

FOSSIL ALGÆ FROM THE UPPER TAL SHELL LIMESTONE AND THEIR AGE IMPLICATION

PRABHA KALIA

DEPARTMENT OF GEOLOGY, UNIVERSITY OF DELHI, DELHI-110007.

ABSTRACT

A rich assemblage of upper Permian calcareous algae is described in this paper. These belong to the arenaceous upper Tal shell limestone exposed in the southern limb of Garhwal syncline in the lesser Himalayan zone near Dogadda. A total of fifteen species are recorded, out of these two are new. The assemblage indicates an upper Permian (Guadalupian) age for this horizon, here designated as *Gymn codium* zone.

INTRODUCTION

The expanse of the Tal formation as established by Middlemiss (1887) was extended and considered by Maithani (1972) include volcanic breccia and purple slates unit within upper Tals along with the Shell limestone and accompanied shales in Dogadda area (see Table 1). Kalia (1972) described upper Permian fusuline foraminifera namely, *Neoswagerina* cf. *crataculifera* (Schwager), *Rauserella* sp. and *Misellina* sp. from the upper Tal shell limestone from the following localities:

- (i) North of the Main Boundary fault on Dogadda-Kotdwar road near Haldwani bridge.
- (ii) West-South-West of Gajwar from the limestone quarry at Bansi (N 29 46' : E 78 39')!

The same horizon that yielded the fusulinid remains is characteristically rich in algae and bryozoa. In the present paper algal assemblage is being described. In spite of the indurated nature of the rock, abundance of algal fragments has enabled the author to obtain desired oriented thin sections of algal genera required for detailed study and specific determinations. The species recorded provide overwhelming support for the upper Permian (Guadalupian) age of the Shell limestone as suggested earlier on fusuline assemblage criterion.

Upper Tal in Dogadda area is biostratigraphically being classified into the following formal units (Table 1.)

Gymn codium zone: Oolitic shell limestone unit characterised by algae, fusuline foraminifera and cryptostome bryozoa.

Wentzelella zone: Shale unit characterised by corals, brachiopods and pelecypods.

List of the fossils recorded from the above mentioned zones is given below:

Gymn codium zone:

ALGAE:

Family Solenoporaceae

Parachaetes lamellatus Konishi, 1954

Family Gymnocodiaceae,

Gymn codium bellerophontis (Rothpletz) Accordi, 1956

Permocalculus ananti Kalia n. sp.

Family Dasycladaceae

Anthracoporella spectabilis Pia, 1926

Anthracoporella mercuri Elliott, 1968

Mizzia bramkampi Rezak, 1959

Pseudoepimastopora cf. *likana* (Kochansky & Herak) Elliott, 1968

Pseudovermiporella sodalica Elliott, 1958

Pseudovermiporella cylindrica Kalia n. sp.

Diplopora sp.

Velebitella triplicata Kochansky-Devide, 1964

Epimastopora sp.

Family Codiaceae

Hikorocodium eleganlae Endo, 1951

Hikorocodium aff. *transversum* Endo, 1957

Ortonella morikawai Endo, 1954

FORAMINIFERA:

Neoswagerina cf. *crataculifera* (Schwager)

Rauserella sp.

Misellina sp.

CRYPTOSTOME BRYOZOANS:

Wentzelella zone:

Wentzelella salinaria (Wager & Wentzel) Grabau in

Huang, 1932
Hustedia sp.
Derbya cf. *senilis*

PECTINIDS

Tiny gasteropods

Repository: Author's collection, Hypotype no. S2/3.2.

Genus *Permocalculus* Elliott, 1955

Permocalculus ananti n. sp.

(Pl. I—1)

SYSTEMATIC DESCRIPTION

Phylum Rhodophycophyta
Class Rhodophyceae
Order Cryptomiales
Family Solenoporaceae
Genus *Parachaetes* Deninger, 1966

Parachaetes lamellatus Konishi, 1954

(Pl.—3)

P. lamellatus Konishi, 1954, Japan Journ. Faculty Sci. Univ. Tokyo, sec. II, vol 9, pt. II, p. 236.

Remarks: The present specimen correspond well with the species described by Konishi, 1954 from the late Permian Kuma formation of southern Kyushu, Japan. Cells forming the tissue range 20-30 μ in width and 30-40 μ in height.

Repository: Author's collection, Hypotype no. II/1.13.

Family Gymnocodiaceae Elliot, 1955

Genus *Gymnocodium* Pia, 1920

Gymnocodium bellerophontis (Rothpletz) Accordi, 1956

(Pl. I, fig. 2)

G. bellerophontis (Rothpletz) Accordi, 1956, Pal. Soc. India, Journ. V. 1, no. 1, p. 82, 83.

Remarks: Segments of this species are quite common and measure up to 6.25 mm. in length and 2.0 mm. diameter; thickness of the wall ± 0.119 , maximum pore diameter in longitudinal section is 150 μ ; medulla does not show calcification.

Description: Thallus waxing and waning type with approximately equal bulge diameter, hollow with moderate calcification showing radial-oblique pores slightly expanding at the outer margin, length of the segment 7.05 mm., diameter 1.3 mm.; wall thickness 0.3 mm.; pore diameter 68 μ ; sporangia not observed.

Comparison and Remarks: This new species is similar to *P. pulmosus* Elliott 1955 described from the upper Permian limestone of northern Iraq but differs in the thickness of the wall, and all other dimensions. With other described species of *Permocalculus* the new species differs in possessing very long segments.

Etymology: The new species has been named after Professor Anant Gopal Jhingran, Honorary Director of the Wadia Institute of Himalayan Geology and Ex-Professor and Head of the Geology Department, University of Delhi, on whose instance this micropalaeontological investigation in Dugadda area was undertaken.

Repository: Authors collection, Holotype no. II/8.1.

Phylum Chlorophycophyta

Family Dasycladaceae

Genus *Anthracoporella* Pia, 1920

Anthracoporella spectibilis Pia, 1920

(Pl. I—4, 5; Pl. II—1, 2)

A. spectibilis Pia, 1920, Zool. Bot. Gesell. WienAbh., Vol. 11, no. 2, p. 15.

Remarks: This cosmopolitan species occurs in the material, measurements of the various sections are given below:

Specimen no.	Segment length	Stem Diameter		Wall thickness	d/D	Pore diameter
		outer	inner			
II/14.5 L.S. ..	4.33 mm,	1.15 mm.	0.7 mm.	p.35 mm	61%	0,034 mm.
II/3.3 TS.	2.0 mm.	35 pores in 1 mm, of wall.
II/13.1						
(a) L.S. ..	6.25 mm,					
(b) T.S.	2.55 mm,				
(c) L.S. (oblique) ..	4.2 mm,					

FOSSIL ALGÆ FROM THE UPPER TAL SHELL LIMESTONE AND AGE IMPLICATION

Table 1

TABLE OF CLASSIFICATION AND AGE ASSIGNMENT TO GARHWAL SUCCESSION

MIDDLEMISS (1887)	AUDEN (1937)	GANESAN (1972)	MAITHANI (1972)	RAVI SHANKAR DHAUN AND KAPOOR (1973)
NUMMULITIC LOWER TERTIARY	NUMMULITIC EOCENE	SUBATHU EOCENE	SUBATHU EOCENE	
TAL UPPER MESOZOIC LOWER	UPPER TAL UPPER CRETACEOUS LOWER JURASSIC	UPPER TAL Shell Limestone MESOZOIC Grity Quartzite	TAL UPPER Shell Lst, Shales, Slates. (Including boulder slate sequence). LOWER	UPPER CRET
MASSIVE LIMESTONE AGE UNKNOWN	KROL PERMIAN	KROL PERMO-TRIAS	KROL FORMATION	
			INFRAKROL	
PURPLE SLATES AND VOLCANIC BRECCIA AGE UNKNOWN	BOULDER SLATES URALIAN	VOLCANIC BRECCIA CARBONIFEROUS (Boulder slate sequence)	INCLUDED WITHIN TAL	BIJNI UPPER Ozt shale sandy lst. LOWER Grity Ozt Boulder sl sequence.
SCHISTOSE SERIES AGE UNKNOWN	NAGTHAT CHANDPUR Lower Palaeozoic to Precambrian DEVONIAN SCHISTOSE SERIES	SCHISTOSE PHYLLITE with LANSDOWNE GRANITE	NAGTHAT FORMATION CHANDPUR FORMATION	
			SIMLA SLATES	

Anthracoporella mercuri Elliott, 1968

(Pl. II—3, 5)

A. mercuri Elliott, 1968, British Museum Nat. Hist. Bull. Geol. Suppl. 4, pp. 22, 23.

Remarks: Upper Permian species similar to *tibialis* but relatively thick walled and smaller kept under *A. mercuri* by Elliott who described Zenner formation of Tunisia. The fragments present material compare well with *A. mercuri* measurements are given below:

Specimen no.	Segment length	Diameter			d/D	Porosity
		Wall thickness	outer	inner		
II/10.8b	.. L.S. .. 2 mm.	0.3 mm,	.. 0.75 mm,	0.4 mm.	53%	
II/1.3	.. L.S. .. 2 mm.	.. 0.3 mm,	.. 0.73 mm,	0.4 mm.	54%	
II/6.5	.. T.S.	0.2 mm,	.. 0.71 mm,	0.43 mm.	56%	

Repository: Author's collection, hypotype no. II/10, 8b, II/1.3, and II/6.5.

Genus *Mizzia* Schubert, 1907 (emend Razak, 1959)

Mizzia bramkampfi Rezak, 1959

(Pl. II—6)

M. bramkampfi Rezak, 1959, Journ. Pal. Vol. 33, no. 4, p. 536.

Remarks: The illustrated section measures 1.4 mm. in outer diameter, 1.2 mm. in inner diameter, wall thickness is 0.28 mm. with 160 μ pore diameter, narrowing

to 40 μ at the base. The shape of the primarium is characteristically funnel shaped and this compares well with *M. bramkampfi* Rezak, described from the upper Permian Khuf formation of Saudi Arabia.

Repository: Authors collection, hypotype

Genus *Pseudoepimastopora* Endo, 1961

Pseudoepimastopora cf. *likana* (Kochansk Elliott, 1968

(Pl. II—7, 8)

AS PROPOSED BY DIFFERENT WORKERS

PHIAL	TEWARI AND KUMAR (1967)	RAVI SHANKAR (1971)	KALIA
	NUMMULITIC	SUBATHU EOCENE (Lower to Middle.)	NUMMULITIC EOCENE
	UPPER TAL Shell Lst APTIAN	UPPER Lst Mm Lower &/or Qtz Mm middle Cret LOWER Lower Cret to Middle Jurassic	UPPER TAL Shell Lst Gymnocodium Zone Shales Wentzelella Zone
		KROL FORMATION	
WESTPHALIAN			
			Qzt QUARTZITE Lst LIMESTONE Mm MEMBER Fm FORMATION Cret. CRETACEOUS

to *A. spec-*
in size were
ibed it from
ments in the
uri and their

ore diameter

0.025 mm.

ary branches
the specimen
scribed from
Arabia.

e no. S2/1.1.

y & Herak)

1960 *Epimastopora likana* Kochansky & Herak, Geoloskinjean zagreb, Vol. 13, p. 78.

1960 *Epimastopora* sp. Elliott, Quarterly Journ. Geol. Soc. London, V. 115, p. 219.

1968 *Pseudoepimastopora* cf. *likana* Elliott, (Kochansky & Herak) Elliott, British Museum Nat. Hist. supplement 4, Geology.

Remarks: Few well preserved sections of *Pseudoepimastopora* with typically developed bulbous pores are present. These are very similar to *P.* cf. *likana* described from the Permian Jebel qumer ornan limestone of Middle-East by Elliott. A near surface tangential section shows wall thickness of 0.5 mm. and pore diameter of 0.14 mm. The wall of the other illustrated section is 0.14 mm. thick.

Repository: Author's collection, hypotype nos. S2/7.7 and S2/2.3.

Genus *Pseudovermiporella* Elliott, 1958

Measurements:

Specimen no.	Length	Thickness of Perforated wall	Thickness of inner tube	Por diameter
S2/7-6 L.S. ..	1.25 mm,	0.91 mm.	.. 0.6 mm,	.. 0.0228 mm.
T.S. ..	diameter	no. of pores		
a. ..	0.65 mm,	30		
b. ..	0.5 mm,	25		

Comparison and Remarks: The new species differs from *P. sodalica* in the presence of tubes which lie in contact but not tangled, in the smaller diameter of the tubes and in interpore space being wider than pores. It is also comparable to *P. elliotti* Erk & Bilgulay in size and the hexagonal nature of pores but is distinct in the presence of well defined lining, widely spaced pores and closely associated tubes.

Repository: Author's collection Holotype no. S2/7.6.

COMPARISON AND REMARKS

Specimen no.	Segment length	Diameter	Wall thickness	Pore diameter
II/1.4 ..	6.8 mm.	.. 1.75 mm.	.. 8.5 mm.	150 u

Remarks: The specimen resembles *D. americana* Johnson, 1951, in the club shape of the thallus; in other dimensions, it is comparable to *D. alta* Endo, 1961. Due to the lack of transverse sections, exact specific identification could not be attempted.

Genus *Velebitella* Kochansky-Davide, 1964

Velebitella triplicata Kochansky-Davide, 1964

(Pl. IV—5, 6)

Pseudovermiporella sodalica Elliott, 1958

(Pl. IV—2, 3)

P. sodalica Elliott, 1958, Micropal. Vol. 4, pp. 419-422.

1960 *P. sodalica*, Elliott Bull. Geol. Soc. Turkey, pt. I, p. 188.

Remarks: Many tangential-longitudinal sections very closely comparable to *P. sodalica* are observed in the thin sections of the rock.

Repository: Author's collection, hypotype no. S2/6.13.

Pseudovermiporella cylindrica n. sp.

(Pl. IV—1)

Description: Tubes of fine crystalline calcite, with a distinct inner lining which appears dark yellowish grey in thin sections; outer tube with radially arranged polygonal pores, interpore wider than pores.

Genus *Diploporella* Schafhault, 1863

Diploporella sp.

(Pl. IV—4)

Description: Thallus club shaped and undulating, central stem club shaped, about half the diameter of the thallus, wall thick, branches arranged in whorls, narrowing towards outer surface, about 0.15 mm. in length, pore opening is 0.7 mm. in diameter.

V. triplicata Kochansky-Davide, 1964, Geol. Vjesnik Zagreb, V. 17, pp. 137-139.

Remarks: Few longitudinal and transverse fragments referable to *V. triplicata* described from the middle and upper Permian of Yugoslavia are present in the rock sections.

Genus *Epimastopora* Pia, 1922

Epimastopora sp.

(Pl. IV—7)

Remarks: A few longitudinal wall sections of *Epi-mastopora*, Pia are encountered in the material.

Family Codiaceae

Genus *Hikorocodium* Endo, 1951.

Hikorocodium elegantae Endo, 1951

(Pl. III—2-5)

H. elegantae Endo, Trans. Proc. Pal. Soc. Japan, no. 4, p. 127.

Remarks: A number of fragments of *Hikorocodium* Endo occur in the material, these are identical to *H. elegantae* Endo, described originally from the Mississippian and Permian of Japan. This species has also been recorded from the upper Carboniferous and Permian of Yugoslavia by Kochansky-Devide, 1964.

Hikorocodium aff. *transversum* Endo, 1957

(Pl. III—6)

H. transversum Endo, 1957, Saitama Univ. Sci. Report, Ser. B, V. 2, no. 3, pp. 298-299.

Remarks: Few sections referable to *H. transversum* Endo, are present in the material but are very small in size in comparison to the type specimen of this species.

Genus *Ortonella* Garwood, 1914

Ortonella morikawai Endo, 1954

(Pl. III—1)

O. morikawai Endo, 1954, Saitama Univ. Sci. Report, Sec. B, V. 2, no. 2, p. 241.

Remarks: A few sections of *O. morikawai* are present in the material, these show a tube diameter of 102 μ and angle of branching at 30°. This species has been recorded from the Carboniferous and Permian of Japan and Yugoslavia.

Note—The classification adopted here is after J. Harlan Johnson, 1963.

Table 2

GEOLOGICAL RANGES OF THE ALGAL GENERA OCCURRING IN THE TAL SHELL LIMESTONE

NAME	AGE	MESOZOIC			PERMIAN		CARBONIFEROUS		DEVONIAN	SILURIAN	ORDOVICIAN
		U	M	L	U	L	U	L			
GYMNOCODIUM					Belierophontis						
PERMOCALCULUS											
ANTHRACOPORELLA					Mercuri						
					Spectribilis						
EPIMASTOPORA											
MIZZIA											
					Brankampi						
PSEUDOEPIMASTOPORA											
PSEUDOVERMIPORELLA											
DIPLOPORA											
VELEBITELLA											
					Triplicata						
HIKOROCODIUM											
ORTONELLA											
PARACHAETES											
					lamellatus						

Table 3
 KNOWN DISTRIBUTION OF ALGAL SPECIES OCCURRING IN THE UPPER
 PERMIAN OF THE GARHWAL HIMALAYA

NAME	N AMERICA	WEST & CENTRAL EUROPE	MIDDLE EAST	INDIA	JAPAN	SALT RANGE
<i>Parachaetes lamellatus</i>				●	●	
<i>Gymnocodium bellerophontis</i>		●	●	●		●
<i>Permocalculus ananti</i>				☆		
<i>Anthracoporella spectabilis</i>		●	●	●		
<i>Anthracoporella mercuri</i>			●	●		
<i>Diplopora cf. americana</i>	○			●		
<i>Pseudoepimastopora cf. likana</i>		●	●	●		
<i>Epimastopora sp.</i>				○		
<i>Mizzia bramkampi</i>		●		●		
<i>Hikopocodium elegantae</i>		●		●	●	
<i>Pseudovermiporella sodalica</i>				●	●	
<i>Pseudovermiporella cylindrica</i>				☆		
<i>Ortonella morikawi</i>		●		●	●	
<i>Velebitella triplicata</i>		●		●		

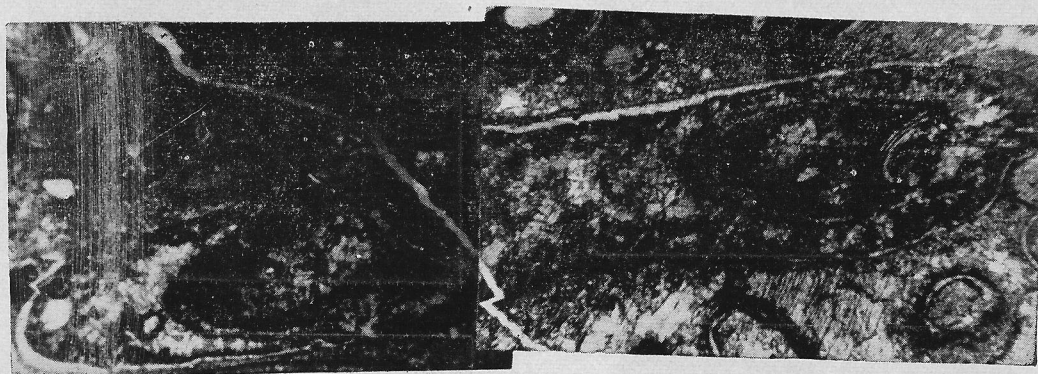
☆ New species

○ Similar but not identical species

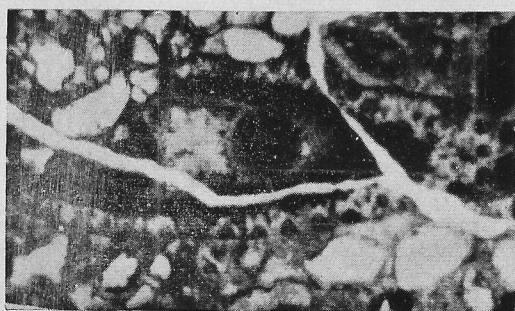
DISCUSSION AND COMPARISON

The age of the Tal formation had been uncertain and subject to contradictory assessments by different workers (see Table 1). The author's report (1972) on the occurrence of fusulinids, especially *Neoschwagerina cf. crataculifera* provides a more definitive and logical basis for the determination of the age of Shell limestone horizon in Dogadda area. The algal assemblage described in this paper is represented by fifteen algal species. Out of the twelve genera recorded herein, *Gymnocodium*, *Mizzia*, *Pseudoepimastopora* and *Pseudovermiporella* are restricted to Permian and the genus *Permocalculus* has not so far been recorded from the rocks older than Permian in age (see Table 2). An upper Permian age for the Tal Shell Limestone horizon of Dogadda area, deduced earlier by Kalia on the basis of fusulinid forms is further substantiated and keyed especially by the presence of *Anthracoporella mercuri* Elliott, 1968, *Mizzia bramkampi* Rezak, 1959, *Pseudoepimastopora cf. likana* (Kochansky & Herak) Elliott, 1968 and *Gymnocodium bellerophontis* (Rothpletz) Accordi 1956. As is evident from the Tables 2 & 3,

Gymnocodium bellerophontis is known from the upper Permian tethyan belt of the old world, namely Italy (Bellerophon limestone), Iraq (Zenner & Darari Formation) and Salt Range, Pakistan (Middle Productus beds). Rao and Varma (1953) while describing the *Gymnocodium* assemblage from the Middle Productus beds of Nammal gorge, observed that in view of the occurrence of *Gymnocodium* and also associated fusulinid genera *Leela*, *Condofusiella* and *Nipponitella*, the age of the middle Productus beds is definitely indicated as upper Permian and not Middle Permian as was generally considered earlier. This was later confirmed by Teichert (1966) and Kummel and Teichert (1970) who assigned Upper Permian (Gadupian) age to the Middle Productus beds (renamed as Wargal Formation) on the basis of its faunal content. Elliott (1955, 1968) described a rich algal flora from the Zennar and Darari Formations of Iraq and on the presence of characteristic species *Gymnocodium bellerophontis*, *Mizzia velebitana* assigned upper Permian age to them. The lower Zennar Formation includes *Anthracoporella mercuri* and is characterised by the presence of *Neoschwagerina crataculifera* and *Wentzelella*. In the upper



1



2



3



4



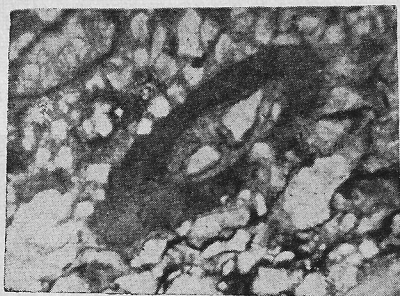
5



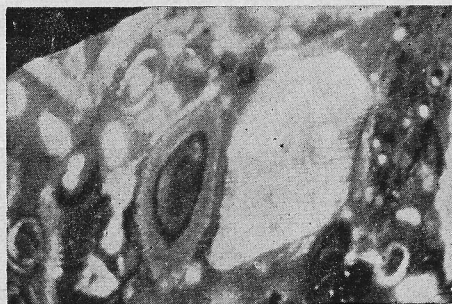
1



2



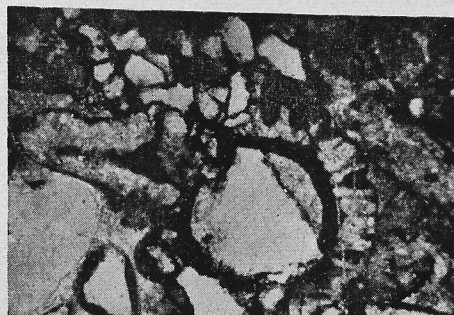
3



4



5



6



7



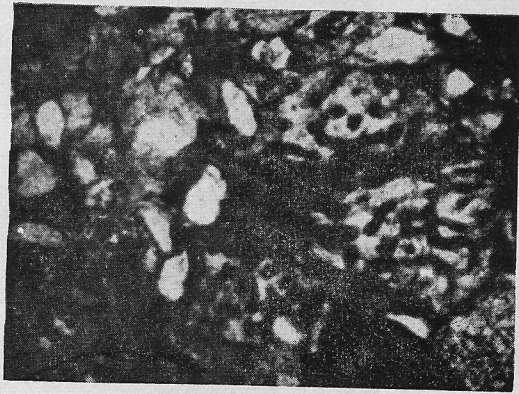
8



1



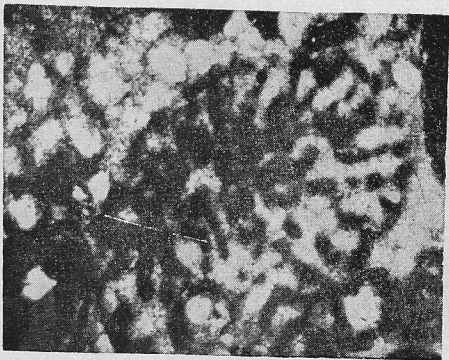
2



3



4



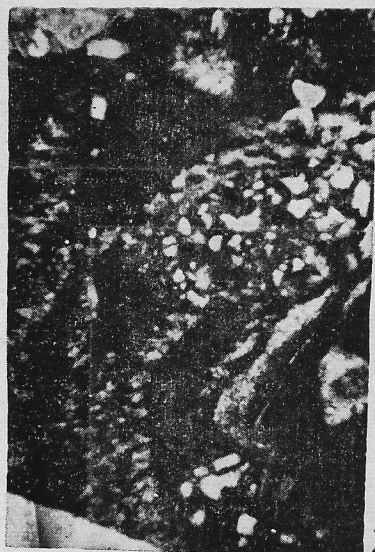
5



6



1



2



3



4



5



6



7

Tal Limestone also *A. mercuri* is found occurring with *N.* cf. *crataculifera* and the lower shale unit is characterised by the presence of *Wentzelella salinaria*. These typical forms and the associated assemblage suggests an upper Permian (Guadalupian) age for the Upper Tal Formation, particularly to the shales and oolitic Shell limestone in Dogadda area, here designated as *Wentzelella* and *Gymnocodium* zones, respectively.

ACKNOWLEDGEMENTS

The author is grateful to Professor A. G. Jhingran, Wadia Institute of Himalayan Geology for inspiration, to Dr. S. N. Singh for initiating me to this study and going through the manuscript, to Dr. Valdiya for discussions. Thanks are due to Sri Ruprai, Draftsman in the Department of Geology, University of Delhi.

REFERENCES

- ACCORDI, B., 1956. Calcareous Algae from the Upper Permian of the Dolomites (Italy) with Stratigraphy of Bellerophon' Zone *Jour. Pal. Soc. India*, **1**: 75-84.
- AUDEN, J. B., 1937. The Structure of Himalaya in Garhwal. *Rec. Geol. Surv. India*, **74** (4): 407-433.
- BEBOUT, D. G. and GOOGAN, A. H., 1964. Algal genus *Anthracoportella* Pia *Jour. Pal.* **38**: 1093-96.
- ELLIOTT, G. F., 1955 a. The Permian Calcareous Alga *Gymnocodium*. *Micropal.* **1**(1): 83-90.
- ELLIOTT, G. F., 1955 b. Fossil Calcareous Algae from the Middle East. *Micropal.* **1**(2): 125-131.
- ELLIOTT, G. F., 1956. Further Records of fossil Calcareous Algae from the Middle East. *Micropal.* **2** (4): 327-334.
- ELLIOTT, G. F., 1958. Fossil Microproblematica from the Middle East. *Micropal.* **4**(4): 419-428.
- ELLIOTT, G. F., 1960. Fossil Calcareous Algal flora of Middle East with a note on Cretaceous problematica *Hensonella cylindrica*. *Quart. Jour. Geol. Soc. London*, **115**: 217-232.
- ELLIOTT, G. F., The sexual organisation of Cretaceous *Permocalculus* (calcareous algae) *Palaeontology, London*, **4**: 82-84.
- ELLIOTT, G. F., 1962. More Microproblematica from the Middle East. *Micropal.*, **8**(1):
- ELLIOTT, G. F., 1968. Permian to Palaeocene Calcareous Algae (Dasicladaceae) of the Middle East. *Brit. Mus. Nat. Hist. Supplement 4, Geology*.
- GANESAN, T. M., 1972. Fenestellid Bryozoa from the Boulder Slate Sequence of Garhwal. *Himalayan Geology* **2**: 431-451.
- JOHNSON, J. H., 1963. Pennsylvanian and Permian Algae. *Quart. Colorado School of Mines*, **58** (3).
- KALIA, P., 1972. Upper Permian Fusulinids from Garhwal Himalaya. *Proc. II Indian Colloq. on Micropal. and Stratigr.* 107-110.
- KOCHANSKY, DEVIDE, V., 1964. *Velebitella*, eine neue jumpaläozoische Diploporengattung und ihre phylogenetischen Verhältnisse: *Velebitella*, novi gorjopaleozojski rod diploporae i njeni filogenetski odnosi. *Geoloski Vjesnik, Zagreb*, **17**: 135-142.
- KOCHANSKY, DEVIDE, V., 1970. Permski Mikorofosili zahadnih Karavank. *Geologija-Razprane in Porocila-13. Knjiga*, 175-250.
- KOCHANSKY, DEVIDE, V., 1973. *Ramovsia limes* n. g. n. sp. (Problematica), ein Leitfossil der Grenzlandbanke (unteres Perm). *N. Jb. Geol. Paläont. Mh.* **8**: 462-468.
- RAO, S. R. N. & VARMA, C. P., 1953. Fossil algae from the Salt Range. *Palaeobotanist*, **2**: 19-23.
- RAVI SHANKAR, 1971. Stratigraphy and Sedimentation of Tal Formation, Mussoorie Syncline, Uttar Pradesh. *Gour. Pal. Soc. India*, **16**: 1-15.
- RAVI SHANKAR, DHAUNDIAL, J. N. & KAPOOR H. M. 1973. The Age of Fossiliferous bed (Boulder Slate Member) of Garhwal Syncline. *Jour. Pal. Soc. India*, **17**: 50-54.
- REZAK, R., 1959. Permian Algae from Saudi Arabia. *Jour. Pal.* **33** (4): 531-38.
- TEWARI, B. S. & GUPTA, R. K., 1967. Foraminifera from Nummulitic beds of Nilkanth and Organic Remains from Tal Limestone, Garhwal Himalayas. *Indian Geotogist's Association*, **3**: 39-53.

EXPLANATION OF PLATES

PLATE I

1. *Permocalculus ananti* n. sp. $\times 20$; slide no. II/8.1.
2. *Gymnocodium bellerophontis* (Rothpletz) Accordi, 1956; $\times 12.5$, slide no. S2/3.2
3. *Parachaetes lamellatus* Konishi; $\times 36$; slide no. II/1.13.
4. *Anthracoportella spectabilis* Pia, L.S. $\times 24$; slide no. II/14.5
5. *A. spectabilis* Pia, T.S. $\times 20$; slide no. II/13.1.

PLATE II

1. *A. spectabilis* Pia, $\times 78$; slide no. II/3.1
2. *A. spectabilis* Pia, T.S., $\times 28$; slide no. II/3.3
- 3-5. *A. mercuri* Elliott, 3. L. S. $\times 21$; slide no. II/10.8b; 4. L. S. $\times 15$, slide no. II/1.3; 5. T.S. $\times 35$, slide no. II/3.11.
6. *Mizzia bramkampi* Rezak; $\times 10$; slide no. S2/3.11.
- 7, 8. *Pseudoepimastopora* cf. *likana* (Kochansky & Herak), 7. $\times 43$, slide no. S2/7.7; 8. $\times 14$; slide no. S2/2.3.

PLATE III

1. *Ortonella morikawai* Endo, $\times 50$; slide no. S2/3.13.
- 2-5. *Hikorocodium elegantae* Endo, 2. T.S. $\times 50$; slide no. S2/1.2; 3. T.S. $\times 25$; slide no. II/6.16; 4. T.S. $\times 15$; slide no. II/6.16.5. slightly oblique T.S. $\times 20$, slide no. II/8.11.
6. *H. aff. transversum* Endo, $\times 20$; slide no. II/8.12.

PLATE IV

1. *Pseudovermiporella cylindrica* n. sp. $\times 32$; slide no. S2/7.6.
- 2, 3. *Pseudovermiporella sodalica* Elliott, 2. $\times 20$; slide no. S2/6.13. 3. Same enlarged $\times 35$.
4. *Diplopora* sp. L.S. $\times 25$; slide no. II/1.4.
- 5, 6. *Velebitella* cf. *triplicata* Kochansky Devidé; 5. L. S. $\times 35$. 6. Slightly oblique T.S. $\times 60$; slide no. II/1.10.
7. *Epimastopora* sp. $\times 7.2$; slide no. S2/3.4.