Preliminary observation on Baltal and Ara sediments, Kashmir

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ABSTRACT

The Baltal assemblage is a mixture of both Centric and Pennate types, which is very rich in genera but poor in species contents. Total 41 samples have been analysed from the Baltal section, exposed along the River Romushi, of which about 60% have yielded diatoms. The following twenty genera have been found: *Melosira, Cyclotella, Stephanodiscus, Liradiscus* (or new centric diatom), *Tetracyclus, Fragilaria, Achnanthes, Cocconeis, Gyrosigma, Diploneis, Caloneis, Stauroneis, Navicula, Pinnularia, Amphora, Cymbella, Gomphonema, Epithemis, Hantzschia* and *Surirella*. In all the samples *Stephanodiscus astraea* (Ehr.) Grun predominated and *Liradiscus* subdominated.

The above species indicate fresh water conditions, and the occurence of genera *Stephenodiscus, Rhoicosphenia, Tetrecyclus, Melosira* point to lacustrine situations and large species of *Pinnularia, Gyrosigma, Cymbella, Stauroneis* indicate cold conditions.

So far all the diatoms reported or discovered have a very wide temporal range which stretches from the Oligocene to the Holocene.

From the Ara locality of Nigle Nullah, total 16 samples have been analysed so far, which yielded diatoms in a very small number. These samples seem to be lignitic.

The following diatoms were found in Ara (Ningle Nullah) section : *Cyclotella* (shells only), *Fragilaria, Synedra, Eunotia* (complete and fragments), *Achnanthes, Pinnularia* (small fragments), *Cymbella* (in fragments) and *Nitzschia*, which indicate fresh water conditions.

Proc. X Ind. Coll. Micropal. & Strat. : 555-570 1988

INTRODUCTION

There are few records available on fossil diatoms from the Karewa Beds of Kashmir. They are mostly far from being satisfactory. The earlier workers are Lundquist (1936), Conger (in De Terra and Peterson, 1939), Iyengar and Subrahamanyan (1943), Rao and Awasthi (1962), Roy (1971, 1975, 1980), Gándhi *et al.* (1983a, 1983b) and Mohan *et al.* (1982a, 1982b) who have recorded diatoms from different localities of the Karewas. The present authors have recorded several diatoms - genera and species - from Baltal which is a new locality. The following are the additional diatoms recorded from Baltal. *Achnanthes exigua* Grun.; *A. lanceolata* Breb.; *A.v. elliptica* Cl.; *A. peragalli* Brun u. Herib.; *Amphora ovalis* Kutz. v. *pediculus* Kutz.; *Cyclotella ocellata* Pant.; *Cymbella thumensis* (A.May.) Hust.; *C. ventricosa* Kutz.; *Fragilaria leptostauron* (Ehr.) Hust. v. *trigona* v.nov.; F. *virescens* Ralfs; *F.v. capitata* Krasske; *F.v.elliptica* Hust.; *F.v mesolepta* Rabh.; *Navicula bacilliformis* Grun.; *N. v. signata* v.nov.; *Opephora baltalensis* sp. nov.; *Stauroneis legumen* Ehr. and some more entities of *Fragilaria* and *Navicula*, etc.

The authors have further discovered the diatomflora from another new locality Ara of the Ningle Nallah Valley. From Ara 39 samples were collected of which 61% yielded diatoms. In our preliminary examination of the sediment samples several diatoms are noted. We here present a table comprising diatom assemblages found in sediments of Baltal and Ara along with those reported by Lundquist (1936) and Conger (1939) from other localities with remarks on their bio-stratigraphic status as recorded in the published literature.

TABLE 1

A table showing the diatom assemblages found in sediments from Baltal, Ara and those reported by Conger and Lundquist from other localities with remarks on their bio-stratigraphic status as recorded in the published literature.

Diatom taxa	*by Conger*			*by*	*Bal-*	*Ara*	*Known bio-*
	Hand -wor	*Sample 30*	*No. 17*	*Lund quist*	*tal*		*stratigra-phic status*
1. *Achnanthes* Bory 1822							
1. -baltalensis sp. nov.	.	.	.	.	+	.	
2. -v. lanceolata v. nov.	.	.	.	.	+	.	
3. -exigua Grun.	.	.	.	.	+	+	
4. -lanceolata Breb.	.	.	.	.	+	.	Ple
5. -v.elliptica Cl	.	.	.	.	+	.	Ple
6. -peragalli Brun et Her	.	.	.	.	+	.	Ple
2. *Amphipleura* Kutzing 1844							
7. -pellucida Kutz	+	.	.	.	.	.	Ple
3. *Amphora* Ehrenberg 1931							
8. -ovalis Kutz.	+	.	.	+	.	.	
9. -v. lybica (Ehr.) Cl.	+	+	.	.	+	+	Ple
10. -v. pediculus Kutz.	+	.	.	+	+	.	Ple
4. *Anomoeoneis* Pfitzer 1871							
11. -sphaero phora (Kutz.) Pfit. (=*Navicula sphaerophora Kz.*)	+	.	.	.	.	.	Ple

Diatom taxa	*by Conger*			*by*	*Bal-*	*Ara*	*Known bio-*
	Hand -wor	*Sample 30*	*No. 17*	*Lund- quist*	*tal*		*stratigra- phic status*
12. -v. polygramma (Ehr.) O.M. (=*Navicula polygramma E.*)	+	"	"	.	"	"	
5. *Caloneis* Cleve 1891							
13. -amphisbaena (Bory) C_1. (=*Navicula amphisbaena* Bory)	+	.	"	+	.	"	Ple
14. -limosa Kutz. (=*Navicula limosa* Kz.)	+	"	"	"	.	.	
15. -schumanniana (Grun.)C_1 v. biconstricta Grun.	"	"	"	"	+	+	Ple
16. -silicula (Ehr.) C_1	"	"	.	"	.	+	Ple, M.
17. -v.gibba A. Mayer	"	"	.	.	+	+	Ple
18. -v. truncatula Grun.	"	"	"	"	.	+	
6. *Cocconeis* Ehrenberg 1835							
19. -placentula Ehr.	+	.	+	+	.	+	O-R, Ple
20. -v. euglypta (Ehr.) C_1	+	.	"	+	+	+	Ple
21. -v. klinoraphe Geitl.	"	"	.	"	.	+	
22. -v. lineata (Ehr.) C1.	+	"	"	+	+	+	Ple
7. *Cyclotella* Kutzing 1833							
23. -comta (Ehr.) Kutz.	+	"	"	+	+	+	Ple
24. -iris Brun.	.	"	"	.	+	+	reported from Aurillac fossil
25. -v. elliptica v. nov.	.	"	.	"	+	+	
26. -Kutzingiana Thw.	.	"	.	"	+	+	Ple
27. -v. ambigua v. nov.	"	.	"	.	+	+	
28. -v. radiosa Fricke	"	.	.	.	+	+	
29. -v. planetophora Fricke	"	.	"	.	+	+	
30. -ocellata Pant.	"	"	"	.	+	"	
8. *Cymatopleura* W. Sm. 1951							
31. -elliptica W. Sm.	+	+	.	+	.	"	
32. -solea (Breb.) W.Sm.	+	.	+	+	"	.	Ple
9. *Cymbella* Agardh 1830							
33. -aspera (Ehr.) C1.	.	.	.	+	+	+	Ple, M
34. -cesatii (Rabh.) Grun.	+	.	.	.	"	.	
35. -cistula (Hemp.) Grun.	+	"	.	+	"	"	O,M,R, Ple
36. -v. maculata (Kutz.) V.H.	.	"	.	"	.	+	M-R
37. -cuspidata Kutz.	"	"	"	"	+	"	M-R, Ple
38. -ehrenbergii Kutz.	+	+	+	+	+	"	Ple
39. -lanceolata (Ehr.) V.H.	+	+	+	+	.	"	Ple

Diatom taxa	by Congex Hand -wor	Sample 30	No. 17	by Lund-quist	Bal-tal	Ara	Known bio-stratigra-phic status
40. -lata Grun.	"	.	"	"	+	+	Ple
41. -naviculiformis Aures	"	"	.	"	"	+	Ple
42. -obtuiscula (kutz.) Grun	"	.	.	"	+	"	Ple
43. -prostrata (Berk.) Cl.	+	"	.	.	.	"	Ple
44. -reinhardtii Grun	.	"	"	"	+	.	
45. -tumida (Breb.) V.H.	.	"	.	"	.	+	O-R, Ple
46. -turgida (Greg.) Cl.	+	.	"	"	"	"	Ple
47. -thumensis (A.Mayer) Hust.	"	"	"	.	+	"	
48. -ventricosa Kutz.	+	"	+	+	+	"	O-R, u.T, Ple
10. *Diatoma* de Candolle 1805							
49. -vulgare Bory	"	"	"	.	.	+	
11. *Diploneis* Ehrenberg 1840							
50. -elliptica (Kutz.) Cl.	"	.	.	.	+	"	
51. -v. ladogensis Cl.	.	"	.	"	+	"	
52. -subovalis Cl. v. ovata v. nov.	.	.	"	"	+	"	
12. *Epithemia* Brebisson 1838							
53. -argus Kutz.	+	+	+	+	.	.	
54. -hyndmanni W.Sm.	"	"	"	"	.	+	Ple
55. -sorex Kutz.	+	"	"	+	+	+	Ple
56. -v. gracilis Hust.	"	"	.	"	"	?	
57. -turgida (Ehr.) Kutz.	+	"	.	+	+	+	Ple
58. -zebra (Ehr.) Kutz.	+	+	+	+	+	+	Ple
59. -v. porcellus (Kz.) Grun.	+	"	"	+	+	+	Ple
60. -v. saxonica (Kz.) Gr.	"	.	"	.	+	+	Ple
61. -v. subcapitate A. Mayer	.	"	"	"	+	"	
13. *Eunotia* Ehrenberg 1837							
62. -alpina (Naeg.) Hust.	"	"	"	"	.	?	
63. -pectinalis (Kutz.) Rabh.	"	"	"	"	"	+	
64. -v. undulata (Ralfs) Rabh	.	"	"	.	"	+	Ple, M.
65. -polyglyphis Grun.	"	"	"	"	"	+	
66. -praerupta Ehr.	"	"	.	"	.	+	
67. -v. bidens Grun.	"	.	"	"	"	+	Ple
14. *Fragilaria* Lyngbye 1819							
68. -bicapitata A. Mayer	"	"	"	"	+	"	O,M,R
69. -capucina Desm.	+	"	"	+	"	"	
70. -construens (Ehr.) Grun.	+	"	"	+	+	+	O-R, Ple

Diatom taxa	*by Conger Hand-wor*	*Sample 30*	*No. 17*	*by Lund-quist*	*Bal-tal*	*Ara*	*Known bio-stratigra-phic status*
71. -v. baltalensis v. nov.	.	.	.	+	+	+	
72. -v. binodis (Ehr.) Grun.	.	.	.	.	+	.	M-R, Ple
73. -v. subsalina Hust.	.	.	.	.	+	.	O,M,R
74. -v. venter (Ehr.) Grun.	.	.	.	.	+	+	O-M, Ple
75. -v. -f. baltalensis f.n.	.	.	.	.	+	.	
76. -inflata (Heid.) Hust.	.	.	.	.	+	+	
77. -leptostauron (Ehr.) Hust.	.	.	.	.	+	.	O,M,R,Ple
78. -v. amphitetras Grun.	.	.	.	.	+	.	
79. -v. dubia Grun.	.	.	.	.	+	.	
80. -v. rhomboides Grun.	.	.	.	.	+	.	
81. -v. trigona v. nov.	.	.	.	.	+	.	
82. -pinnata Ehr.	.	.	.	.	+	.	O,R, Ple
83. -v. elliptica Grun	.	.	.	.	+	.	
84. -v. lancettula (Schum.) Hust.	.	.	.	.	+	.	
85. -virescens Ralfs.	.	.	.	.	+	+	E,R, Ple
86. -v. capitata Krasske.	.	.	.	.	+	.	
87. -v. elliptica Rust.	.	.	.	.	+	.	
88. -v. mesolepta Rabh.	.	.	.	.	+	.	
15. *Frustulia* Agardh							
89. -vulgaris Thw.	.	.	.	.	.	+	Ple
16. *Gomphonema* Agardh 1824							
90. -augur Ehr.	.	.	.	.	.	+	Ple
91. -v. gautieri V.H.	.	.	.	.	.	+	Ple
92. -bohemicum Reichelt et Pricke	.	.	.	.	.	+	
93. -constrictum Ehr.	+	.	.	+	.	+	Ple
94. -v. capitata (Ehr.) Cl. (=*G. capitatum* Ehr.)	+	.	.	.	.	.	Ple
95. -geminatum Ag.var. hybrida Grun.	+	.	.	.	.	.	
96. -grovei M.S.	.	.	.	.	+	+	M,P,Ple
97. -intricatum Kutz.	+	.	+	+	+	+	Ple
98. -v. dichotoma (Kz.) Grun.	.	.	.	.	+	+	
99. -lanceolatum Ehr.	+	.	.	+	.	.	
17. *Gyrosigma* Hassl							
100. -sp.	.	.	.	.	+	.	
101. -attenatum (Kz.) Rabh. (=*Pleurosigma attenuatum* Kutz.)	+	.	.	+	.	.	Ple
102. Kutzingii (Grun.) Cl. (=*P. Kutzingii* Grun.)	+	.	.	+	.	.	

Diatom taxa	by Congex Hand-wor	Sample 30	No. 17	by Lund-quist	Bal-tal	Ara	Known bio-stratigra-phic status
18. *Hantzschia* Grunow 1877							
103. -amphioxys (Ehr.) Grun.	.	.	.	.	+	.	Ple
104. -var.	"	.	.	"	+	+	
19. *Melosira* Agardh 1824							
105. -ambigua (Grun.) O.M.	.	"	.	.	.	+	M-R
106. -granulata (Ehr.) Ralfs.	"	.	.	.	+	+	O,M,R,Ple
20. *Navicula* Bory 1822							
107. -americana Ehr.	"	"	.	"	.	+	Ple
108. -anglica Ralfs	.	"	.	"	+	+	
109. -bacillum Ehr	"	.	.	.	+	.	M,Ple
110. -bacilliformis Grun.	+	"	"	+	+	.	Ple
111. -bacilliformis var. signata v. nov.	.	"	"	"	+	"	
112. -baltalensis sp. nov.	"	"	"	.	+	.	
113. -cuspidata Kutz.	+	+	.	+	.	"	Ple
114. -v. ambigua (Ehr.) Cl. (= *N. ambigua* Ehr.)	.	+	"	+	"	.	Ple
115. -gastrum Ehr.	"	"	.	.	+	.	M,Ple
116. -v. signata Hust.	.	"	"	"	+	"	
117. -karewansis sp. nov.	.	"	"	.	+	.	
118. -oblonga Kutz.	+	"	"	+	"	.	Ple
119. -peregrina (Ehr.) Kutz.	"	"	"	"	+	.	Ple
120. -placentula (Ehr.) Grun.	"	.	.	.	+	"	
121. -v. rostrata Mayer	.	.	.	"	+	.	Ple
122. -pseudoscutiformis Hust.	.	"	.	"	+	+	M,Ple
123. -radiosa Kutz.	+	.	.	+	"	"	Ple
124. -scutelloides W. Sm.	.	"	"	.	+	+	Ple
125. -v. baltalensis v. nov.	.	.	.	.	+	.	
126. -v. curvistriata v. nov.	"	.	"	"	+	"	
21. *Neidium* Pfitzer 1871							
127. -affine (Ehr.) Cl. var. amphirhynchus (E.) Cl. (*Navicula amphirhynchus* Ehr.) Cl.	+	+	"	+	"	"	Ple
128. -iridis (Ehr.) Cl. (*Navicula Neidium iridis* (E.) Cl.	+	"	"	"	"	"	Ple
129. -v. amphigomphus (Ehr.) V.H.	"	.	"	"	"	+	Ple
130. -kozlowi Meresch. (*Navicula Neidium kozlowi* Meresch.)	+	"	"	"	"	.	
22. *Nitzschia* Hassal 1845							

Diatom taxa	*by Hand -wor*	*Conger Sample 30*	*No. 17*	*by Lund- quist*	*Bal- tal*	*Ara*	*Known bio- stratigra- phic status*
131. -sp. 1	.	.	.	.	+	.	
132. -sp. 2	.	.	.	.	+	.	
133. -sp. 1	.	.	.	.	.	+	
134. -sp. 2	.	.	.	.	.	+	
135. -angustata (W.Sm.) Grun.	+	.	.	+	.	.	
136. -hungarica Grun.	+	.	.	+	.	.	
137. -palea (Kutz.) W. Sm.	+	.	.	+	.	.	
138. -sigmoidea (Ehr.) W. Sm.	+	.	.	+	.	.	
23. *Opephora* Petit							
139. -martyi Herib.	.	.	.	.	+	.	Ple
140. -robusta sp. nov.	.	.	.	.	+	.	
24. *Pinnularia* Ehrenberg 1840							
141. -boreal is Ehr. (= *Navicula boreal is* E.)	+	.	.	+	.	.	Ple
142. -brebissoni (Kutz.) Cl. (= *Navicula brebissonii* (= *P. microstauron* (Ehr.) Cl v. brebissonii (Kutz. Hust.)	+	.	.	+	.	.	M
143. -dairiana A.S.	.	.	.	.	+	.	
144. -deollo-juradii (Freng.) Gandhi (=*Navicula deollo-juradii* Freng.)	.	.	.	.	+	.	
145. -eburnea Zanon	.	.	.	.	+	.	
146. -lacunarum Hust.	.	.	.	.	+	.	
147. -lata (Breb) W. Sm. v. thuringiaca (Rabh.) Mayer	.	.	.	.	+	+	Ple
148. -major (Kutz.) Cl. (= *Navicula major* Grun. v)	+	.	.	+	.	.	Ple
149. -obtusa Krasske	.	.	.	.	+	.	
150. -viridis (Kutz.) Ehr.	+	+	+	+	+	+	M,Ple
25. *Rhopalodia* O. Muller 1895							
151. -gibba (Ehr.) O. Mull.	+	+	.	+	.	.	M-R, Ple
152. -v. ventricosa (E.) Grun.	+	.	.	+	.	.	Ple
26. *Rhoicosphenia* Grunow 1860							
153. -curvata (Kutz.) Grun.	+	.	.	+	.	.	Ple
27. *Stauroneis* Ehrenberg 1843							
154. -acuta W.Sm. var. tenuis Gonzal, et Gandhi	.	.	.	.	+	.	Ple

Diatom taxa	by Conger Hand-wor	Sample 30	No. 17	by Lundquist	Baltal	Ara	Known biostratigraphic status
155. -anceps Ehr.	+	.	.	+	.	.	Ple
156. -legumen Ehr.	.	.	.	.	.	+	
157. -phoenicenteron Ehr.	+	+	+	+	.	.	O-R,M,Ple
28. *Stephanodiscus* Ehrenberg 1855							
158. -astraea (Ehr.) Grun.	+	.	.	+	+	+	Ple
159. -v. minutula (Kz.) Grun.	.	.	.	.	+	+	M,P,Ple
160. -hantzschii Grun.	.	.	.	.	?	.	
29. *Surirella* Turpin 1827							
161. -sp. 1	.	.	.	.	+	.	
162. -sp. 2	.	.	.	.	+	.	
163. -biseriata Breb. var. bifrons (Ehr.) Hust. (= *S. bifrons* Kutz.)	+	.	.	.	.	.	
164. -robusta Ehr.	.	.	.	.	+	.	Ple
30. *Synedra* Ehrenberg 1831							
165. -capitata Ehr.	+	.	.	+	.	.	
166. -gaillonii (Bory) Ehr.	+	.	.	+	.	.	
167. -obtusa W. Sm.	+	.	.	+	.	.	
168. -parasitica W. Sm.	.	.	.	.	.	+	Ple
169. -pulchella Kutz.	+	.	.	+	.	.	
170. -ulna (Nitz.) Ehr.	+	+	.	+	.	+	O-R. Ple
171. -v. amphirhynchus (E.) Grun.	.	.	.	.	.	+	Ple
172. -v. biceps Kutz.	.	.	.	.	.	.	Ple
173. -v. danica (Kutz.) Grun	+	.	.	+	.	.	
174. -v. subaequalis Grun.	.	.	.	.	.	+	
175. -vitrea Kutz.	+	.	.	.	.	.	
31. *Tabellaria* Ehrenberg 1831							
176. -fenestrata (Lyngh.) Kutz.	.	.	.	.	.	+	Ple
177. -flocculosa (Roth) Kutz.	.	.	.	.	.	+	Ple
32. *Tetracyclus* Ralfs 1843							
178. -emarginatus (Ehr.) W. Sm.	.	.	.	.	+	,	Ple
179. -japonica Reichelt ?Petit.	.	.	.	.	.	+	P, Ple (only from Japan)
32 Genera and 179 species	64	13	10	50	94	70	

Abbreviations stand for : u.T. = upper Tertiary; O = Oligocene; M = Miocene; P = Pliocene; Ple = Pleistocene; R = Recent; E = Eocene

The diatom taxa listed by Conger and Lundquist should be understood of Pleistocene period.

TABLE 2

Table showing the analysis of fossil diatom genera and their species contents so recorded, reported or noted from the region of the Karewa Beds of Kashmir by Conger, Lundquist and present workers, and the known stratigraphic status is indicated in remarks.

Name of Genus	by Conger Hand -wor	Sample 30	No. 17	by Lund- quist	by present workers Bal- tal	Ara	Remarks Known stratigraphic status u.T,O,M,P, Ple.					R.
1. *Achnanthes*	-	-	-	-	6	1					6	
2. *Amphipleura*	1	-	-	-	-	-					1	
3. *Amphora*	3	1	-	3	1	1					3	
4. *Anomoeoneis*	2	-	-	-	-	-					2	
5. *Caloneis*	2	-	-	1	2	4			1		4	
6. *Cocconeis*	3	-	1	3	2	4		1			3	1
7. *Cyclotella*	1	-	-	1	8	8					3	
8. *Cymatopleura*	2	1	1	2	-	-					1	
9. *Cymbella*	7	2	3	4	8	5		3	4		12	5
10. *Diatoma*	-	-	-	-	-	1						
11. *Diploneis*	-	-	-	-	2	-						
12. *Epithemia*	5	2	2	5	6	7					6	
13. *Eunotia*	-	-	-	-	-	6			1		1	
14. *Fragilaria*	2	-	-	2	20	5	1E	6	5		7	7
15. *Frustulia*	-	-	-	-	-	1					1	
16. *Gomphonema*	5	-	1	3	3	7			1		6	
17. *Gyrosigma*	2	-	-	1	1	-					1	
18. *Hantzschia*	-	-	-	-	2	1					1	
19. *Melosira*	-	-	-	-	1	2		1	2		1	2
20. *Navicula*	4	2	-	4	15	3			3		12	
21. *Neidium*	3	1	-	1	-	-					3	
22. *Nitzschia*	4	-	-	4	-	2						
23. *Opephora*	-	-	-	-	2	-					1	
24. *Pinnularia*	4	2	1	4	6	2			3		7	1
25. *Rhopalodia*	2	1	-	2	-	-			1		2	1
26. *Rhoicosphenia*	1	-	-	1	-	-					1	
27. *Stauroneis*	2	1	1	2	2	-		1	1		3	1
28. *Stephanodiscus*	2	-	-	1	3	2			1		2	
29. *Surirella*	1	-	-	-	3	-					1	
30. *Synedra*	7	1	-	6	-	5	1	1			5	
31. *Tabellaria*	-	-	-	-	-	2					2	
32. *Tetracyclus*	-	-	-	-	1	1			1		2	
32. Genera, 179 species	64	13	10	50	94	70	2	13	23	2	100	19

Roy (1975) has indicated generic assemblages of diatoms based on his 1,000 samples collected from 32 sites under his 16 localities or a group of them. On the basis of these he ascribed the Mio-Pliocene Age of the Karewas. He further made bio-zones I and II of the lower Karewas and generic diatom assemblages presented localitywise with expressions of very rich, rich, moderately rich and poor and somewhere percentages are given.

It may be emphasised here that unless the diatoms are completely and correctly identified to the species level — and where varieties and forms exist of the species — then upto that level, the diatom biostratigraphy is wholly valueless, unscientific and imaginary. The assemblages of diatom genera are mute in the extreme, they not at all serve bio-stratigraphic studies, since such generic assemblages occur in many or diverse bodies of water. They only indicate to some extent the nature of their habitats e.g. fresh water, brackish water, marine, etc. The diatom genera can be even identified by a laboratory peon and such non-scientific staff and the diatom assemblages can be given. This is where Roy's work stands and, therefore, the diatom bio-stratigraphy based on only generic assemblages pointing to the Mio-Pliocene Age of the Karewas is preposterous. And equally so, his concept of bio-zones, very rich, rich, moderately rich and poor assemblages and percentages.

Considering the diatom generic assemblages stated by Roy, they show their fresh water ecology which is no where mentioned by him. However, his record of genera such as *Coscinodiscus, Raphoneis* (specified as *Rhaponeis*), *Mastogloia* and *Pleurosigma* are incompatible here as they mostly represent marine ecology and if the marine ecology is accepted then their many other closely associated taxa are inexplicably absent. In the same assemblage *Coscinodiscus* and *Frustulia* being of very diverse ecology simply cannot coexist — but Roy has shown them.

The genera, *Melosira, Cyclotella, Stephanodiscus, Coscinodiscus Stephanopyxis* etc., have no evolutionary status in the present area and context (they are even reported from the Oligocene and older strata) — hence their presence in these strata does not make the Karewas to be of the Mio-Pliocene Age. To be sure, the diatoms are even known from the Upper Cretaceous sediments and cores — 110 million years old strata, and from such old strata both centric and pennate types are recorded. It may further be pointed out that an element of the Miocene age may even be found in the Holocene but not the contrarywise. It seems Roy has not appreciated this situation and hence he ran into an error of calling the Karewas of Mio-Pliocene Age.

On page 218, Roy states, "this uplift ..... virtual extinction of the spectacularly rich diatomaceous and tropical to subtropical megaflora was ..... so profusely present in the Lower Karewa times. No diatom would withstand..... to survive." We comprehand that this is a wonderful cock and bull story, since the diatomflora and megaflora do not go hand in hand due to their very diverse ecology — should not suffer destruction wholly at a time. They have vastly different status and physical characteristics and structures.

PRESENT WORK

In our this preliminary work we have determined most of the diatoms to the species, varietal and form level (new elements are excepted) from Baltal and Ara and presented them in the Table I, and these assemblages are set in comparison with Conger's (in De Terra and Peterson 1939) and Lundquist's (1936) reports. Our report concurs to a very large measure with Conger, Lundquist and many others. On checking the individual diatom species a large majority of them indicate their Pleistocene or Plio-Pleistocene period and hence the Pliocene-Pleistocene stratigraphy of the Karewas, at the most liberal estimate. There are some diatoms of the Oligocene, and older period which continue to the Recent period as revealed into the same Table I. The Table II shows a complete analysis of species content of genera with their known stratigraphic status where the Pleistocene diatoms predominate. All these diatoms come from the fresh water ecology and many of them are of cold climate. The lacustrine ecology is indicated by one or more species of *Melosira, Cyclotella, Stephanodiscus, Tetracyclus, Tabellaria, Rhoicosphenia, Opephora, Fragilaria* etc.

In the course of time we hope to present illustrated accounts of all these diatoms in a series of papers. Our present aim is to reveal the wealth of fossil diatomflora that existed in the past in an area which at present makes the Karewa Beds of Kashmir.

Here, we describe an interesting diatom and its varieties with help of a number of camera-lucida illustrations of the specimens noted and a S.E.M. photomicrograph of one of them, which significantly bears on the Pleistocene or Plio-Pleistocene Age sequence of the Karewas of Kashmir.

1. *Gomphonema grovei* M. Schmidt (Pl. 1, Fig. 1, Pl. 2, Figs. 1-8)

Schmidt, A., 1874-1959, *Atlas Diat.*, Pl. 214, figs. 13-18 esp. 18; Okuno, H. 1956, J.J. Sci., 31(10); Sovereign, H.E. 1963. *Proc. Calif. Acad. Sci.*, 4th Ser., 31(14); 367, fig. 43.

Valves 17-37.2µ long and 8-12µ broad, broadly clavate with apex broadly rounded and base narrowed, produced and rounded. Raphe thin and straight, with central pores distinct; terminal fissures bayonet shaped more or less obliquely reflexed. Axial area very wide; central area inevident, unilateral stigma absent. Striae 8-12 in 10µ, very slightly radial, coarse, very short, interrupted into one or more pieces of unequal lengths.

A table of typical dimensions as recorded

	Length in µ	*Breadth in* µ	*Striae in 10*µ
1.	17	8	12-13
2.	21.3	10	10
3.	21.3	8	12
4.	22.6	9.3	10-11
5.	23.4	9.3	11
6.	26.6	12	10-11
7.	28	8	12
8.	30.6	10.7	9-10
9.	33.2	10.7	11-12
10.	37.2	10.6	11

Fresh water fossil. Stratigraphically known from the Mio-Pliocene to the Pleistocene beds. Originally recorded from Oregon and Washington Country, North America.

This diatom closely compares *G. grovei* M. Schmidt, as given in the *Atlas Diat.*, in all the characteristics. It was originally recorded by M. Schmidt in 1899 in the Mio-Pliocene sediments obtained from the Pitt River (samples collected by Grove) and Washington County (in samples collected? by Tempere and Peragallo). Again, it was recorded by Sovereign in 1963 from Oregon and Washington areas. It was also reported by Okuno 1956, from Japan in the Pleistocene deposits at Yatsuka-Mura and Kawakami-Mura. So far, from no other countries this diatom is known and, therefore, it has a particular importance that it finds a new locality — Karewa Beds of Kashmir — reflecting on them to be of the Plio-Pleistocene Age. It is recorded in Baltal and Ara sediments and it is believed that it should be prevelent in whole of the area.

Ihere is another similar looking diatom reported by Hustedt from Japan, is *Gomphonema lingulatum* Hust. (Hustedt, 1927, *Arch. Hydrobial.*, 18:166, t.5, fig. 5, the given dimensions are 15µ long 7µ broad and 17 striae in 10µ.). Subsequently, it is also reported by some workers from different areas or countries (Hustedt, 1938, *Arch. Hydrobiol. Suppl.*, 15:443, t.27, fig. 1; Skvortzow, 1937a, *Philipp. J. Sci.*, 61:32, pl.13, figs. 6-7; 1937b, *ibid.*, 61:283, pl.3, fig. 13; Gandhi, 1960, *J. Bombay Nat. Hist. Soc.*, 57(1): 124, f.119; Kasahara, *et al.*, 1982 *Bull. GIFU Pref. Mus.*, 3, 122, pl. 10, figs. 57; Mori, 1975, *Paleolimno. Biwa Japan Pleistocene* 3:389, figs. 69-70). However, none of the authors have commented upon *Gomphonema grovei* M. Schmidt, while reporting this diatom. To be sure *Gomphonema lingulatum* Hust. seems to be a different species altogether inhabiting fresh water in living as well as in fossil condition. The main characters for this species are: apex more or less apiculate, striae are denser and uninterrupted and the terminal fissures of the raphe not abruptly and obliquely reflexed. In these characters, therefore, *G. lingulatum* Hust. differs from *G. grovei* M. Schmidt.

Here, on Pl. II several illustrations for *G. grovei* M.S. are given to show a certain range of variation falling within the cycle. A SEM photomicrograph shows all the typical structural details as described. The specimen here is somewhat tilted and overlaid

with some waste matter. Ihe striae probably show fine lineations obliterated in fossilization.

2. *Gomphonema grovei* M.S. v. *conspicua* v. nov. (Pl. 2, fig. 9).

Valvae 45-47μ longae stque 12μ latae, lanceolati-clavatae, apicibus cuneatis rotundatis, ad basim products, late rotundatis. Raphe tenuis et recta, fissuris terminalibus ad polos discincte remotis, unilateraliter abrupte reflexa, nodulae in pori inclusa. Striae circiter 10-11 in 10μ. In omni cetera similis ut typus.

Fossil aqua dulcis - sedimenta in Baltal.

Valves 45-47μ long and 12μ broad, lanceolate-clavate, apex cuneate rounded and base produced, broadly rounded. Raphe thin and straight, terminal fissures conspicuously distant from the poles and sharply reflexed on one side, knots lie in pore. Striate 10-11 in 10μ. In all other characters like the type.

Fresh water fossil in Baltal sediments.

Ihis diatom differs from the type in being robust, lanceolate clavate in shape with produced capitate base. The terminal fissures of the raphe conspicuously distant from the poles and abruptly reflexed to one side, the knots lie in pore. The central nodule between raphe ends shows a fissure. With these characteristics noted, it is considered to be new variety.

3. *Gomphonema grovei* M.S. v. *rhomboidea* v. nov. (Pl.2, figs. 10-12).

Valvae 33.2-40μ longae atque 9.6-12μ latae, rhomboideo-clavatae, ad apice cuneatis rotundatis, basim product is plus minus capitatis. Striae circiter 9-10 in 10μ. In omni cetera similis ut typus.

Fossil aqua dulcis-sedimenta in Baltal.

Valves 33.2-40μ long and 9.6-12μ broad, rhomboid clavate, apex cuneate, rounded; base produced, more or less capitate. Striae 9-10 in 10μ. In all other characters like the type.

Fresh-water fossil in Baltal sediments.

This diatom differs from the type proper in having rhomboid-clavate shape with produced capitate base and cuneate apex. A number of specimens represented this feature constantly. It is, therefore, considered to a new variety.

4. *Gomphonema* grovei M.S. v. *lanceolata* v. nov. (Pl. 2, figs. 13-16).

Valvae 21.2-36.6μ longae atque 8-10.6μ latae, lanceolati-clavatae, apicibus rotundatis, ad basim products rotundatis aliquantum dilatatis vel capitatis. Striae circiter 9-11 in 10μ. In omni cetera similis ut typus.

Fossil aqua dulcis-sedimenta in Baltal Ara.

Vales 21.2-36.6μ long and 8-10.6μ broad, broadly lanceolate-clavate, apex rounded, base produced, rounded slightly dilated or capitate. Striae 9-11 in 10μ. In all other characters like the type.

Fresh water fossil found in Baltal and Ara sediments.

This diatom differs from the type in having broadly lanceolate clavate shape and produced, slightly capitate base. A similar specimen of *G. grovei* M.S., is illustrated in the *Atlas Diat.*, t.214, f.16, is included here. This is considered to be a new variety, since a number of specimens which marked by differed from the type proper.

ACKNOWLEDGEMENT

Ihe authors are thankful to Shri P.H. Gandhi who helped in emending and giving the finishing touch to camera lucida illustrations.

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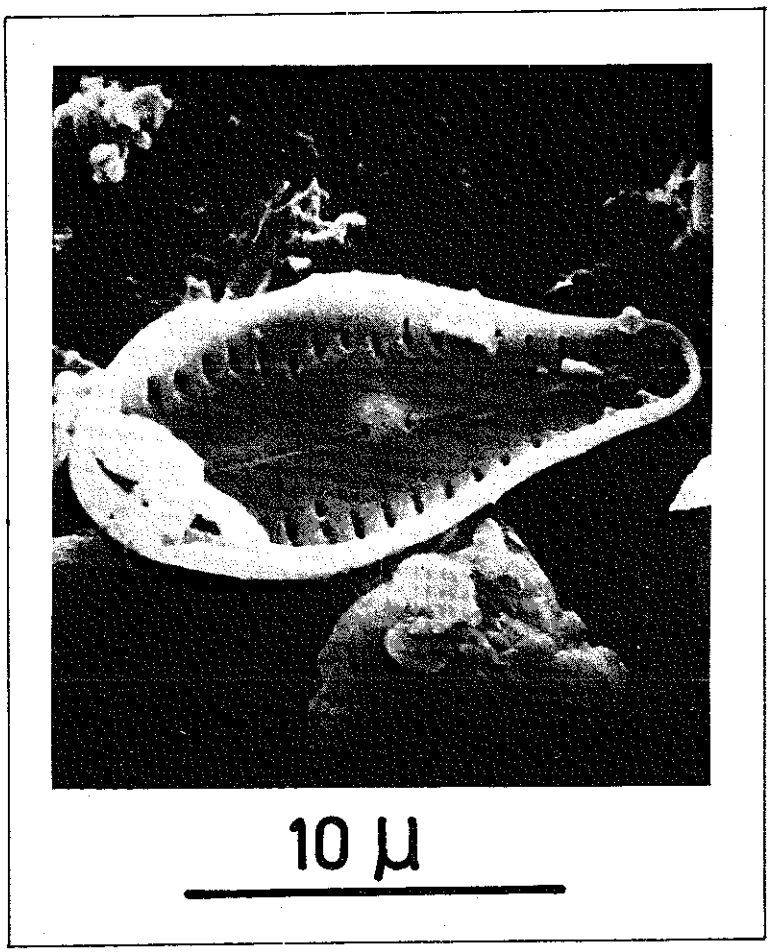
EXPLANATION OF PLATE 1

1. *Gomphonema grovei* M. Schmidt



EXPLANATION OF PLATE 2

1-9. *Gomphonema grovei* M. Schmidt

9. *G. grovei* var. *conspicua* var.nov.

10-12. *G. grovei* var. *rhomboidea* var.nov.

13-16. *G. grovei* var. *lanceolata* var.nov.

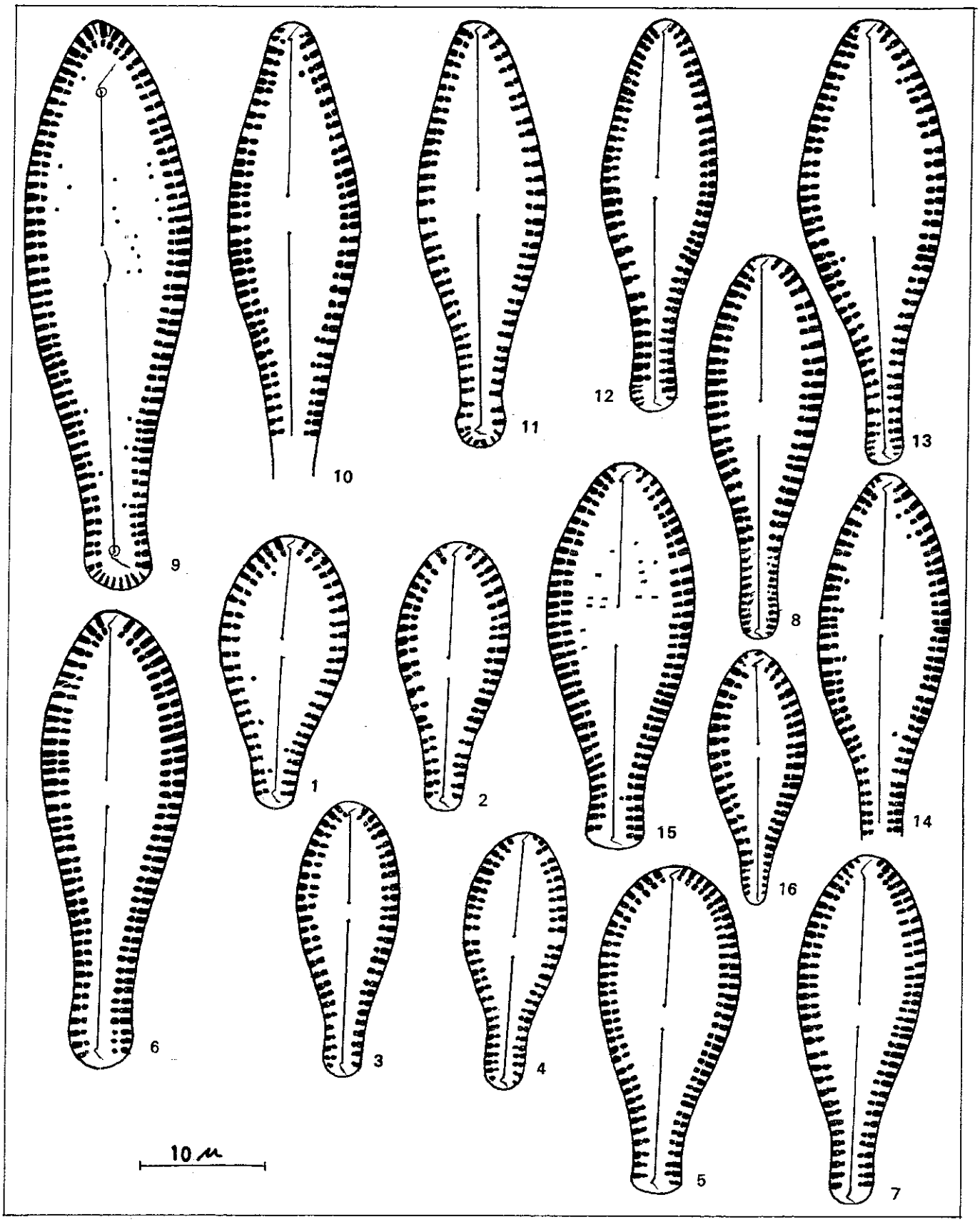


PLATE – 2