum* as a freshwater indicators shed light on the deposition of Butmah Formation which could have been caused by freshwater influxes of the Triassic rivers in the lagoon were the Formation is deposited.

Key words: *Pediastrum,* Butmah Formation, Kand-1 Northern Iraq

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INTRODUCTION

Upper Triassic (Norian) rocks of Butmah Formation were recorded in borehole kand-1 between depths (3100-3040)m. The location of this well is shown in Fig1. and the stratigraphic section studied is shown in Fig.2. The Butmah Formation is first described by(1) from well Butmah -2 in the Foothill zone of North Iraq (Since Butmah Formation has no outcrop section , and known only from the penetrated wells). (2) redescribed the formation as lithologically heterogeneous with a thickness of (500)m. in the type section. The upper (200)m. consist of oolitic and detrital limestone with beds of argillaceous limestone, shale and anhydrite. Whereas middle part of the formation (180)m. is oolitic, argillaceous and dolomitic with sandstone and shale beds. The lower part (120)m. is composed of limestone with bedded anhydrite. The lithofacies and faunal assemblages indicate that Butmah Formation has been deposited in shallow lagoonal and sabkah environment. The formation is overlained and underained by Adayah and Baluti Formations successively.

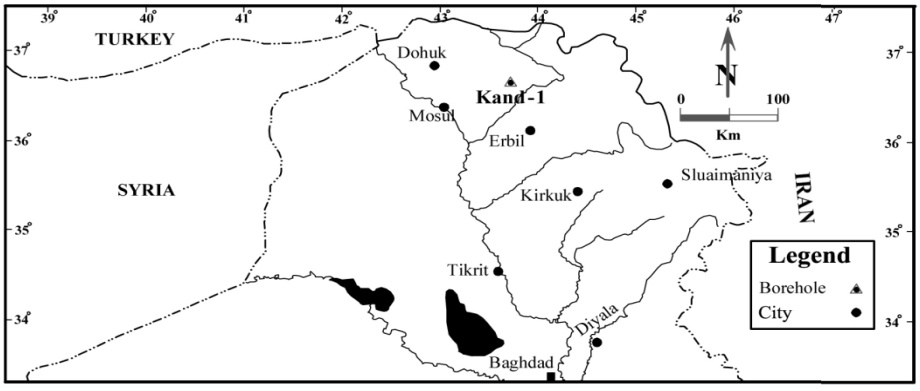

Fig.1: Location map of Butmah Foramtion in borehole Kand-1

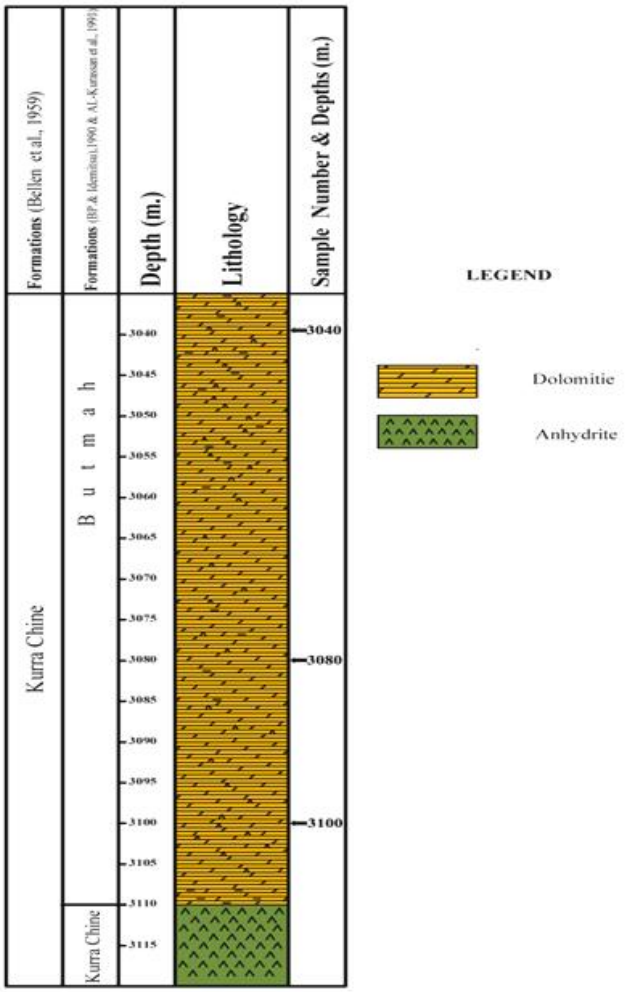

Fig.2: stratigraphic section of Part of Butmah Foramtion in borehole Kand-1

The spore and pollen slides prepared from Butmah Formation contain a considerable percentage of green algae especially the genus *Pediastrum*, these remnant of sporopollenin cell wall turn our attention to study them to complete the picture of Butmah Formation palynomorphs.According to [3] *Pediastrum* genus can be used as a bioindicater for paleoecological reconstruction because (1) it is abundant in freshwater lakes and wetland and is often found in high concentration in sediments cores; (2) It survives the harsh chemical treatment of pollen preparation , and can there be analyzed along with pollen; (3) It is globally distributed ; and (4) It can be resolved to species , and often subspecies level with the use of light microscopy. Despite these strength, the full potential of *Pediastrum* as a paleoenvironmental proxy has remained unexplored.

***Pediastrum* (Meyen) 1829:**

From: Greek Pedion= Plain
Astron=Star

Pediastrum is a colonial, free floating (Plankton), plate like, microscopic alga. The coenobia of the genus is flat, circular commonly comprising between 4 and 128 cells or coenocysts depending on the species.

Pediastrum spcecies are thought to have existed since the Early Cretaceous [4]; [5]), but the majority of those described have recorded from Cenozoic deposits where it is also most commonly encountered. [6] ,

Wilson and Hoffmeister [7] and Borge and Erdtmann [8] were among the first to document *Pediastrum* species in fossil assemblages. In Italy [9] recorded *Pediastrum* species from Late Triassic – Early Jurassic of the Lombardy Basin. Also [10] found *Pediastrum* from Carnian -Norian age form borehole 6610/ 7-2 in Norway.

The aim of this contribution is to review the fossil record of *Pediastrum* in Butmah Formation. Identification of the illustrated specimens and some interpretation about the depositional condition of the sedimentary basin containing the *Pediastrum* are discussed.

SYSTEMATIC STUDY

The phytoplanktonic algal flora of Butmah Formation was studied by analysing 3 samples taken from borehole Kand-1 at depths (3l00, 3080, 3040) meter. The identification of species and varieties of *Pediastrum* based on the paper by [11], Which provide determination keys and detailed drawing explaining: 1. Morphology of cells; 2. Structure of coenobia and 3. Surface structure of sporopollenin layer.

Taxonomical description of *Pediastrum* species were determined on the basis of phenotypic morphological features such as: outline of cells; number of lobes and processi; depth of incisions in marginal cells and sculpture of cell wall. The identification of the majority of taxa with *Pediastrum* is relatively easy. It is of special importance that taxa of good indicative value are easily identifiable [12].

All observation were made using light microscopy under immersion(with focus level X1000).

Division: **Chlorophyta**
Class: **Chlorophyceae**
Order: **Neochloridales**
Family: **Hydrodictyaceae** Cohn, 1880.
Genus: ***Pediastrum*** Meyen, 1829.
Type species: ***Pediastrum duplex***

Pediastrum simplex Meyen, 1829.
(Description from Komarek and Jankovska, 2001, p.32-33,Figs.12A-F, Plate 7)

Coenobia more or less circular in outline, with or without holes, with 4-32(128) cells. Cells arranged usually in concentric circles, rarely spirally, sometimes forming one circle with one large central opening. Marginal cell always only with one conically narrowed lobe, terminating with long, narrow, cylindrical processus; the lobe situated in the middle of the outer margin of a marginal cell. Cell-wall is granular, near the cell-walls connecting with neighboring cells occur short, solitary, chimney-like rosettes, larger than those from the cell surface.
Notes: This is variable species with many recent infraspecific taxa and many described ecomorphs.

Pediastrum simplex Meyen var.***simplex*** Komarek, 1983.
Pl.1 **, Figs.**1-10
(Description from Komarek and Jankovska, 2001, p.32, fig.12A)

Coenobia always with distinct and usually regularly disposed holes, which can be smaller or larger than the cell diameter cell-wall granulation distinct, regular.
Jena and Adhikary, 2007, p.172,pl.1, fig.11, gave the following description:

Coenobia circular, 8-16 celled coenobia up to 80-85 µm in diameter; large intercellular spaces or a central space with the cells arranged in a ring at the periphery, inner side of marginal cells concave, outer surface prolonged into a single delicately tapering process, sides of marginal cellsconcave or straight, internal cells similar to marginal cells with shorter process, cell wall smooth; chloroplast single and parietal; cells 12-15 µm broad and 20-25 µm long.

Pediastrum simplex Meyen var.***biwaense*** Fukushima, 1953.
Pl.2 **, Figs.**1-4
(Description from Komarek and Jankovska, 2001, p.34, fig.12F)

Coenobia always with holes, the diameter of which is larger than the diameter of cells; lobes of marginal cells narrow, always two neighbouring ones arcuate one to another; granulation very fine.

Jena and Adhikary, 2007[13], p.171,pl.1, figs.6,7, gave the following description (Coenobia 16-32 or more celled, circular large intercellular spaces or a single central spaces with the cell arranged in a ring at the periphery, inner face of the marginal cells concave, outer face prolonged into a single tapering processes, side of marginal cells concave or nearly straight; inner cells simaller to marginal cells but short in processes; cell wall smooth or slightly punctate.

Pediastrum simplex Meyen var.***sturmii*** (Reinsch) Wolle,1887.
Pl.2 **, Figs.**5-8
(Description from Komarek and Jankovska, 2001, p.34, fig.12D)

Coenobia with small, usually irregular holes, which are usually smaller than the cell diameter, or completely with out holes, lateral side of lobes in old coenobia distinctly concave; cell wall granulation regular, very fine.
Jena and Adhikary, 2007, p.172, pl.1, fig.12, gave the following description:

Coenobia 8-16 celled, inner side of marginal cells nearly straight, outer side produced into a gradually tapering process, sides concave, cells polygonal, cells in contact with adjacent cells without intercellular spaces; chloroplast single and parietal, cell wall smooth, cells 5-13 µm broad and 20-30 µm long.

Family: **Coelastraceae** Wille, 1909
Genus: ***Coelastrum*** Nägeli, 1849
Type species: ***Coelastrum sphaericum*** Nägeli, 1849.

Coelastrum reticulatum (Dangeard) Senn, 1899.
Pl.2 **, Figs.**9-13

Description: Coenobia spherical, 8-32 celled, 30-70µm in diameter; cells spherical, enclosed by a gelatinous sheath, cells interconnected by 6-9 long gelatinous processes; chloroplast single without pyrenoid; cells 7-15 µm in diameter.
Jena and Adhikary, 2007, p.177, pl.3, fig.7, gave the following description:
Coenobia spherical, 8-16-32 celled, 30-70 µm diameter; cells spherical, enclosed by a gelatinous sheath, cells interconnected by 6-9 long gelatinous processes; chloroplast single, parietal, without pyrenoid; cells 7-15 µm diameter.

PALEOECOLOGY

Algae and their remnant sporopollenin cell wall are common and important component of spores and pollen slides of Butmah Formation. Recently much attention has been devoted to the so-called "extra fossils" in pollen analytical research (Komarek & Jankovska, 2001) [(11)].

The fossil ceonobia of the green algae in the Butmah slides is mostly belong to the genus *Pediastrum* with few specimens belong to the genus *Coelastrum*. Fossil *Pediastrum* seem to have been most abundant in tropical to subtropical, permanent low salinity (Stenohaline) lakes. An association with dysoxic-anoxic eutrophic lakes is also apparent (Tyson, 1995) [(14)] .

The recent genus *Pediastrum* contains only freshwater species.

Commen *Pediastrum* species (*Pediastrum simplex*) are usually ecologically classified as indicator of oligo- to β-mesosaprobic water (unpolluted to low polluted with much dissolved oxygen).

Komarek and Jankovska, 2001 [(11)] found that assemblages of *Pediastrum* species are characteristics for warmer and higher nutrient loading (mesotrophic to eutrophic) lakes, usually found in lowland to not very high mountainous regions.

Pediastrum speciemens in the Upper Triassic sediments of Butmah Formation could have been caused by freshwater influxes of the Triassic rivers in the lagoon where the formation is deposited.

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Note:
All photograph in the plates are from borehole Kand-1.
R: Label of the slide is to the right hand side.
L: Label of the slide is to the left hand side.

PLATE 1

Fig.1: ***Pediastrum simplex Meyen*** var.***simplex*** / 3080(3)/ R.4.6, 122/Size:39µm.
Fig.2: ***P. simplex Meyen*** var.***simplex*** / 3080(3)/ R.8.2, 124.3/Size: 40µm.
Fig.3: ***P. simplex Meyen*** var.***simplex*** / 3040(1)/ R.0.3, 131.1/Size: 35µm.
Fig.4: ***P. simplex Meyen*** var.***simplex*** / 3100(3)/ L.9.7, 125.1/Size: 40µm.
Fig.5: ***P. simplex Meyen*** var.***simplex*** / 3080(2)/ R.0, 130.5/Size: 41µm.
Fig.6: ***P. simplex Meyen*** var.***simplex*** / 3080(2)/ R.7.8, 127.6/Size: 55µm.
Fig.7: ***P. simplex Meyen*** var.***simplex*** / 3040(3)/ R.2.7, 126.3/Size: 28µm.
Fig.8: ***P. simplex Meyen*** var.***simplex*** / 3080(1)/ R.4.7, 126.1/Size: 41µm.
Fig.9: ***P. simplex Meyen*** var.***simplex*** 3040(1)/ L.11.1, 132/Size: 50µm.
Fig.10: ***P. simplex Meyen*** var.***simplex*** 3040(3)/ R.9.4, 124.3/Size: 25µm.

PLATE 2

Fig.1: ***Pediastrum simplex*** Meyen var.***biwaense***. / 3080(3)/ R.0, 126.9/Size:40µm.
Fig.2: ***P. simplex*** Meyen var.***biwaense***. / 3100(4)/ R.11.4, 124.6/Size:80µm.
Fig.3: ***P. simplex*** Meyen var.***biwaense***. 3080(3)/ R.0, 126.9/Size:40µm.
Fig.4: ***P. simplex*** Meyen var.***biwaense***. / 3080(2)/ R.6.9, 121.6/Size:120µm.
Fig.5: ***Pediastrum simplex*** Meyen var.***sturmii*** 3100(3)/ R.7.3, 133.8/Size:50µm.
Fig.6: ***P. simplex*** Meyen var.***sturmii*** / 3100(4)/ R.4.3, 129.4/Size:60µm.
Fig.7: ***P. simplex*** Meyen var.***sturmii*** / 3080(3)/ L.3.4, 110.4/Size:48µm.
Fig.8: ***P. simplex*** Meyen var.***sturmii*** / 3080(1)/ L.4.7, 126.1/Size:62µm.
Fig.9: ***Coelastrum reticulatum*** / 3080(2)/ L.3.6, 124.9/Size:27µm.
Fig.10: ***C. reticulatum*** / 3080(2)/ R.3, 123.2/Size:28µm.
Fig.11: ***C. reticulatum*** / 3040(4)/ R.9.4, 128.4/Size:25µm.
Fig.12: ***C. reticulatum*** / 3100(4)/ L.0, 126.2/Size:26µm.
Fig.13: ***C. reticulatum*** / 3040(1)/ L.5.3, 128/Size:27µm.

PLATE 1

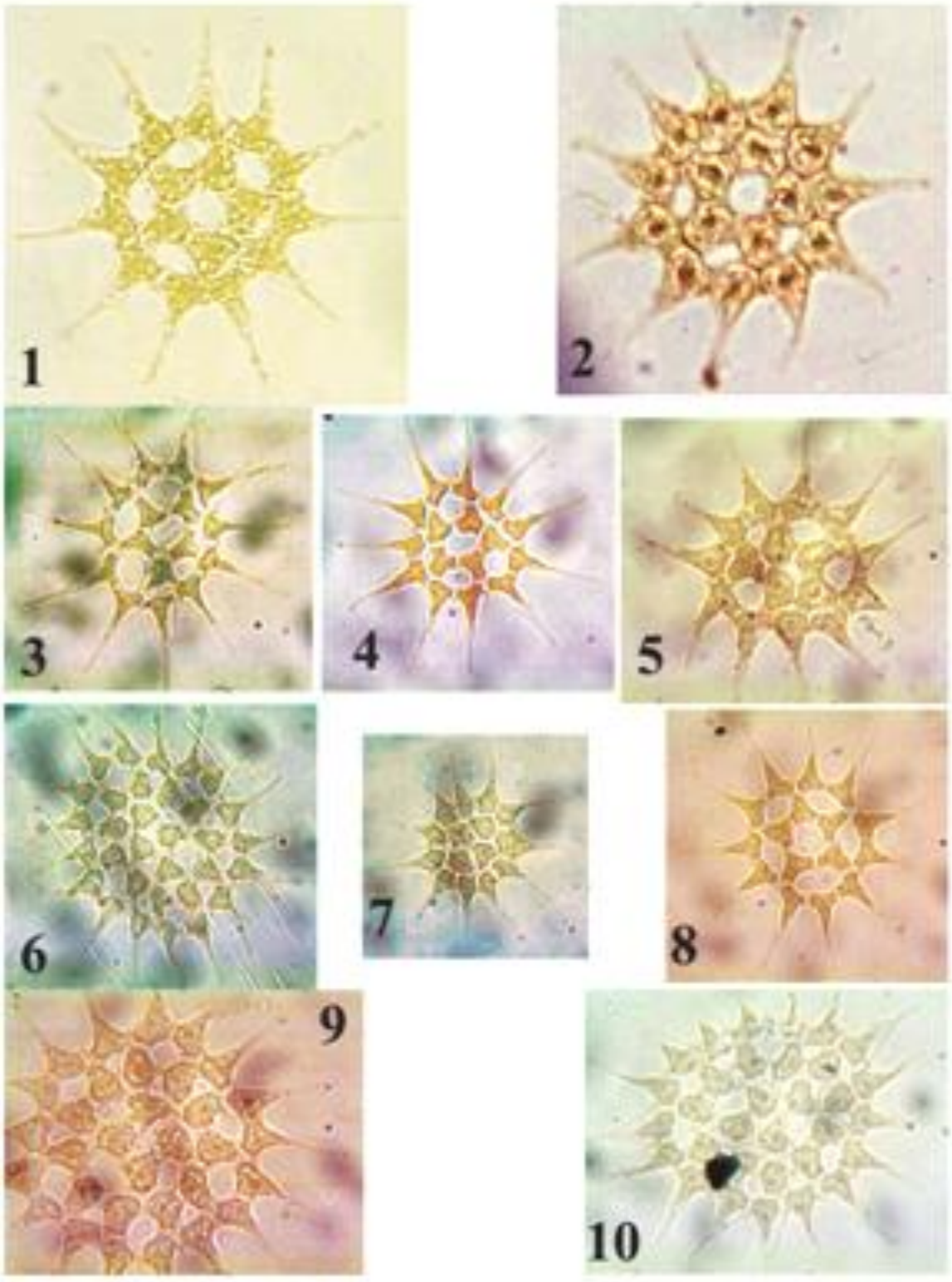

PLATE 2