5.

A COMPARATIVE SURVEY OF THE EPIPELIC DIATOM FLORA OF SOME IRISH LOUGHS.

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During the visit of the twelfth International Limnological Congress to Ireland, samples of sediment were collected from the littoral zone of many loughs in the north and west. Loughs of two extreme types were visited; these were the highly oligotrophic waters of Galway, many of which are notable for the occurrence of the Pipewort, *Eriocaulon septangulare*, and the moderately to extremely rich calcareous loughs of the central region and Co. Clare. The location of the loughs and the surrounding geological formations are briefly described in Round and Brook (1959.)[1] The calcareous loughs are of particular interest since few examples of this type occur in England, Wales or Scotland.

One or, in some cases, two samples were taken from each lough and thus the records can only give an incomplete account of the littoral flora. That there are minor differences between stations in a single lough is only to be expected, but unless there are wide divergences in sediment structure (e.g., Malham Tarn, Round, 1953) these will not greatly affect the flora. However, since the calcareous and the acid loughs each have dominants peculiar to them, it can be assumed that the samples give a fairly true picture of the diatom floras.

METHODS.

Thirty samples of sediment were collected from twenty-six loughs. These were obtained by drawing a plastic tube across the surface of the sediments so that it filled with a mixture of mud and water, this was transferred to glass collecting tubes to which formalin was added. Portions of these sediments were boiled in a mixture of concentrated sulphuric and nitric acids in order to oxidise the organic matter. The residue was washed

[1] Sediments were also collected from L. Neagh (area approx. 150 sq. miles) near Antrim in Co. Antrim, and L. Eskragh (area 54 acres) in Co. Tyrone, whilst from the two turloughs whose plankton was recorded in Round and Brook (1959) no sediment samples were taken. Two samples were obtained from Conn, one from the east shore opposite Annaghroe Island (Conn I) and one just north of Pontoon bridge (Conn II).

TABLE I.—*The distribution of Diatoms in the loughs.*

	Neagh	Beg	Erne	Carrick	Melvin	Glencar	Gill	Gara (St. I)	Gara (St. II)	Key	Arrow	Colgagh	Talt (St. I)	Talt (St. II)	Conn (St. I)	Conn (St. II)	Cullin	Leveally	Corrib (N.)	Corrib (S.)	Bunny	Rea	Beltra	Kylemore	Balynahinch	Derryclare	Oorid	Arddcrry	Aumerin	Bofin
Melosira varians C. A. Ag.	+		+				2	2	+														2							
M. granulata (Ehr.) Ralfs	1		67			5		29			2																			
M. islandica subsp. *Helvetica* O Mull			+					+																						
M. italica (Ehr.) Kutz.		+																												
M. distans (Ehr.) Kutz.		2	+		+																									
M. arenaria Moore	2													+																
Cyclotella Kutzingiana Thwaites									+																					
C. stelligera Cl et Grun.			+																			+								
C. ocellata Pant.													+		+	+	+		+											
C. Meneghiniana Kutz.	+	+			+																									
C. comta (Ehr) Kutz.	2	19	1	+		7			+	2	+	+			+	1	+		9	7			11				+	+	5	
Stephanodiscus astraea (Ehr.) Grun	2		20		2	1	1	+		+	+				+		+		+			+							
S. Hantzschii Grun.	+	+	+																				17							
Cosmiodiscus lacustris Grun.	+																		4											
Tabellaria fenestrata (Lyngby) Kutz.	+	+	5	1	3	2		1	+				+																	
T. flocculosa (Roth) Kutz	+			+		+	+			+											+									
Diatoma vulgare Bory.			2	+																										
D. vulgare v. *grandis* (W. Sm) Grun.	+					+			+	+	+									5	+									
D. elongatum Agardh.	+	+	+					+		+																+				
Meridion circulare Agardh.								+			+																			
Opephora marina Hëmbaud	2				3		+	2			+				+	7			3	+										
Fragilaria crotonensis Kitton			+				+	+	+		+																			
F. capucina Desmazières	+																													
F. capucina v. *Mesolepta* (Rabh.) Grun.	+																													

F. intermedia Grun.	+		+	2	2		+	+	+				+	+		4						2								
F. harrissonii W. Sm. ..					+	+	+	+	+	+		+		+	4	1				1		+								
F. harrissonii v. *rhomboides* Grun.										+	+																			
F. harrissonii v. *dubia* Grun. ..	+																+													
F. construens (Ehr.) Grun. ..	1					+		7	+	8	+			+	+		+		+	8			+							
F. construens v. *binodis* (Ehr.) Grun.	+				+	+	50	1	+	+				+	+	+			+	+										
F. construens v. *venter* (Ehr.)	+								+	+		+				+				+										
F. pinnata Ehr.		+			+		+	+	+																					
F. pinnata v. *lancettula* (Schun.) Hust.								+			+																			
F. virescens v. *elliptica* Hust. .		+		+													+		1	+				+		+	+	+		+
F. undata W. Sm.		+																												
F. undata v. *quadrata* Hust .		+																												
Asterionella formosa Hassall ..			+					+																						
Synedra ulna (Nitzsch.) Ehr. ..	2		1						+		+							+					6		+					
S. ulna v. *danica* (Kutz.) Grun.	+																													
S. capitata Ehr. .									+																					
S. acus Kutz.	+																													
S. rumpens Kutz.	+																													
S. pulchella Kutz.	+																													
S. vaucheriae v. *capitellata* Grun.																							+							
S. parasitica W. Sm.	+	+	+			+		3											+											
S. parasitica v. *subconstricta* Grun.	+	+	+													+			1											
Peronia erinacea Bréb. et Arn.																										+	+			+
Eunotia robusta v. *tetraodon* (Ehr.) Ralfs.		+																						+	+	+	+		+	+
E. robusta v *diadema* (Ehr.) Ralfs.																									+	+			+	+
E. praerupta Ehr.			+			+											+						+			+		+		+
E. arcus Ehr . . .																									+				+	
E. arcus v. *bidens* Grun. .																					+									
E. arcus v. *fallax* Hust. ...									2			+		+							4	+								
E. tenella (Grun.) Hust. .																								3						
E. pectinalis (Kutz.) Rabh .		+																	4				3	+		3	5	+	4	2
E. pectinalis v. *minor* (Kutz.) Rabh.																													+	
E. pectinalis v. *minor* fo. *impressa* (Ehr.)		+			+																				+	+	+	+	+	+
E. pectinalis v. *undulata* (Ralfs) Rabh.																									+					
E. pectinalis v. *ventralis* (Ehr.) Hust.																										+		+		+

TABLE I.—*The distribution of Diatoms in the loughs*—continued.

	Neagh	Eskragh	Erne	Carrick	Melvin	Glencar	Gill	Gara (St. I)	Gara (St. II)	Key	Arrow	Colgagh	Talt (St. I)	Talt (St. II)	Conn (St. I)	Conn (St. II)	Cullin	Leveallly	Corrib (N.)	Corrib (S.)	Bunny	Rea	Beltra	Kylemore	Balynahinch	Derryclare	Oorid	Arddcrry	Aunierin	Bofin
E. veneris Kutz.) O. Mull. ..		19		+																			+	+	+	2			+	
E. faba (Ehr.) Grun. . .																														
E. elegans Ostrup		++																												
E. lunaris (Ehr.) Grun.		++		+	+				+										+					+	+				3	8
E. lunaris v. *subarcuata* (Naeg) Grun.																														
E. monodon v. *maior* (W. Sm.) Hust.																														
E. monodon v. *maior* fo. *bidens* (W. Sm.)																														
E. flexuosa Kutz.																														
E. spp.																														
Cocconeis placentula Ehr.	20	18	5		15	6	11	5	+	13	11	1	23	42	10	41	41	19	8	3		5				3				2
C. placentula v. *euglypta* (Ehr.) Cleve	+						2																							
C placentula v. *klinoraphis* Get.					+											+														
C. dimmuata Pant. ..																														
C. disculus Schum. ..								+				7	5	2	++	+	+	3	++++		10		+	7	1	+				
Achnanthes flexella (Kutz.)		+		1					4																					
A. flexella v. *alpestris* (Brun)				+	+			+	++	+	+	+	+	+		+	+		+		++		++	+				+	
A. microcephala Kutz.																														
A minutissima Kutz. ..					+								++		+						5				+					
A. linearis W. Sm		+		+								+				+								+						
A. trinodis Arnott ..		+					+		+	+				+		+	+		+								+			
A. exigua Grun.	+			+	+			+																						
A. Peragalli Brun. et Hér. ..	+																													
A. calcar Cleve.	+			+	+				+																					
A. lanceolata Bréb.																				+										
A. lanceolata v. *elliptica* Cleve. ..			1	4	7			+			+				15	7	11	13	+	5				2						
A. lanceolata v. *rostrata* Hust. .	+	+																												

	5	9		33	18	9	18		40	51	9	7	27	43	24	+	34	47	12	10		4	4	6	25	8	9	19	9	
A. coarctata Bréb.				1																										
A. spp.	5	9								+	+	1	3	+	+	+	+	+				1								
A. gracillima Hust.																					+									
Rhoicosphenia curvata (Kutz.) Grun.			+					+											3			12								
Mastogloia Grevillei W. Sm. ..			+					3				2	5						1			+								
M. smithii v. *lacustris* Grun. ...								1			5																			
M. smithii v. *amphicephala* Grun.								+			5																			
Amphipleura pellucida Kütz. ..				+										+	+		++								+					
Frustulia rhomboides (Ehr.) de Toni		2																				2								
F. rhomboides v. *saxonica* (Rabh.) de Toni ...		+					4															+	+	21	4					
F. vulgaris Thwaites				+												+						+								
Gyrosigma acuminatum (Kutz.) Rabb.		2		1	1	4	+		+	+	+	1	+	+			+			2										
G. attenuatum (Kutz.) Rabh. ..		+		+		+																								
Caloneis amphisbaena (Bory) Cl																														
C. amphisbaena v. *subsalina* (Donk.) Cl.	+																													
C. latiuscula (Kutz.) Cleve. .								+	+	+					3	+									+					
C. bacillum (Grun.) Meres .		+		+		+	+					+		+			+										+		
C. silicula (Ehr.) Cleve ..		+		+				+		+					+															
C. schumanniana v. *bavaensis* Grun.													+																	
C. alpestris (Grun.) Cleve .								+		+		+																+		
Navicula bisculeatum (Lagerst) Cleve.																														
N. affine v. *amphirhynchus* (Ehr.) Cleve		+				+																								
N. irrita (Ehr.) Cleve.					+																					+				
N. irrita fo *vernalis* Reichelt ..																										+				
N. producta (W. Sm.) Cleve																														
N. dubium (Ehr.) Cleve. .	1								+	+			+			+	+	+				+								
N. hitchcockii (Ehr.) Cleve. .		+																												
Diploneis ovalis (Hilse) Cleve ..	1	+		+	+	+	+		+	2	+		+	+	+	+	+	1		2				+	+			1		
D. ovalis v. *oblongella* (Naeg.) Cleve.		+		+			+		1																					
D. margaritata Hust. .		+		+						+							+							+						
D. puella (Schumann) Cleve.																					+					+				
D. elliptica (Kutz.) Cleve. .																														
D. domblittensis (Grun.) Cleve.								+																						

TABLE I.—*The distribution of Diatoms in the loughs*—continued.

	Neagh	Erskragh	Erne	Carrick	Melvin	Glencar	Gill	Gara (St. I)	Gara (St. II)	Key	Arrow	Colgagh	Talt (St. I)	Talt (St. II)	Conn (St. I)	Conn (St. II)	Cullin	Levally	Corrib (N.)	Corrib (S.)	Bunny	Rea	Beltra	Kylemore	Balynahinch	Derryclare	Oorid	Arddcrry	Aunierin	Bofin
D. donblittensis v. *subconstricta* A. Cl.																														
D. finnica (E.) Cl.											+		+																	
Stauroneis phoenicenteron Ehr.		++																							+++	++				+
S. anceps Ehr. ...									+							+														
S. anceps fo. *gracilis* (Ehr.) Cleve. ..		+																												
S. acuta W. Sm. ..					+																									
S. parvula Grun. .					+		+									+									+					
S. smithii Grun. .		+	+			+																								
Anomoeoneis sphaerophora (Kutz.) Pfitzer.									+																					
A. serians (Bréb.) Cleve. .																														
A. serians v. *brachysira* Bréb. Hust.																														
A. serians v. *brachysira* fo. *thermalis* (Grun.) Hust. .				+					+					+										3					
A. exilis (Kutz.) Cleve. .		++						3	2			+	++	+					+		+			7	13				
A. exilis v. *lanceolata* A. Mayer ..									++															7	++				
A. zellensis (Grun.) Cleve. .										+			+				+			++		+							
Navicula cuspidata Kutz. .			+		+					+																				
N. mutica v. *nivalis* (Ehr.) Hust.			+		+			1			++		+																	
N. binodis Ehr.	+																													
N. bacillum Ehr.					5		+																							
N. bacillum v. *gregoryana* Grun.				3	+			1					+	+			+		+	+	+	2				+		+		
N. pupula Kutz. ...	3	+	2						+																					
N. pupula var. *capitata* Hust. ..																														
N. pupula var. *rectangularis* (Greg.) Grun. ...																						1								

N. cocconeiformis Greg. ...	2	2		1	+						+				+	+	4	12	7	+	1		1			+			2	+
N. pseudoscutiformis Hust. ...		+		10	4		+								3	+	+		3					1	+				+	
N. cryptocephala Kütz. ...	7		+		10	+	1	1	+	1	+	6							3		5		3					3		2
N. cryptocephala v. *intermedia* Grun.				17																										
N. rhyncocephala Kütz. ...	+	+	2	+	+		+	+																						+
N. viridula Kütz.					+																									
N. vulpina Kütz.			+	+	+			+			+		+			+			+											
N. costulata Grun.								2																						
Navicula hungarica v. *capitata* (Ehr.) Cleve.	+	+	+		1		+	+		+							+													
N. cari Ehr.			+		1		+	+	+		+		+			+	+	+				+								
N. cari v. *angustata* Grun. ...		+							+		+													+	+	+	+	+	+	+
N. radiosa Kütz.	1	3	2	5	3	5	3	1	2	2	1	1	+	+	+	1	+	+	1	4	2	3	3	10	+	8	1	3	2	6
N. gracilis Ehr.			+		+																	+								
N. menisculus Schumann ...			1		+		+	+			+											9								
N. reinhardtii Grun.	2	+						+		+	+					+	+		+			+	+							
N. laterostrata Hust.																+														
N. dicephala (Ehr.) W. Sm . ..	+	+										+								+		+								
N. placentula fo. *latiuscula* (Grun.) Meister										+	+																			
N. placentula fo. *rostrata* A. Mayer	+		+								+					+	+													
N. platystoma Ehr.	+																													
N. lanceolata (Agardh) Kütz. ..	+		2		+			+				1	+	+	+	+			+		+		+							
N. hasta Pantocsek											+	+																		
N. oblonga Kütz.	+								+		+	3		+																
N. tuscula (Ehr.) Grun. ..	1		+						+	+	+	+	+	+		+	+	+			+		+							
N. tuscula fo. *rostrata* Hust. ..	+											+	4	+		1	+	3			+									
N. tuscula fo. *obtusa* Hust. ...	+				+																									
N. scutelloides W. Sm. ...	+				+		4	+	+	+	4		+		+	+	+													
N. pygmaea Kütz.											+				+															
N. rostellata Kütz.				2		6		1				4		+	+	+	+		5		3	+								
Pinnularia undulata Greg. ...																								+	+	+		+	+	5
P. appendiculata (Ag.) Cleve. ...		+																												
P. subcapitata v. *hilseana* (Janisch) O. Müll.		+																										+		
P. interrupta W. Sm.		+																								+				+
P. mesolepta (Ehr.) W. Sm. ...							+																							
P. globiceps Greg.		+																										+		
P. divergentissima (Grun.) Cl. ...																							+			+	+			3
P. microstauron (Ehr.) Cl. ...																														

TABLE I.—*The distribution of Diatoms in the loughs*—continued.

	Neagh	Eskragh	Erne	Garrick	Melvin	Glencar	Gill	Gara (St. I)	Gara (St. II)	Key	Arrow	Colgagh	Talt (St. I))	Talt (St. II	Conn (St. I)	Conn (St. II)	Cullin	Levally	Corrib (N.)	Corrib (S.)	Bunny	Rea	Beltra	Kylemore	Balynahinch	Derryclare	Oorid	Ardderry	Aunierin	Bofin
P. mucrostauron v. *brebissonii* (Kutz.) Hust.																														
P. subsolaris (Grun) Cl.																							5							
P. divergens W. Sm.																									+	+	+	+	+	+
P. divergens v. *undulata* Héri et Peragallo																									+	+	+	+	+	
P. episcopalis Cl.																							1			3				
P. alpina W. Sm.																											+	+	+	+
P. borealis Ehr.																											+	+	+	+
P. gibba Ehr.			+														+													
P. gibba fo *subundulata* Mayer		+															+						1							
P. stomatophora Grun.																														
P. acrosphaera Brèb.		+								+																				
P. nodosa Ehr.																														
P. maior Kutz.	+																		+											
P. dactylus Ehr.		+																												
P. viridis (Nitzsch.) Ehr.		+																												
Amphora ovalis Kutz.	+	+	2	+		5	+		+	+		+	9		+	+	+	+	+			+								+
A. ovalis v. *pediculus* Kutz.	9		+	3		3	7		7	17	8	33			28	6	2	1	7	9	1	3								
A. veneta Kutz.								+	6		+		+		+	2	1	+	+		+	+								
Cymbella microcephala Grun.		+				+							3								+	1								
C. cesatii (Rabh.) Grun.		+				1			7												6		6	4		2	7	4		
C. obtusiuscula (Kutz.) Grun.													+								5	+								
C. delicatula Kutz.														+																
C. laevis Naeg.					2		3										+													
C. lepiceros (Ehr.) Grun.		+		+		3			+			+	1			+					+	1								
C. ehrenbergii Kutz.		+					3		+			1																		
C. naviculiformis Auerswald	+			+																										

C. cuspidata Kutz.	+							+	2	+	+	2	+	+	+	+	+					+								+
C. hybrida Grun.									7			3									+							+		
C. lacustris (Ag.) Cl.	+									+																				
C. prostrata (Berk.) Cl. ..			+			+	+		+	+	+	+	+	+					+			+		1	+		+	+		
C. ventricosa Kutz.	6	5	+	7	1	5	1	+	9	2		+	2	1		3	+	1	5	7	3	6	6	+	+	+		4	1	+
C. gracilis (Rabh.) Cl. .		1		+																			+	2	5	10	4	+	2	+
C. norwegica Grun.																						2								
C. incerta Grun.									3														+		+	2			+	+
C. perpusilla A. Cl.									+																					
C. aequalis W. Sm.					+		+						+	+							+		+	+	+	+		1		
C. sinuata Greg.	+		+		+						+		+	+	+	+	+	+				+								
C. affinis Kutz.		+	+		+	+		5	8			9	4	3	1					1	4		+	+	1		2	2		
C. hustedtii Krasske																												+		
C. parva (W. Sm.) Cl. ..											+		+											+	+		+	+		
C. cistula (Hemp.) Grun. ..	+		+									+						2						+	+	+				
C. cistula v. *maculata* (Kutz.) V. H.											+																	+		
C. lanceolata (Ehr.) V. H. ..									+	+		+																		
C. helvetica Kutz.	1	3				11			8			3	9	+			+	+	7	1	16	25	+							
C. aspera (Ehr.) Cl.		+									+																			
C. obtusa Greg.									1													6								
C angustata (W. Sm.) Cleve ..																+						+								
C. thumensis (A. Mayer) Hust.									+			+	+							+		+								
Didymosphenia geminata (Lyng.) M. Sch.																							+							
Gomphonema acuminatum Ehr. .																													+	
G. acuminatum v. *coronata* (Ehr.) W. Sm.	+	+	+	2	+		+																+	+	1	+	+	+	+	1
G. acuminatum v. *brebissonii* (Kutz.) Cl.			+			+																	4							
G. acuminatum v. *turris* (Ehr.) Cl.																				+	+									
G. parvulum Kutz.	+																													
G. parvulum v. *subelliptica* Cl. .																+														
G. intricatum Kutz.	+													+										+	+				+	
G. intricatum v. *pumila* Grun. .	+	10	1	+	13		+		1	+	+		3				+		10	+		20				5				
G. intricatum v. *vibrio* (Ehr.) Cl.																									+					
G. constrictum Ehr.	1				+						+																			
G. constrictum v. capitata (Ehr.) Cl.	+	+	+																											
G. olivaceum (Lyng.) Kutz. ..			+		+		+				+					+														
G. olivaceoides Hust.																						+								

TABLE I.—*The distribution of Diatoms in the loughs*—continued.

	Neagh	Eskragh	Erne	Carrick	Melvin	Glencar	Gill	Gara (St. I)	Gara (St. II)	Key	Arrow	Colgagh	Talt (St. I)	Talt (St. II)	Conn (St. I)	Conn (St. II)	Cullin	Levally	Corrib (N.)	Corrib (S.)	Bunny	Rea	Belfra	Kylemore	Balynahinch	Derryclare	Oorid	Arddeiry	Aunierin	Bofin
Denticula tenuis Kütz. ...		+	+	3	9	31	5		+	15		+	20	3	+	3	+		13	31	6	+	7	+	+	+	1	1		
Epithemia spp. ...	11													8																
Epithemia argus v. *longicornis* Grun. ...	+																													
*E. mueller*ı Fricke ...									++										+											
E. zebra (Ehr.) Kutz. ...									2	+				+																
E. zebra v. *saxonica* (Kutz.) Grun. ...	+						1	+			6		+	+			+	+		+			+							
E. zebra v. *porcellus* (Kutz.) Grun. ...											+	7	1			3					+									
E. intermedia Fricke ...									+		13			+				+												
E. turgida (Ehr.) Kutz. ...												+	++	+																
E. turgida v. *granulata* (Ehr.) Grun. ...	+										+	+	+	+			+													
E. hyndmanni W. Sm. ...											+	+	+	+			+													
E. sorex Kutz. ...	+									+	+	+																		
Rhopalodia parallela (Grun.) O. Mull. ...	+									+																				
R. gibba (Ehr.) O. Mull. ...								+																						
R. gibba v. *ventricosa* (Ehr.) Grun. ...								2																	+					
Hantzschia amphioxys (Ehr.) Grun. ...																					+									
Nitzschia tryblionella Hant. ...	+		++						+	+																				
N. angustata (W. Sm.) Grun. ...			1			1		3	4	++		+	3	+		+	+		+	+	7	1			+			1	1	
N. angustata v. *acuta* Grun. ...																						+								
N. thermalis Kutz. ...			+						+	+		+	+	+		+				+	+	+								
N. denticula Grun. ...																														

N. sinuata (W. Sm.) Grun.									1					+																
N. dissipata (Kutz.) Grun.			7	+	+	4	+	1	+	+	+					+	+		+	1		6	1	+				+		
N. capitellata Hust.			+									+					+					2								
N. amphibia Grun.											+																			
N. frustulum v. *perminuta* Grun.																					5	+								
N. fonticola Grun.	+																	2												
N. palea (Kütz.) W. Sm.	+																													
N. sigmoidea (Ehr.) W. Sm.			+		+	+	1	+	+		+			+	+	+		+												
N. ignorata Krasske.				+																										
Cymbellonitzschia diluviana Hust.	17											+																		
Cymatopleura solea (Bréb.) W. Sm.	+		+		+	+	+	+	+	+	2						+			+		3								
C. solea v. *regula* (Ehr.) Grun.			+																											
C. solea v. *apiculata* (W. Sm.) Ralfs.																				+										
C. elliptica (Bréb.) W. Sm.	+		+			+	+	+	+	+				+	+	+	+						+							
C. elliptica v. *hibernica* (W. Sm.) Hust.													+																	
C. elliptica v. *constricta* Grun.									+																					
Stenopterobia intermedia Lewis																								+	+	+		+	+	+
Surirella biseriata Bréb.																														
S. linearis W. Sm.		+	+	+		+	+		+		+						+	+	+	3	+		+	+	+	+	+	+		+
S. linearis v. *constricta* (Ehr.) Grun.											+				+														+	
S. linearis v. *helvetica* (Brun.) Meist.										+																				
S. birostrata Hust.																									+	+			+	
S. gracilis (W. Sm.) Grun		+																												
S. angustata Kütz.					+		+																							
S. delicatissima Lewis																									+				+	+
S. tenera Greg.			1																											
S. robusta Ehr.		+																												
S. robusta v. *splendida* (Ehr.) V. H.			+																											
S. elegans Ehr.		+																												
S. ovata Kütz.	+		+					3	+												2									
Campylodiscus noricus v. *hibernica* (Ehr.) Grun.											+																			

in distilled water and mounted in Hyrax, so that the diatom frustules could be identified and counted. The samples, rich in calcium carbonate, were decalcified before boiling in the acids. Three slides were prepared from each sample and identification of all the diatoms was attempted. A random count was then made of 100 frustules in order to determine dominance; these are the records compiled in Table I.

THE FLORA.

The total diatom flora comprises some 289 taxa which can be grouped according to their distribution in the various loughs. Since only one, or, at the most, two samples were taken from each lough, the data in Table I are unlikely to be a complete list of the taxa in each. Nevertheless an attempt has been made to record all the major taxa and thus give a fairly comprehensive picture of the composition and distribution of the flora. On the basis of their distribution the species may be divided into 6 groups:

Group I. Species widely distributed and fairly abundant in loughs of both types.

These species tolerate a wide range of nutrient conditions and are sometimes referred to as " indifferent species ". This term is misleading, since they often have an optimum development over part of their range. Although it was not possible to measure any nutrient factors the geology of the regions can be used to indicate the nutrient status of the waters and this can be amplified from biological evidence obtained from a study of the phytoplankton of the loughs (Round and Brook, 1959). The species of wide tolerance can be seen by inspection of Table I, but it is preferable to use a more exact method of classification. The occurrence of a species in 50% of the samples from both the acid and the alkaline loughs has been selected as a suitable criterion for this group. This gives the following species:—*Cyclotella comta*, *Achnanthes flexella*, *A. microcephala*, *Diploneis ovalis*, *Navicula cocconeiformis*, *N. radiosa*, *Cymbella naviculiformis*, *C. prostrata*, *C. ventricosa*, *C. affinis*, *Denticula tenuis*, *Nitzschia angustata* var. *acuta* and *Surirella linearis*. Of these only *N. radiosa* is more abundant in the acid series of loughs; *S. linearis*, *C. prostrata*, *A. microcephala* and *Cyclotella comta* are approximately equally distributed in either series ; and the remainder are more abundant in the alkaline loughs.

There are only a few species which are equally sparsely scattered in both of the lough types. The majority are confined, or almost so, to one group or another. Only isolated species such as *Diatoma elongatum*, *Caloneis latiuscula*, *Neidium iridis*, *N. affine* var. *amphirhynchus*, *Stauroneis parvula*, *Cymbella cistula* (and var. *maculata*) have an equally low rate of occurrence in both types.

GROUP II. SPECIES MORE ABUNDANT IN THE CALCAREOUS LOUGHS.

This group may be divided into two (*a*) species which are confined to the calcareous loughs, and (*b*) species common in the calcareous loughs, but also found sparsely in the acid series. Occurrence in 50% or more of the loughs in the alkaline series is the criterion used to delimit this group of species.

The subgroup (*a*) comprises the following alkaliphilic species:— *Opephora martyii*, *Fragilaria intermedia*, *F. harrissonii*, *F. construens* var. *binodis*, *Gyrosigma attenuatum*, *Navicula cari*, *N. scutelloides*, *N. rostellata*, *Amphora ovalis* var. *pediculus*, *Cymbella sinuata*, *Nitzschia sigmoidea*, *Cymatopleura solea* and *C. elliptica*. These are species which, owing to their distribution, may be regarded as good indicators of neutral to alkaline waters (cf. Round, 1956, where they are distributed only sparsely in the more eutrophic of the English Lake District Lakes).

Subgroup (*b*) comprise the following species, the number of acidic loughs in which they also occur is given in brackets after each:—

Stephanodiscus astreae (1), *Fragilaria construens* (1), *Cocconeis placentula* (3), *A. lanceolata* var. *elliptica* (1), *Gyrosigma acuminatum* (1), *Caloneis bacillum* (2), *Neidium dubium* (1), *Navicula pupula* var. *capitata* (3), *N. cryptocephala* (3), *N. lanceolata* (1), *N. tuscula* (1), *Amphora ovalis* (2), *A. veneta* (1), *C. cuspidata* (1), *Cymbella helvetica* (1), *Gomphonema intricatum* var. *pumila* (2), *Epithemia zebra* var. *saxonica* (1), *Nitzschia dissipata* (3). The low rate of occurrence of all these species in the acid loughs suggests that they only extend slightly into acid waters and undoubtedly reach their greatest development in the alkaline series. The presence of these species in certain of the acid loughs may distinguish these loughs from the rest of the acid series.

GROUP III. SPECIES PRESENT IN THE CALCAREOUS LOUGHS BUT NOT SO ABUNDANT AS THOSE OF GROUP II.

A subgrouping similar to that made in Group II is desirable here. Only species present in 5 or more loughs, i.e., distributed in 25% of the calcareous loughs, are recorded.

Subgroup (*a*) includes species present in 5 or more calcareous loughs (but less than 11) and completely absent from the acid series. These are *Melosira varians*, *Cyclotella occellata*, *Diatoma vulgare*, *Fragilaria crotonensis*, *F. construens* var. *venter*, *F. pinnata*, *Synedra parasitica*, *Eunotia arcus* var. *fallax*, *Achnanthes peragalli*, *A. calcar*, *Mastogloia smithii* var. *amphicephala*, *Navicula bacillum*, *N. pupula*, *N. vulpina*, *N. hungarica* var. *capitata*, *N. menisculus*, *N. dicephala*, *N. placentula* fo. *rostrata*, *N. oblonga*, *Cymbella leptoceros*, *C. ehrenbergii*, *C. thumensis*, *Gomphonema olivaceum*, *Epithemia intermedia*, *E. sorex*, *Rhopalodia parallela*, *R. gibba*, *Nitzschia denticula* and

Surirella ovata. Since these species are confined to the calcareous loughs but only present in a small number of them, it is possible that they are indicators either of extreme or moderate calcium content and delimit a subgroup within the calcareous facies, or further that their presence in only a few loughs is fortuitous (see discussion).

(*b*) These are species present in 5 or more calcareous loughs and occur in a few of the acid loughs the number of which are given in brackets :— *Melosira granulata* (1), *Synedra ulna* (2), *Achnanthes linearis* (1), *A. exigua* (2), *Mastogloia smithii* var. *lacustris* (1), *Caloneis silicula* (2), *C. alpestris* (1), *Diploneis marginestriata* (2), *Stauroneis smithii* (1), (*Anomoeonis exilis* (6)), *Navicula pseudoscutiformis* (3), *N. rhyncocephala* (1), *N. reinhardtii* (1), *N. tuscula* fo. *obtusa* (1), (*Cymbella cesatii* (7)), (*Gomphonema angustatum* var. *coronatum* (8)). The species bracketed, although selected by this analysis, are also present in all or almost all of the acid series of loughs. If abundance of cells is considered, the first two must be placed in the acidophilic section (see later), whilst the *Gomphonema* species is peculiar in that it is present in all the acid loughs and confined to seven of the calcareous loughs. This suggests that the loughs supporting *G. angustatum* var. *coronatum* are less calcareous than the others of their group.

The two groups of taxa within Group III are of different ecological ranges. The subgroup (*a*) includes species of extreme alkaline lake types, whilst subgroup (*b*) includes taxa of less alkaline lakes, which are species not favoured by extreme alkalinity or acidity. In fact, the methods of selection may result in some of either ecological group occurring in either subgroup (*a*) or (*b*) (see discussion).

Group IV. Rare species confined to the calcareous loughs.

These are all recorded in Table I and only those of possible indicator value are listed here, viz., *Melosira arenaria*, *Coscinodiscus lacustris*, *Achnanthes trinodis*, *Diploneis domblittensis* var. *subconstricta*, *Navicula costulata*, *Cymbella aspera*, *Gomphonema constrictum* (and var. *capitata*), *Epithemia* spp., *Cymbellonitzschia diluviana*, *Cymatopleura* spp. and *Campylodiscus noricus* var. *hibernica*. These are all indicators of calcareous sediments (cf. the late glacial sediments of Kentmere, Round, 1957).

Group V. Species common in the acid series of loughs.

These are all species which are extremely sensitive to the presence of bases in the waters and in the benthos correspond to the so-called Caledonian phytoplankton species. Two subgroups can be recognised. Subgroup (*a*) includes all species confined to the acid loughs; *Eunotia robusta* var. *tetraodon* *E. robusta* var. *diadema*, *E. faba*, *E. elegans*, *E. monodon* var. *maior* fo. *bidens*, *Frustulia rhomboides*, *F. rhomboides* var. *saxonica*, *Stauroneis phoenicentron*, *Anomoeoneis serians*, *Pinnularia undulata*, *P. microstauron*, *P. divergens*, *Stenopterobia intermedia*.

Subgroup (*b*) includes species common in the acid loughs but also found in a few of the calcareous loughs, the numbers of which are given in brackets, viz. : *Tabellaria flocculosa* (9), *Fragilaria virescens* var. *elliptica* (4), *Eunotia praerupta* (2), *E. pectinalis* (1), *E. pectinalis* var. *minor* fo. *impressa* (1), *E. veneris* (1), *E. lunaris* (4), *Achnanthes flexella* var. *alpestris* (4), *Anomoeoneis serians* var. *brachysira* fo. *thermalis* (3), *A. exilis* (5), *A. exilis* var. *lanceolata* (4), *Pinnularia gibba* (1), *P. viridis* (3), *Cymbella cesatii* (5), *C. gracilis* (1), *C. incerta* (1), *C. aequalis* (4), *C. parva* (2), *Gomphonema acuminatum* var. *coronata* (6), *G. intricatum* (2).

Group V (*a*) can be considered as species confined to waters of extremely low base status whilst those of V (*b*) tolerate a small increase in base status.

GROUP VI. SPECIES OCCURRING IN THE ACID SERIES BUT PRESENT IN LESS THAN 50% OF THESE LOUGHS.

Subgroup (*a*). Confined to the acid loughs. *Synedra vaucheriae* var. *capitellata*, *Fragilaria undata* and var. *quadrata*, *Peronia erinacea*, *Eunotia arcus*, *E. tenella*, *E. pectinalis* var. *undulata*, *E. pectinalis* var. *ventralis*, *E. lunaris* var. *subarcuata*, *E. monodon* var. *maior*, *E. flexuosa*, *Neidium iridis* fo. *vernalis*, *N. productum*, *N. hitchcockii*, *Diploneis fennica*, *D. elliptica*, *Stauroneis anceps* fo. *gracilis*, *Pinnularia appendiculata*, *P. subcapitata* var. *hilseana*, *P. interrupta*, *P. globiceps*, *P. divergentissima*, *P. microstauron* v. *brebissonii*, *P. subsolaris*, *P. divergens* var. *undulata*, *P. episcopalis*, *P. alpina*, *P. stomatophora*, *P. acrosphaeria*, *P. nodosa*, *P. dactylus*, *Didymosphenia geminata*, *Gomphonema intricatum* var. *vibrio*, *G. olivaceoides*, *Surirella birostrata*, *S. gracilis*, *S. delicatissima*, *S. robusta*, *S. elegans*.

Subgroup (*b*). Species found occasionally in the alkaline loughs: *Neidium bisculatum* (1), *N. iridis* (1), *Stauroneis anceps* (2), *Anomoeoneis zellensis* (1), *Pinnularia borealis* (1), *P. maior* (2), *Cymbella incerta* (1), *C. cistula* (3) and var. *maculata* (1). Species which could be recorded in subgroup (*b*), but obviously belonging in Group II (*b*) or III (*b*) are excluded.

The total number of species in each lough varies between 90 (L. Neagh) and 25 (L. Levally). The average number of species is 52 in the calcareous loughs and 54 in the acid, these are not appreciably different.

The preceding analysis shows that certain genera are favoured by one or the other type of water. Thus *Fragilaria*, *Cocconeis*, *Achnanthes*, *Mastogloia*, *Gyrosigma*, *Caloneis*, *Diploneis*, *Neidium*, *Navicula*, *Amphora*, *Cymbella*, *Denticula*, *Epithemia*, *Rhopalodia*, *Nitzschia* and *Cymatopleura* are more abundant in the calcareous loughs. On the other hand, *Tabellaria*, *Peronia*, *Eunotia*, *Frustulia*, *Anomoeoneis*, *Pinnularia* and *Stenopterobia* are more frequent in the acid loughs. Thus there is clearly a difference in the number of genera prevalent in the two types, 16 in the one as opposed to 7 in the other, but as noted above the average number of species appears to be similar.

Of the dominant species in the calcareous loughs, see Table II, only 8 are found in more than one of them. These are as follows, with the

number of loughs in which they form over 10% of the total diatom population given in brackets: *Cocconeis placentula* (14), *Achnanthes* spp. (15), *Denticula tenuis* (5), *Achnanthes lanceolata* v. *elliptica* (3), *Cymbella helvetica* (3), *Gomphonema intricatum* v. *pumila* (3), *Melosira granulata* (2) and *Amphora ovalis* v. *pediculus* (2). The remaining species of Table II are dominants in only one lough. Of the 22 species in Table II, ten are mainly attached epiphytic or epilithic forms, viz., *Cocconeis placentula*, *Epithemia* spp., *E. intermedia*, *Achnanthes* spp., *A. lanceolata* v. *elliptica*, *Fragilaria* spp., *Cymbella helvetica*, *Gomphonema intricatum* v. *pumilla*, *Denticula tenuis* and *Amphora ovalis* v. *pediculus*. *Cyclotella comta*, *Melosira granulata* and *Stephanodiscus astreae* are planktonic and the remaining species epipelic. The species listed above, which are dominant in several loughs are, with the exception of *Melosira granulata*, attached forms. The absolute dominants in the samples are also taken from this community, with the exception again of the two loughs with *Melosira granulata* dominant and the somewhat aberrant L. Gara.

TABLE II.—*The dominant diatom species in the calcareous loughs.*

Neagh	*Cocconeis placentula* (20) ; *Cymbellonitzschia diluviana* (17) ; *Epithemia* spp. (11).[2]
Eskragh	*Cocconeis placentula* (18); *Eunotia veneris* (18); *Cyclotella comta* (18); *Gomphonema intricatum* v. *pumila* (10); *Achnanthes* spp. (10).
Erne	*Melosira granulata* (67); *Stephanodiscus astreae* (20); *Nitzschia dissipata* (7); *Cocconeis placentula* (5).
Carrick . .	*Achnanthes* spp. (32); *Navicula pseudoscutiformis* (10).
Melvin	*Achnanthes* spp. (18); *Cocconeis placentula* (14); *Gomphonema intricatum* v. *pumila* (12); *Denticula tenuis* (10).
Glencar	*Denticula tenuis* (32); *Cymbella helvetica* (10).
Gill	*Fragilaria* spp. (50); *Cocconeis placentula* (10).
Gara (St. I) ...	*Melosira granulata* (28); *Achnanthes* spp. (18); *Cocconeis placentula* (10).
Key	*Achnanthes* spp. (40); *Amphora ovalis* v. *pediculus* (17); *Denticula tenuis* (15); *Cocconeis placentula* (13).
Arrow	*Achnanthes* spp. (52); *Epithemia intermedia* (12); *Cocconeis placentula* (10).
Colgagh	*Amphora ovalis* v. *pediculus* (32); *Achnanthes* spp. (10).
Talt (St. I) ...	*Cocconeis placentula* (32); *Achnanthes* spp. (20).
Talt (St. II) ...	*Cocconeis placentula* (40); *Achnanthes* spp. (8).
Conn (St. I) ...	*Achnanthes* spp. (42), *Amphora ovalis* v. *pediculus* (28); *Achnanthes lanceolata* v. *elliptica* (14); *Cocconeis placentula* (10).
Conn (St. II) ...	*Cocconeis placentula* (40); *Achnanthes* spp. (24).

[2] Percentage occurrence in the counts

Cullin	*Cocconeis placentula* (40); *Achnanthes* spp. (34); *Achnanthes lanceolata* v. *elliptica* (12).
Levally	*Achnanthes* spp. (46); *Cocconeis placentula* (18); *Achnanthes lanceolata* v. *elliptica* (14); *Navicula cocconeiformis* (12).
Gara (St. II) ...	*Navicula rostellata* (12).
Corrib (N.) ...	*Denticula tenuis* (14); *Achnanthes* spp. (10); *Gomphonema intricatum* v. *pumila* (10).
Corrib (S.) . .	*Denticula tenuis* (30); *Achnanthes* spp. (10).
Bunny	*Cymbella helvetica* (16); *Eucocconeis flexella* (10).
Rea	*Cymbella helvetica* (26); *Mastogloia smithii* v. *lacustris* (12).

TABLE III.—*The dominant diatom species in the acidic loughs.*

Beltra	*Gomphonema intricatum* v. *pumila* (20); *Tabellarie flocculosa* (17);[2] *Cyclotella comta* (10).
Kylemore ...	*Tabellaria flocculosa* (39); *Frustulia rhomboides* v. *saxonica* (20); *Navicula radiosa* (10).
Ballynahinch ...	*Achnanthes* spp. (26); *Tabellaria flocculosa* (20); *Anomeoneis exilis* (14); *Anomoeoneis exilis* v. *lanceolata* (12).
Derryclare ...	*Frustulia rhomboides* v. *saxonica* (16); *Anomoeoneis exilis* v. *lanceolata* (16); *Cymbella gracilis* (10).
Oorid	*Tabellaria flocculosa* (18); *Frustulia rhomboides* v. *saxonica* (16); *Eunotia* spp. (16); *Achnanthes* spp. (10).
Ardderry ...	*Achnanthes* spp. (20); *Anomoeoneis exilis* v. *lanceolata* (12); *Tabellaria flocculosa* (11).
Aunierin	*Tabellaria flocculosa* (15); *Anomoeoneis exilis* (12); *A. exilis* v. *lanceolata* (12); *Achnanthes* spp. (10).
Bofin	*Anomoeoneis exilis* v. *lanceolata* (24); *Frustulia rhomboides* v. *saxonica* (18); *Tabellaria flocculosa* (14).

In the acidic loughs only nine species (Table III) are found with percentage occurrences of over 10 and five species, *Tabellaria flocculosa* (7), *Anomoeoneis exilis* v. *lanceolata* (5), *Frustulia rhomboides* v. *saxonica* (4), *Achnanthes* spp. (3) and *Anomoeoneis exilis* (2), occur in more than one lough, the numbers of which are in brackets. The absolute dominants in each lough are formed by the first four of the above five species and, with the possible exception of *A. exilis* v. *lanceolata*, are attached forms. *Frustulia rhomboides* v. *saxonica* also grows on sediments but is more common in the epiphytic and epilithic habitats where it forms long mucilage tubes inside which the frustules are found. Of the group of species in Table III only *Cyclotella comta* is planktonic, whilst *Navicula radiosa* and *Anomoeoneis exilis* are epipelic.

[2] Percentage occurrence in the counts.

The only genus which is dominant in both series of loughs is *Achnanthes*. Examination of Table I, however, shows that this range applies only to certain species of the genus and it is probable that a more detailed analysis would show little overlap of species from one series of loughs to the other. Of the remaining dominants only *Cyclotella comta* and *Gomphonema intricatum* v. *pumila* are common to both acidic and alkaline loughs. The calcareous series may be classed as *Cocconeis/Achnanthes/Denticula/Melosira granulata/Cymbella (helvetica)/Fragilaria* waters and the acid as *Tabellaria/Frustulia/Anomoeonis/Achnanthes* waters. Thus not only does the chemical nature of the waters affect a selection of species but it also greatly influences the growth, and hence dominance, of the components.

From a consideration of the dominants two loughs are outstanding. L. Eskraig supports the acidophilic *Eunotia veneris* and L. Beltra the alkaliphilic species *Gomphonema intricatum* v. *pumila* and thus both must be treated as intermediate lough types not truly assignable to either major subgroup (see later).

The subgrouping of the loughs into acidic and calcareous series is based primarily on the geology and surface deposits around each (Round and Brook, 1959). However, within these two broad sub-divisions it is pertinent to enquire whether or not further groups can be distinguished either from a consideration of the dominants, from indicator species, or from the slight extension of species favouring the acidic or calcareous habitats into the opposite habitat. In the calcareous series L. Eskraig is anomalous since, although situated in a region which is predominantly alkaline, it supports a flora in which a few distinctly acidophilic species are important, e.g., *Tabellaria flocculosa*, *Fragilaria undata*, *Eunotia veneris* (and other species to a lesser extent) and *Pinnularia* (8 spp. are recorded here compared with only 10 records of this genus for all the other calcareous loughs). Some species can be regarded as indicators of extreme alkalinity, being found most frequently in waters with deposits containing abundant calcium carbonate. These, with their distribution data, are given in Table IV, which shows that three loughs, Gara, Colgagh and Talt are probably the most calcareous of this series followed by loughs Bunny, Rea, Conn, Corrib and Arrow as an intermediate series, whilst the remainder are only moderately alkaline. Even the three extremely alkaline loughs support some species which are normally regarded as acidophilic, e.g., *Tabellaria flocculosa*, *Anomoeoneis exilis*, *A. exilis* v. *lanceolata* and *Cymbella cesatii*. This in no way alters the status of these three loughs but emphasises the wide range over which some species can grow even when their optimum growth occurs in highly acidic waters. Of the moderately calcareous loughs, Corrib has five acidophilic species in the flora, Bunny and Rea one each, and there is a slight scatter of some of these species in the remainder; none of these records are sufficiently important to affect the primary division of the calcareous loughs. The high calcium content of some of the loughs is not so high as to restrict the growth of any of the species favouring the alkaline waters.

TABLE IV.—*The distribution in the alkaline loughs of some indicators of extremely calcareous sediments.*

	Neagh	Erne	Carrick	Melvin	Glencar	Gill	Gara	Key	Arrow	Colgagh	Talt	Conn	Cullin	Levally	Corrib	Bunny	Rea
Mastogloia spp.							+			+	+	+	+			+	+
Navicula costulata .							+										
N. oblonga .. .	+						+		+	+	+						
N. tuscula . .	+	+		+			+	+	+	+	+	+	+	+		+	
Cymbella leptoceros .					+		+			+	+	+				+	
C. ehrenbergii ...							+				+					+	+
C. helvetica .	+				+		+			+	+		+	+	+	+	+
C. thumensis ...							+			+	+				+		+
Denticula tenuis ... (over 15% in counts)				+	+			+			+				+	+	
Epithemia intermedia									+	+	+	+				+	
E. sorex									+	+	+						+
E. spp. .. .	+				+	+	+	+	+	+	+	+	+	+	+		
Nitzschia denticula ..							+			+	+	+			+	+	+
N. sinuata .							+				+						
Total No. of records	4	1	–	2	4	1	11	3	5	10	13	6	4	3	5	8	6

Within the acid series L. Beltra is anomalous in that it supports species more common in the calcareous loughs and, as shown in Table V, has only three species indicating extreme acidity. The remaining acidic loughs subdivide into two series, the first contains many species tolerant of high acidity (L. Aunierin, L. Boffin, L. Derryclair and L. Ballynahinch) and the second contains fewer such species (L. Kylemore, L. Ardderry and L. Oorid). Of the alkaliphilic species only two (*Mastogloia*—1 record, *Denticula*—5 records) extend their range into the acid series of loughs, whereas several of the acidophilic species extended in the opposite direction. This suggests that diatoms are more sensitive to acidity than alkalinity (cf. Hustedt's (1945) comments on the greatest abundance of species in alkaline habitats).

TABLE V.—*The distribution in the acid loughs of some indicators of extreme acidity.*

	Beltra	Kylemore	Balynahinch	Derryclare	Oorid	Ardderry	Aunierin	Bofin
Tabellaria flocculosa	+	+	+		+	+	+	+
Fragilaria virescens v. *elliptica*		+		+	+	+		+
Peronia erinacea				+	+			+
Eunotia pectinalis	+	+		+	+	+	+	+
E. pectinalis v. *ventralis*				+		+		+
Frustulia rhomboides } above 10% in count	+		+		+		+	+
F. rhomboides v. *saxonica* } above 10% in count		+		+	+			+
Anomoeoneis serians		+			+		+	+
A. exilis } above 10% in count			+				+	
A. exilis v. *lanceolata* } above 10% in count			+	+		+	+	+
Pinnularia undulata		+	+	+		+	+	+
P. episcopalis							+	+
P. alpina			+	+			+	
P. stomatophora				+			+	+
Cymbella Cesatii } when in count above 1%			+	+	+	+	+	
C. gracilis } when in count above 1%		+	+	+	+		+	
Stenopterobia intermedia		+	+	+		+	+	+
S. birostrata			+	+			+	
S. delicatissima			+				+	+
Total No. of records	3	8	11	13	9	8	15	14

DISCUSSION.

As far as the author is aware no comparable data has been obtained by earlier workers for the algal floras of these or other lough sediments in Ireland. Data from the English Lake District (Round, 1957 (*a*), (*b*) and (*c*)) and from Malham Tarn (Round, 1953 and unpublished) are, however, strictly comparable since similar methods of analysis were used. The flora

of the acidic Irish loughs is similar to that of the Group I lakes (low nutrient status) of the English Lake District, particularly to the four "rocky lakes": Wastwater, Ennerdale, Buttermere and Crummock. Species which are common and/or abundant in the acidic waters of both regions are *Anomoeoneis exilis*, *A. exilis* v. *lanceolata*, *A. serians* v. *brachysira* fo. *thermalis*, *Frustulia rhomboides*, *F. rhomboides* v. *saxonica*, *Cymbella gracilis*, *Stenopterobia intermedia*, *Peronia erinacea*, *Eunotia pectinalis* v. *ventralis* and *Pinnularia undulata*. The regions differ in that *Surirella ovata* and its varieties occur in the English Group I lakes (Crummock and Buttermere only of the rocky lakes) whilst they are absent from the acidic Irish loughs but occur in some of the alkaline loughs, and also in the limitation of *Stauroneis phoenicenteron* to the acid Irish series whilst it is widespread in the English lakes. This latter species may be a calcifuge since it is very rare in Malham Tarn, Yorkshire (Round, unpublished data), and its absence from the calcareous series of Irish loughs suggests that they are more alkaline than even the productive Group II (higher nutrient status) lakes of the English Lake District. This emphasises the point (Round, 1957) that although there is a very wide range of calcium content in the sediment samples from the English Lake District, they are still all within the acidic range. The species in Table IV indicative of extreme alkalinity are either absent or only rarely found in the English lakes and of these only *Cymbella leptoceros* and *Denticula tenuis* are found in the "rocky" lakes, the former with a single isolated record and the latter never with a large number of cells. Of these alkaliphilic species only *Cymbella helvetica* is important in the flora of the English Lake District and then only in Brother's Water and Ullswater (Brother's Water flows into Ullswater). The species characteristic of the Group II lakes in the English Lake District are those requiring a high concentration of nutrients and a high pH ; as expected, these are also more frequent in the calcareous Irish loughs. The species abundant in the English Group I (acid, low nutrient) lakes are hardly represented in the calcareous Irish loughs.

Of the species found in the Irish loughs and absent from the English Lake District, two are confined to the acid series (*Neidium iridis* fo. *varnalis* and *Pinnularia microstauron* v. *brebissonii*) and twelve others extend their range into it. Important species growing on the English Lake District sediments but absent from those of the Irish loughs are *Tetracyclus lacustris*, *Diatoma hiemale* v. *mesodon*, *Fragilaria virescens*, *F. lapponica*, *Ceratoneis arcus*, *Eunotia exigua*, *E. parallela*, *E. sudetica*, *E. denticulata*, *E. flexuosa*, *Achnanthes obliqua*, *Neidium affine*, *N. iridis* v. *ampliata* fo. *rostrata*, *Diploneis boldtiana*, *D. petersenni*, *Pinnularia subcapitata*, *P. polyonca*, *P. platycephala*, *P. gibba* v. *linearis*, *P. brandelii*, *P. irrorata*, *P. cardinaliculis*, *P. semicruciata*, *Cymbella turgida*, *Gomphonema gracile*, *Hantzschia elongata*, *Nitzschia vermicularis*, *Surirella moelleriana*, *S. robusta* v. *splendida* fo. *punctata*, *S. tenera* v. *nervosa* and several others of less frequent occurrence (particularly some small *Navicula* species). These are all probably acidophilic species and their absence from the western Irish loughs may be related to the peatiness of the water rather than unfavourable pH conditions.

All the alkaliphilic species present in the calcareous English lake, Malham Tarn (Round, 1953 and unpublished), are present in the calcareous Irish loughs.

Several species recorded in the base rich Irish loughs, but absent from the present day flora of the English lake district are found in cores from lakes of that region (Pennington, 1943; Round, 1957d). Notable examples are *Melosira arenaria* (only recorded from L. Neagh, where it may be derived from the neighbouring late glacial deposits), *Fragilaria harrissonii* v. *dubia*, *Achnanthes calcar*, *A. peragallii*, *Caloneis latiuscula*, *Navicula placentula* fo. *rostrata*, *Cymbella delicatula*, *C. thumensis*, *Epithemia hyndmanni* and *Cymatopleura elliptica*. They are, however, confined to the late glacial period in the history of lakes of the English Lake District when conditions were certainly more alkaline than they are to-day. However, the indicator species of extreme calcareous conditons are rare, or in most instances completely absent, in the lower levels of the English Lake District cores, indicating that conditions of only moderate alkalinity existed at that time (Round, 1957). One species, *Cymbellonitzchia diluviana*, is new to the flora of the British Isles and has previously been recorded in alkaline interglacial sediments from Oberohe in the Lüneburger-Heide and recently in Priestersee (Lauenburg) and in Crater Lake, Oregon. Its abundance in L. Neagh may be due to the presence of the above-mentioned late glacial deposit but it has also been recorded in L. Colgagh, where it is probably a living species in the present flora. Comparison of the data from the acid and alkaline Irish loughs with that from other European waters of similar pH values, shows a remarkable degree of similarity but also a lack of certain "endemic" species in the Irish Loughs. Quennerstedt (1955) records many of the common species of the acid Irish Loughs in the Långan district in western Jämtland, Sweden. For example, important species in the Swedish lakes are *Achnanthes flexella* and v. *alpestris*, *Anomoeoneis exilis* and v. *lanceolata*, *A. serians* v. *brachysira* and fo. *thermalis*, *Cymbella gracilis*, *C. naviculiformis*, *C. ventricosa*, *Eunotia* spp., *Fragilaria virescens*, *Frustulia rhomboides* and var. *saxonica* and fo. *undulata*, *Gomphonema acuminatum* v. *coronatum*, *Melosira distans* v. *litrata*, *Navicula cocconeiformis*, *N. radiosa* v. *tenella*, *Nitzschia fonticola*, *Peronia heribaudii*, *Pinnularia* spp., *Stauroneis anceps* and fo. *gracilis*. *Stenopterobia intermedia*, *Surirella linearis* and *Tabellaria flocculosa* and v. *flocculosa*. Of these only the *Melosira* and the *Nitzschia* species are rare, whilst the others or closely related forms are common in the Irish loughs. Likewise the flora of the calcareous loughs has many species in common with calcareous waters at Abisko, Sweden (Hustedt, 1942), the Balkans (Hustedt, 1945) and the North German Holstein lakes (Hustedt, 1950); these species mainly belong to the genera *Fragilaria*, *Mastogloia*, *Navicula* (e.g., *N. tuscula* and *N. oblonga*), *Cymbella* (e.g., *C. ehrenbergii* and *C. helvetica*) *Epithemia*, *Rhopalodia*, *Nitzschia* (e.g., *N. sinuata* and *N. denticula*), and *Cymatopleura*. However, in the alkaline Balkan region many endemic species were recorded whereas none of these occur in Ireland and no group such as this occurs in the Irish waters.

SUMMARY.

The epipelic diatom flora of some Irish loughs lying in acidic and alkaline regions has been investigated. The distribution of the species has been analysed and compared with the flora of similar habitats in the British Isles and Europe.

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