Zeitschrift: Eclogae Geologicae Helvetiae
Herausgeber: Schweizerische Geologische Gesellschaft
Band: 68 (1975)
Heft: 2

Artikel: Imperiella gen. nov., a new Alga from the Ruteh limestone, Upper Permian (Central Alborz Mountains, North Iran)
Autor: Elliott, Graham F. / Süssli, Peter
DOI: https://doi.org/10.5169/seals-164396

Eclogae geol. Helv.	Vol. 68/2	Pages 449–455	3 figures in the text and 1 plate	Basle, July 1975

Imperiella gen. nov., a new Alga from the Ruteh Limestone, Upper Permian (Central Alborz Mountains, North Iran)

By GRAHAM F. ELLIOTT[1]) and PETER SÜSSLI[2])

ABSTRACT

A new section of the Ruteh Limestone, Upper Permian, is described and the conditions of deposition of its five subdivisions estimated. A new dasycladacean alga is described as *Imperiella iranica* gen. et sp. nov. This appears to show unusual branch-structure for these plants and seems not to have survived the Permo-Triassic extinction.

Introduction

A new alga was found during micropaleontological studies on thin-sections of samples collected in a section of the Ruteh Limestone about 3 km south of Emarat, near the Teheran – Amol highway, Lower Heraz Valley, North Iran (Fig. 1). The new alga is described by G. F. Elliott, field work was done by P. Süssli.

Stratigraphy

The studied section consists of mostly dark bioclastic limestone, partly with numerous concretions of black chert and interrupted by a thin detrital sequence in the upper part, subdivision *D* (Fig. 2). The lithology as well as the fossil content correspond well with the section described by several authors (type section: ASSERETO 1963; GLAUS 1965; STEIGER 1966 and others) from the Ruteh Limestone in the Central Alborz. Based especially on the stratigraphic variations of the fossil content, it is possible to divide the Ruteh Limestone in the Lower Heraz Valley into the following 5 subdivisions, from bottom to top (Fig. 2):

– the mostly detrital Dorud Formation (Lower Permian) is conformably overlain by:

A. (40 m) micritic to sparitic bioclastic limestone, with some argillaceous intercalations. Crinoids and bryozoans are predominant; calcareous algae locally common;

[1]) British Museum (Natural History), London, England.
[2]) Federal Institute of Technology, Zürich, Switzerland.

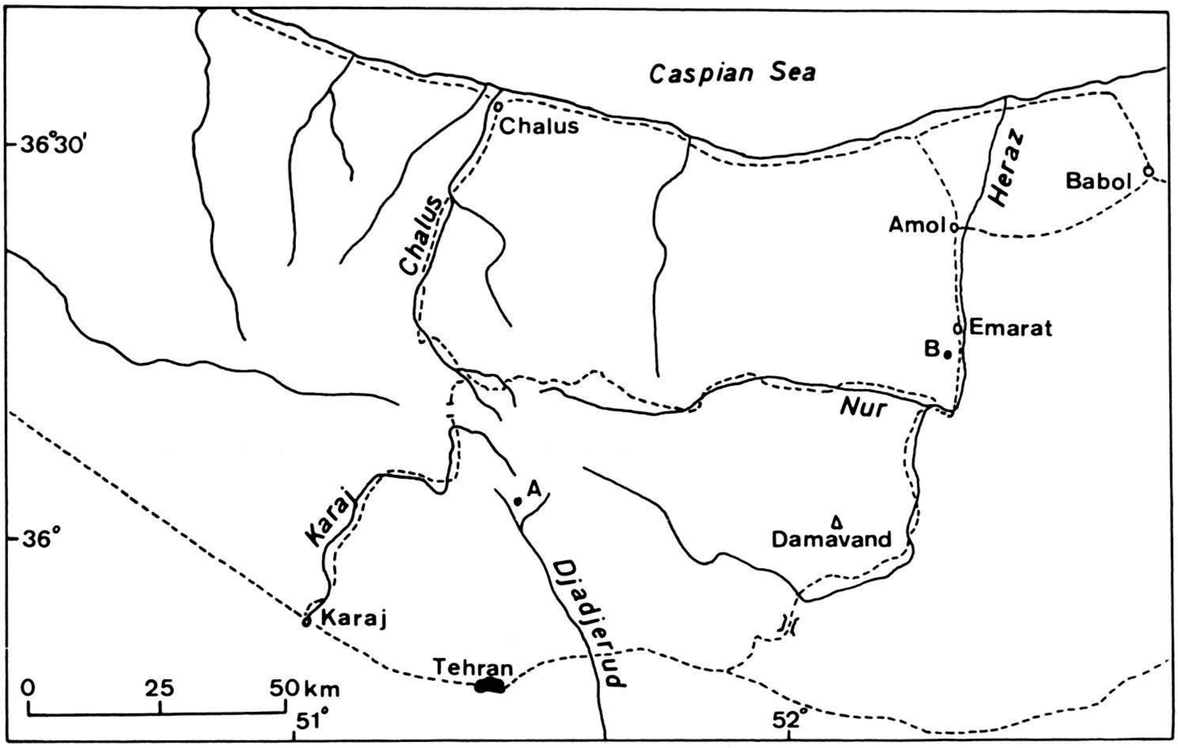

Fig. 1. Position of the described section (B); type section ASSERETO 1963 (A).

the abundant algal structures are oncolitic and allochthonous. Shallow shelf conditions prevailed during the sedimentation of this subdivision.

B. (10 m) micritic biogenic limestone with rare argillaceous intercalations. Autochthonous platy algal structures are predominant apart from a few intercalated bryozoans, other fossils are missing. Restricted shelf (possibly intertidal) conditions prevailed.

C. (420 m) micritic to sparitic bioclastic limestone, partly with argillaceous intercalations and concretions of black chert. Calcareous algae are predominant; crinoids and bryozoans are locally common to abundant. Shallow shelf conditions prevailed.

D. (30 m) argillaceous shale, claystone, siltstone and slightly calcareous sandstone, with some intercalations of sandy bioclastic limestone. Indeterminate vegetable remains are common in the siltstone; calcareous algae, crinoids and ostracods are rare to common in the sandy limestone. Near-shore conditions with continental influences prevailed.

E. (190 m) micritic to slightly sparitic bioclastic limestone, with argillaceous intercalations and in the upper part with concretions of black chert. Ostracods are predominant; crinoids and bryozoans locally common; calcareous algae rare. A shallow open shelf environment is indicated.

Brachiopods, gastropods, corals, fusulinids and other, small foraminifera are irregularly present in the subdivisions *A*, *C* and *E*. A karst erosional surface occurs on the top, which is overlain by lateritic rocks, formed under humid-tropical condi-

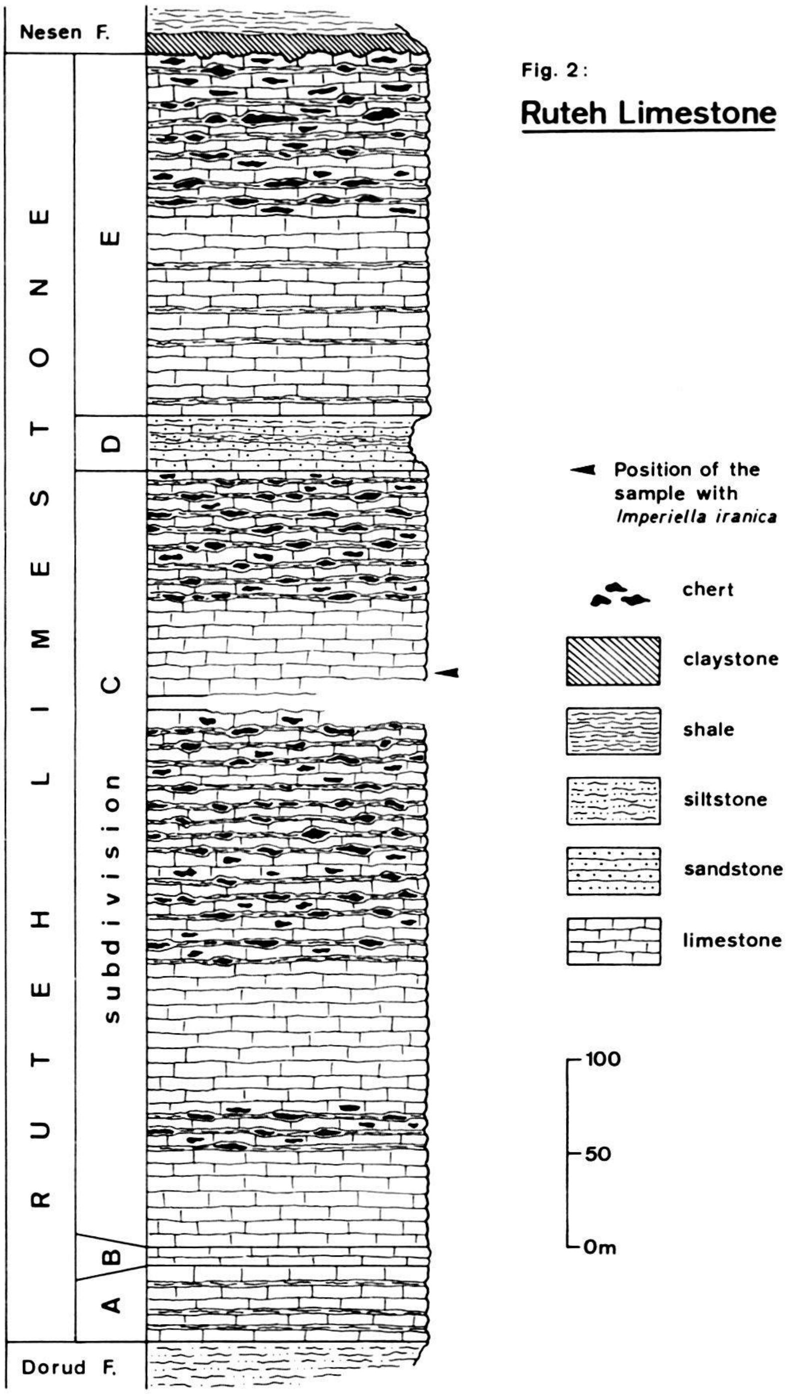

Fig. 2. Ruteh Limestone.

tions and which correspond to the basal beds of the Nesen Formation (Upper Permian).

The notable increase in thickness from the southern to the northern flank of the Alborz is typical for the Upper Paleozoic (STEPANOV, GOLSHANI & STOECKLIN 1969).

The fauna known from the Ruteh Limestone in the Central Alborz (including also the Lower Nesen Formation of GLAUS 1965) belongs to the Upper Darwasian – Lower Murghabian, or to the *Parafusulina* – lower *Neoschwagerina* zones (FLUEGEL

1964; FANTINI-SESTINI 1965; STEPANOV, GOLSHANI & STOECKLIN 1969 and STOECKLIN 1971).

Paleontology

A new and conspicuous dasycladacean alga was revealed in the thin-sections of Ruteh Limestone: this is now described and its position in dasycladacean evolution discussed.

Chlorophyceae (Green Algae)

Family *Dasycladaceae* KÜTZING orth. mut. HAUCK 1488

Genus *Imperiella* gen. nov.

Diagnosis

Cylindrical calcareous dasycladacean tube showing verticils of thinly calcified branches highly compressed adjacent to the stem-cell cavity and dividing outward to the fourth degree. Permian of Iran. Type-species *Imperiella iranica* sp. nov.

Imperiella iranica sp. nov.

Pl. I

Diagnosis

Imperiella of estimated 40 mm length or more, external diameter about 4.0 mm, d/D ratio about 20%, calcification thin relative to original plant structures, so giving a spongy or lattice structure.

Description

The species is known from random cuts in thin-section; the external diameter of the adult calcified thallus is up to 4 mm, but only incomplete "lengths" are known. An estimated height for the living plant would be 40 mm or more.

The stem-cell is seen to be relatively narrow (about 20% of the external diameter) when clearly preserved: the calcification immediately adjacent is very thin and often missing, due either to solution during diagenesis or to original secretion failure due to the adpressed branch-systems. The thallus is regularly verticillate, with an estimated six branches per verticil: these branches do not apparently alternate in position as between successive verticils, unlike a majority of dasycladaceans. This condition is however known elsewhere e.g. the Cretaceous *Trinocladus tripolitanus* RAINERI (PIA 1936).

Each branch communicates with the stem-cell by a small pore, and then swells into a primary adpressed portion, rounded-rectangular in section, against the stem-cell. The pore is not central to the branch, but proximal relative to the stem-cell axis. This primary portion when traced outwards divides into four swollen-cylindrical "secondaries", and these each into two or more "tertiaries" similar in form. These in turn form two "quaternaries" each (not apparently more). These each narrow to a small rimmed orifice; they have a pinched and spaced appearance compared with the earlier crowded and swollen branches. It is noticeable that, after the stem-cell pore, each branch passes into its successive divisions without the constrictions at the points of initiation of new divisions which are seen in most dasycladaceans [cf. the Jurassic *Palaeodasycladus* (PIA 1920)]. This suggests that the whole branch is one structure, though it has been convenient to use the conventional terminology for the sub-structures. This point is further discussed below.

Within the clear calcite filling of the former plant-filled branches, dark organic matter is confined to the outer portions of the branch-systems, particularly filling the quaternaries. It is often concentrated into distinct separate pellets suggesting sporangial structures. If this is a correct interpretation, then *Imperiella* was already cladospore (like most Mesozoic genera). The interpretation of this relative to the branch-detail is discussed below.

The dimensions (in mm) and detail of one typical example of *Imperiella iranica* are:

External diameter of calcified thallus		3.84
Internal diameter		0.686
d/D		18%
Distance between verticils		1.19
Diameter of pore between stem-cell and "primary"		0.137–0.206
"Primary";	dimension parallel to axis of stem-cell	0.96–1.12
	dimension outward from stem-cell	0.48–0.57
"Secondary";	length	0.48
	diameter	0.39
"Tertiary";	length	0.46
	diameter	0.274–0.320
"Quaternary";	length	0.22 or less
	diameter (swollen part)	0.16
	diameter (termination)	0.069–0.092
"Sporangium";	diameter	0.070–0.080

Syntypes

The specimens figured in Plate I, Figures 1–3, from the Ruteh Limestone (subdivision *C*), Upper Permian, near Emarat, Lower Heraz Valley, Elburz, N. Iran. Reg. nos. V.57669, V.57670, V.57671 [British Museum (Natural History) Dept. Paleontology; London].

Other material

Various random sections, same locality and horizon.

Discussion

Imperiella is a very distinctive alga, particularly when compared with other members of the Permian microflora. The thin spaced calcification gives it a noticeable lace-like or "crowded-bubble" pattern in thin-section. The compressed box-like form of the "primary" portion of the branch is slightly reminiscent of the much more heavily calcified Paleocene *Broeckella* (MORELLET 1922), where however traces of the outer branchlets show only as pores. In *Imperiella* the swollen outer subdivisions of the branch are somewhat like the Jurassic *Palaeodasycladus* in proportions. Of Permian Dasycladaceae, *Sinoporella* (YABE 1949) is similar in size and thin calcification, but the branch-structure, and stem-cell proportions, are different.

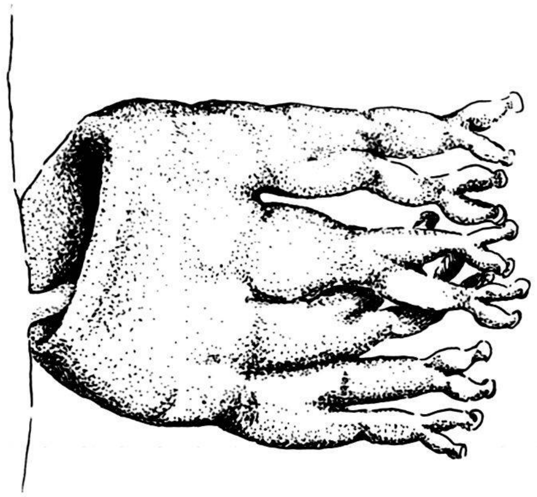

Fig. 3. Reconstruction of a single living radial branch, freed from the aragonitic surround, in a verticil of a full-grown *Imperiella*. The inner portion of the branch may in life have been closely adpressed to the stem-cell wall (left) and the connection (represented fossil by a pore in the calcification when present) shorter than as shown. The branchlets (right) were often closely adjacent both to each other and to those of neighbouring branches of the same and adjacent verticils.

The lack of constrictions between the different branchlets in *Imperiella* is however most distinctive. It suggests strongly that each "branch-system" is in fact a single branch of peculiar form, and that the swollen digitate structure represents a different achievement, by a fast-growing juicy green alga, of the morphological diversity so characteristic of the Dasycladaceae. If, as seems likely, the sporangial contents are preserved at the terminal branchlets, then it seems possible that *Imperiella* shed its reproductive elements during life. In this way the typical dasycladacean evolution from cladospory to choristospory, with post-mortem or pre-regeneration liberation of encysted spores, was not reached and not necessary. The living *Dasycladus* is exceptional in its family in liberating free gametes; this characteristic is believed to have evolved long after the Mesozoic acme of the family, even if the Paleocene *Pagodaporella* (ELLIOTT 1968) was ancestral to *Dasycladus*.

Presumably *Imperiella* became extinct, with so much else, at the end of the Permian. Other surviving dasycladaceans accounted for the familiar post-Paleozoic evolution and decline of the family. But had *Imperiella* survived and its descendants evolved, the whole Post-Paleozoic history of the family might have been different. The reproductive disability of dasycladaceans in competition with codiaceans (ELLIOTT 1968, 1972) would not have obtained, and in favourable environments such as present-day atoll lagoons, dasycladaceans might have been as abundant as they once were in the Triassic and as the codiacean *Halimeda* actually is now.

Acknowledgments

The authors are indebted to Professor Dr. A. Gansser (Zürich), to N. Khadem, Director of the Geological Survey of Iran, to Dr. J. Beckmann (Zürich) and to the Swiss Service for Technical Cooperation for their aid and encouragement.

REFERENCES

ASSERETO, R. (1963): *The Paleozoic Formation in Central Elburz (Iran) (Preliminary Note).* – Riv. ital. Paleont. *69*/4, 503–543.

ELLIOTT, G. F. (1968): *Permian to Palaeocene calcareous algae (Dasycladaceae) of the Middle East.* – Bull. brit. Mus. nat. Hist. (Geol.), Suppl. *4.*

– (1972): *Lower Palaeozoic Green Algae from southern Scotland, and their evolutionary significance.* – Bull. brit. Mus. nat. Hist. (Geol.) *22*/4.

FANTINI-SESTINI, N. (1965): *The geology of the Upper Djadjerud and Lar Valley (North Iran).* II. Paleontology: *Bryozoans, Brachiopods and Molluscs from the Ruteh Limestone (Permian).* – Riv. ital. Paleont. *71*/1, 13–108.

FLUEGEL, H. (1964): *The geology of the Upper Djadjerud and Lar Valleys (North Iran).* II. Paleontology: *Permian Corals from the Ruteh Limestone.* – Riv. ital. Paleont. *70*/3, 403–444.

GLAUS, M. (1965): *Die Geologie des Gebietes nördlich des Kandevan-Passes (Zentral-Elburz), Iran.* – Mitt. geol. Inst. ETH u. Univ. Zürich [N.F.] *48.*

MORELLET, L. & J. (1922): *Nouvelle contribution a l'étude des dasycladacées tertiaires.* – Mém. Soc. géol. France (Paléont.) *47.*

PIA, J. (1920): *Die Siphoneae Verticillatae vom Karbon bis zur Kreide.* – Abh. zool. bot. Ges. Wien *11*/2.

– (1936): *Calcareous green algae from the Upper Cretaceous of Tripoli (North Africa).* – J. Paleont. (Chicago) *10,* 3–13.

STEIGER, R. (1966): *Die Geologie der West-Firuzkuh-Area (Zentral-Elburz, Iran).* – Mitt. geol. Inst. ETH u. Univ. Zürich [N.F.] *68.*

STEPANOV, D. L., GOLSHANI, F., & STOECKLIN, J. (1969): *Upper Permian and Permian-Triassic Boundary in North Iran.* – Rep. geol. Surv. Iran *12.*

STOECKLIN, J. (1971): *Stratigraphic Lexicon of Iran.* Part I: *Central, North and East Iran.* – Rep. geol. Surv. Iran *18.*

YABE, H. (1949): *A new fossil Dasycladaceae from the Lower Permian of China.* – Proc. Japan Acad. *25,* 61–63.

Plate I

Imperiella iranica gen. et sp. nov. – Thin-sections × 15 approx.

Fig. 1 Oblique section, showing stem-cell, detailed branch-structures at centre, and characteristic lacy pattern of branchlets at ends. Brit. Mus. (Nat. Hist.), Dept. Paleont., reg. No. V.57669.

Fig. 2 Transverse section; small artefact within stem-cell cavity. V.57671.

Fig. 3 Tangential-vertical section, to one side of stem-cell axis. V.57669.

All from Upper Permian Ruteh Limestone; Emarat, Alborz, Iran.

PLATE I