Some Aspects of the Diatom Flora of Cabin Creek Raised Bog, Randolph Co., Indiana

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This is a brief study of the diatoms from Cabin Creek Raised Bog in Indiana. To my knowledge it is the only report of diatoms from such an area in this country other than that of Chapman (1). Chapman listed a total of nine diatom taxa from the Urbana (Ohio) Raised Bog with a short note of their occurrence and frequency.

Bogs and raised bogs have been studied from the standpoint of extant diatoms in Europe with greater frequency, but even there, much work is yet to be done in separating out the various floristic expressions as they correlate with the type of bog.

In North America several profile studies of lakes and bogs have been made with reference to the diatoms. Patrick has published on the diatom deposits of the Great Salt Lake (31), Linsley Pond, Connecticut (32), Patschke Bog, Texas (33) and Bethany Bog (34). Hutchinson et al. (12) have studied the diatom sediments of Lake Patzcuaro, Mexico. In Indiana, Weaver (46) studied some of the diatoms from a profile of Lakesville Bog. None of these works, however, deal primarily with the present-day flora and none are studies of a raised bog.

Materials and Methods

For a detailed description of the origin, history and structure of the bog the reader is referred to Friesner & Potzger (9) and Daily (5).

Collections for diatoms were made in all three areas mentioned by Daily (5), viz. Spring #1, Spring #2 and Grassy-sedge Knoll area. The first two areas are near the summit of the raised portion and the third is on the eastern slope. This report is restricted to the collection from Spring #1.

The samples from Spring #1, collected by Mr. W. A. Daily, were composited and treated as a single sample. One half of the material was preserved in 3% formalin with no further treatment and retained without further analysis as "uncleaned material." The remainder was "cleaned" of organic matter with nitric acid and potassium dichromate, the common method for diatom "cleaning." Cover slips were placed on a hot plate and some of the "cleaned" diatom material was added by dropper to these cover slips. The sample bottle was thoroughly shaken before the dropper was filled. The material on the cover slips was then allowed to dry under low heat. The cover slips were then inverted onto a 3″ x 1″ slide containing a drop of hyrax. The entire mount was then returned to the hot plate for about 1 minute to evaporate the hyrax solvent.

For this analysis a single, evenly distributed slide from the composite collection material of Spring #1 was used. The diatoms were observed under oil immersion by rows, each specimen being identified and tabulated until a total of approximately 8,300 were counted. Results of this analysis are given in Table 3.

Results (Floristic)

As is true of most diatom samplings and analyses of this type, a large number of taxa (about 45% of all taxa observed) were seen only a very few times (Table 3, Frequency "A"). This pattern is indicated by the work of Patrick et al. (35). Such a pattern points up the advisability of doing mass counts in a floristic study.

Table 1 shows the general structure of the diatom population analyzed. It is clear that there is no direct relationship between the numbers of

TABLE 1. Structure of diatom population analyzed

Genera	Number of subordinate taxa	Appx. percentage of population
Achnanthes	8	47
Amphora	2	–1
Anomoeoneis	1	1
Caloneis	5	2
Cocconeis	2	–1
Cymbella	14	4
Denticula	1	1
Diploneis	3	1
Epithemia	2	–1
Eunotia	3	2
Fragilaria	2	–1
Gomphonema	8	1
Mastogloia	2	–1
Navicula	33	15
Neidium	6	–1
Nitzschia	18	10
Pinnularia	6	2
Rhopalodia	4	–1
Stauroneis	7	–1
Surirella	5	1
Synedra	4	11

subordinate taxa and their percentage representation in the population analyzed. There is even a suggesion of an inverse relationship between the two.

Although it is often dangerous to consider the absence of certain genera as important in such a study, it is well to note that the genera *Cyclotella, Stephanodiscus, Melosira* and, in fact, all of the other members of the order *Centrales* are lacking from the generic list.

Hustedt (21) notes this phenomenon in a high mountain (swampy) spring area in Switzerland. Woronikhine (47) lists diatoms found in a spring area in the Caucasus Mountains. His list shows the same situation but no particular note is made of the absence of the *Centrales*.

Also of note in this connection is the very low numbers of species of *Araphidineae*. Only 6 taxa are diatoms which have no active means of locomotion and these are generally considered as epiphytic and rheobionts. Of the 81 forms found by Hustedt (21) in the spring area, only 3 lacked the ability of active motion.

A comparison of the diatom population observed (Spring #1) and those populations observed by others in different habitats is given in Table 2. Only such studies have been included here in which large numbers of extant diatoms have been observed.

TABLE 2. Percentage occurrence (in other floristic studies) of diatom taxa found in Spring #1, Cabin Creek Raised Bog.[1]

STREAMS AND RIVERS		
Dystrophic	Soft water	Hard water
New Jersey Assunpink Creek (95,000)[2] 25%	California Sacramento River (67,000) 28%	Maryland Potomac River (60,500) 30%
SPRINGS	SPRINGS	ACID BOGS pH 3.5-5
Florida (Hohn-11) Silver Springs (ca. 300,000) 26%	Denmark (Foged-7) Danish Springs (ca. 10,000) 50%	Germany (Niessen-30) Murnauer Moor (100 samp.) 23%
LAKES	SALT BOG	MOOR & RAISED BOGS pH 7-8.5
Switzerland (Hust.-21) Lakes of Davos (50 samp.) 40%	Denmark (Foged-6) Langemose Bog (8,000) 41%	Germany (Niessen-30) Murnauer Moor (100 samp.) 42%

1. Based on approximately 8,300 specimens. Data supplied through courtesy of Dr. Ruth Patrick, Head, Limnology Department, Academy of Natural Sciences of Philadelphia. 2. Indicates number of specimens counted or number of samples.

We have here some suggestion that the diatom flora in Spring #1 is more completely represented in the lake, danish spring, neutral to alkaline bog and raised bog studies. The percentage agreement with river studies seems relatively low. There is also a low percentage agreement with the Silver Springs study.

Some of the taxa listed in Table 3 have rather wide-spread occurrence and are reported for a wide variety of ecological conditions. Most of the frequently observed species would fit this category. There is one exception amongst thet common species. That is *Navicula tantula* Hust. (15). This taxon was originally observed in Poggenpohls Moor, Germany. Later, Hustedt (21) found it in two lakes in Switzerland and more recently he reported it as rare in the Weser River (24). I can find no published records of its distribution outside of Europe.

Other species in Table 3 seem not to be quite so widely distributed either ecologically or geographically. Some remarks about a few of these species might be of interest in a better understanding of the flora analyzed.

The following notes are taken from some of Hustedt's major floristic and ecological studies: *Cymbella leptoceros*—a littoral form especially numerous in alkaline waters (19) . . . found widespread and frequent in alkaline lakes of subalpine region but absent in acid lakes and lakes with a wide pH range (24). *Cymbella norvegica*—found in alpine lakes, a

TABLE 3. List of diatoms observed

	Citation	Description and Illustration	Frequency
ACHNANTHES			
exigua v. heterovalvata Krasske	13	p. 202, textfig. 288	A
flexella (Kütz) Brun	14	p. 416, textfig. 869	A
lanceolata Bréb.	13	p. 207, textfig. 306a	D
lanceolata v. elliptica Cl.	13	p. 208, textfig. 306c	D
lapponica (Hust.) Hust.	14	p. 414, textfig. 868	D
microcephala Kütz.	13	p. 198, textfig. 273	G
minutissima Kütz.	13	p. 198, textfig. 274	F
sp.			A
AMPHORA			
*ovalis Kütz.	13	p. 342, textfig. 628	A
ovalis v. pediculus Kütz.	13	p. 343, textfig. 629	A
ANOMOEONEIS			
*variabilis (Ross) Reim.	37	p. 194, pl. 1, fig. 7-8	D
CALONEIS			
alpestris (Grun.) Cl.	13	p. 240, textfig. 372	D
bacillum (Grun.) Meresch.	13	p. 236, textfig. 360a-c	D
bacillum v. fontinalis Hust.	18	p. 282, pl. 5, fig. 17-19	A
silicula v. truncatula Grun.	13	p. 238, textfig. 363-364	A
sp.			A
COCCONEIS			
diminuta Pant.	13	p. 190, textfig. 265	A
patrickii sp. nov.			A
CYMBELLA			
*aspera (Ehr.) Cl.	13	p. 365, textfig. 680	A
cesatii (Rabh.) Grun.	13	p. 351, textfig. 638	D
cesatii v. linearis var. nov.			D
hybridiformis Hust.	22	p. 937, pl. 40, fig. 23-25	A
incerta Grun.	13	p. 360, textfig. 665	A
laevis Naeg.	13	p. 353, textfig. 643	D
leptoceros (Ehr.) Grun.	13	p. 353, textfig. 645	B
microcephala Grun.	13	p. 351, textfig. 637	B
*naviculiformis Auersw.	13	p. 356, textfig. 653	A
norvegica Grun.	13	p. 359, textfig. 664	B
obtusa f. krasskei Foged	8	p. 56, pl. 11, fig. 5-6	A
turgida (Greg.) Cl.	13	p. 358, textfig. 660	C
*ventricosa Kütz.	13	p. 359, textfig. 661	A
sp.			A
DENTICULA			
elegans Kütz.	13	p. 382, textfig. 725	D
DIPLONEIS			
elliptica (Kütz.) Cl.	13	p. 250, textfig. 395	A
oculata (Bréb.) Cl.	13	p. 250, textfig. 392	A
ovalis v. oblongella (Naeg.) Cl.	13	p. 249, textfig. 391	D
EPITHEMIA			
argus v. protracta A. Mayer	29	p. 100, pl. 6, fig. 15	B
zebra v. saxonica (Kütz.) Grun.	13	p. 385, textfig. 730	A

	Citation	Description and Illustration	Frequency
EUNOTIA			
arcus Ehr.	13	p. 175, textfig. 216	B
arcus v. bidens Grun.	13	p. 175, textfig. 217	D
*lunaris (Ehr.) Grun.	23	p. 70, pl. 2, fig. 11-15	B
FRAGILARIA			
brevistriata v. inflata f. curta Skv.	40	p. 17, pl. 1, fig. 18	A
construens v. venter (Ehr.) Grun.	13	p. 141, textfig. 138	A
GOMPHONEMA			
angustatum v. intermedia Grun.	43	pl. 24, fig. 47	A
angustatum v. producta Grun.	43	pl. 24, fig. 52-55	A
*constrictum Ehr.	43	pl. 23, fig. 6	A
intricatum Kütz.	43	pl. 24, fig. 28-29	B
intricatum v. dichotomum (Kütz.) Grun.	43	pl. 24, fig. 30-31	A
*parvulum Kütz.	45	textfig. 11-14	B
subtile v. sagitta (Schum.) Grun.	43	pl. 23, fig. 27	A
sp.			A
MASTOGLOIA			
grevillei W. Sm.	13	p. 215, textfig. 313	A
smithii v. lacustris Grun.	13	p. 217, textfig. 316	C
NAVICULA			
amphibola v. polymorpha Fusey	10	p. 15, textfig. 67, 68, 69	B
arvensis Hust.	18	p. 249, pl. 20, fig. 19-20	A
bacilliformis Grun.	13	p. 273, textfig. 446	A
bryophila Ostr.	17	pl. 404, fig. 45, 46, 47	B
*cryptocephala Kütz.	13	p. 295, textfig. 496	B
cryptocephala f. terrestris Lund	27	p. 86, textfig. 9H-W	A
cincta v. leptocephala (Bréb.) Grun.	43	pl. 7, fig. 16	D
cincta v. rostrata var. nov.			B
*cuspidata Kütz.	13	p. 268, textfig. 433	A
dailyi sp. nov.			A
dicephala v. lata M. Per.	42	p. 56	B
friesneri sp. nov.			B
graciloides A. Mayer	13	p. 299, textfig. 515	B
hustedtii Krasske	13	p. 273, textfig. 449	A
indianensis sp. nov.			A
insociabilis Krasske	26	p. 114, pl. 3, fig. 17	B
minima Grun.	13	p. 272, textfig. 441-442	C
minima v. okamurae Skv.	41	p. 203, pl. 1, fig. 23	A
perpusilla v. distans Cl.-Eul.	4	p. 168, fig. 848d	A
potzgeri sp. nov.			C
potzgeri v. quadripunctata var. nov.			A
pupula Kütz.	13	p. 281, textfig. 467a	E
pupula v. capitata Hust.	13	p. 281, textfig. 467c	B
pupula v. mutata (Krasske) Hust.	13	p. 281, textfig. 467f	A

	Citation	Description and Illustration	Frequency
pupula v. rectangularis (Greg.) Grun.	13	p. 281, textfig. 467b	B
*radiosa Kütz.	13	p. 299, textfig. 513	A
radiosa v. parva Wallace	44	p. 3, pl. 1, fig. 5	A
radiosa v. tenella (Bréb.) Grun.	13	p. 299	D
stroemii Hust.	16	pl. 399, fig. 25-28	B
subhamulata Grun.	13	p. 282, textfig. 468	A
tantula Hust.	16	pl. 399, fig. 54-57	E
sp.			A
sp.			A
NEIDIUM			
binodis (Ehr.) Hust.	36	p. 17, pl. 2, fig. 4	C
bisculcatum (Lagerst.) Cl.	13	p. 242, textfig. 374	B
bisculcatum v. baicalensis (Skv.) Reim.	36	p. 18, pl. 2, fig. 2	B
iridis (Ehr.) Cl.	13	p. 245, textfig. 379	A
iridis f. vernalis Reichelt	13	p. 245, textfig. 380	A
iridis v. conspicua A. Mayer	28	p. 115, pl. 11, fig. 16	A
NITZSCHIA			
*amphibia Grun.	13	p. 414, textfig. 793	C
angustata (W. Sm.) Grun.	13	p. 402, textfig. 767	C
angustata v. acuta Grun.	13	p. 402	A
communis v. obtusa Grun.	43	pl. 69, fig. 33-34	B
denticula Grun.	13	p. 407, textfig. 780	D
denticula v. abberans Fusey	10	p. 20, textfig. 100	A
dissipata (Kütz.) Grun.	13	p. 412, textfig. 789	C
frustulum (Kütz.) Grun.	13	p. 414, textfig. 795	B
hiemalis Hust.	21	p. 223, textfig. 57-59	B
intermedia Hantz.	43	pl. 69, fig. 10	A
kuetzingiana Hilse	13	p. 416, textfig. 802	C
linearis W. Sm.	13	p. 409, textfig. 784	D
*palea (Kütz.) W. Sm.	13	p. 409, textfig. 784	E
palea v. tropica Hust.	23	p. 147, pl. 13, fig. 26-29	A
paleoides Hust.	19	p. 483, pl. 41, fig. 11	E
*sigmoidea (Ehr.) W. Sm.	13	p. 419, textfig. 810	A
sp.			A
sp.			A
PINNULARIA			
braunii v. amphicephala (A. Mayer) Hust.	13	p. 319, textfig. 578	B
gibba v. mesogongyla (Ehr.) Hust.	13	p. 327, textfig. 603	D
microstauron (Ehr.) Cl.	13	p. 320, textfig. 582	A
*streptoraphe Cl.	13	p. 337, textfig. 620	A
undulata v. subundulata Grun.	13	p. 315	A
*viridis (Nitz.) Ehr.	13	p. 334, textfig. 617a	B
RHOPALODIA			
gibba (Ehr.) O. Müll.	13	p. 390, textfig. 740	A
gibba v. parallela (Ehr.) O. Müll.	43	pl. 32, fig. 3	B

	Citation	Description and Illustration	Frequency
gibberula v. vanHeurckii O. Müll.	13	p. 391, textfig. 744	A
musculus (Kütz.) O. Müll.	13	p. 392, textfig. 745	A
STAURONEIS			
acuta W. Sm.	13	p. 259, textfig. 415	A
*anceps Ehr.	25	p. 772, textfig. 1120a	B
ignorata Hust.	37	p. 201, pl. 2, fig. 7	A
ignorata v. rupestris (Skv.) Reim.	37	p. 202, pl. 2, fig. 8	A
norvegica Hust.	25	p. 795, textfig. 1141	A
phoenicenteron v. amphilepta (Ehr.) Cl.	3	p. 149	A
smithii Grun.	25	p. 810, textfig. 1157a-c	C
SURIRELLA			
linearis v. constricta (Ehr.) Grun.	13	p. 434, textfig. 839	D
robusta Ehr.	13	p. 438, textfig. 850	A
spiralis Kütz.	13	p. 445, textfig. 870	B
tenera Greg.	13	p. 438, textfig. 853	A
tenera v. nervosa A. Mayer	13	p. 439, textfig. 854	B
SYNEDRA			
amphicephala v. intermedia Cl.-Eul.			
parasitica W. Sm.	13	p. 161, textfig. 195	C
parasitica v. subconstricta Grun.	13	p. 161, textfig. 196	F
*ulna (Nitz.) Ehr.	13	p. 151, textfig. 158-159	A

Key to frequencies: A—1-5 specimens observed
B—6-20 specimens observed
C—21-50 specimens observed
D—51-150 specimens observed
E—151-500 specimens observed
F—501-1000 specimens observed

* Previously reported for Indiana.

nordic-alpine species. In Germany it has been found only in the Riesengebirge and in springs of Tyrol. *Mastogloia grevillei*—it is frequent as a littoral species in alpine lakes (14). *Mastogloia smithii* var. *lacustris*—frequent as a littoral form in fresh water lakes . . . generally favors standing waters but in Europe sometimes found in springs and brooks (19). *Navicula insociabilis*—an aerophilous species especially in springs and swamps at a pH of 5.5-8.0 with maximum development around pH 7.0 (19). *Pinnularia braunii* var. *amphicephala*—the species is acidophilous. In contrast to the species, however, var. *amphicephala* is frequent at pH's of 7.5 and at higher temperatures (19). *Stauroneis smithii*—in North Germany the species is certainly alkaliphilous. It is missing in acid lakes but very widespread in alkaline ones. Likewise in the alpine lakes it prefers alkaline waters. The species can certainly be characterized as alkaliphilous even if here and there it is found in more or less weakly acid water (24).

Results (Systematic)

The diatoms included in this section are considered as new taxa. Other forms were observed which may have been new, but they have been excluded from this section and merely listed in Table 3 as "sp." since clear observation of the valve features was not possible.

The following data applies to all of the new taxa:

Type locality: Indiana, Randolph Co., Cabin Creek Raised Bog, 6 miles north of Modoc; artesian rivulet at summit of bog. Collection #2835A of W. A. Daily, July 9, 1960.

Illustration slides: All illustrations were taken from the same preparation which is deposited in the Diatom Herbarium of the Academy of Natural Sciences of Philadelphia in the General Collection with the designation: ANSP-GC 45669.

Holotypes: The holotypes for all of the following new taxa are here designated as being on the above slide.

Sub-order: *Monoraphidineae*
Family: *Achnanthaceae*
Sub-family: *Cocconeioideae*

Cocconeis patrickii sp. nov. pl. 1, fig. 7A, 7B

Valva elliptica. Valva cum raphe: Area axiali et raphe sigmoid. Area centrali parva, ovata. Valva sine raphe: Area axiali angustalanceolata, diagonalis, non clare sigmoid. Area centrali non clare diversa ab area axiali. Striis diagonalibus, punctatis tenuiter. Longitudo 10-19 mu, latitudo circa 5 mu, striis (valva cum raphe) 28 in 10 mu ad 34 in 10 mu prope apices; striis (valva sine raphe) 26 in 10 mu ad 32 in 10 mu prope apices; punctis 33-36 in 10 mu.

Valve elliptical. Raphe-valve with sigmoid axial area and raphe. Central area small, oval. Pseudo-raphe-valve with narrow lanceolate axial area, diagonal, but not distinctly sigmoid. No distinct central area. Striae on both valves diagonal, very finely punctate, curved. Length 10-19 mu; width about 5 mu; striae on raphe-valve 28 in 10 mu at center becoming 34 in 10 mu at ends; striae on pseudo-raphe-valve 26 in 10 mu at center becoming about 32 in 10 mu at ends; puncta about 33 to 36 in 10 mu.

This taxon is similar to *Eucocconeis elliptica* Savelj-Dolgowa (38) but is smaller, has mostly curved-diagonal striae and a more straight pseudo-raphe. It also resembles *Cocconeis diruptoides* Hust. (14) but, again, is narrower and has more diagonally displaced striae which are not distinctly punctate as in *C. diruptoides*.

This diatom is named in honor of the well-known limnologist-diatomist Dr. Ruth Patrick, Head, Limnology Department, Academy of Natural

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EXPLANATION OF PLATE FIGURES

Fig. 1	Navicula	cincta var. rostrata var. nov.
2	"	friesneri sp. nov.
3	"	dailyi sp. nov.
4	"	indianensis sp. nov.
5	"	potzgeri sp. nov.
6	"	" var. quadripunctata var. nov.
7A	Cocconeis	patrickii sp. nov. (raphe-valve)
7B	"	" " " (pseudoraphe-valve)

The plate figures were made by Miss Helen Wu, Limnology Department, Academy of Natural Sciences, Philadelphia.

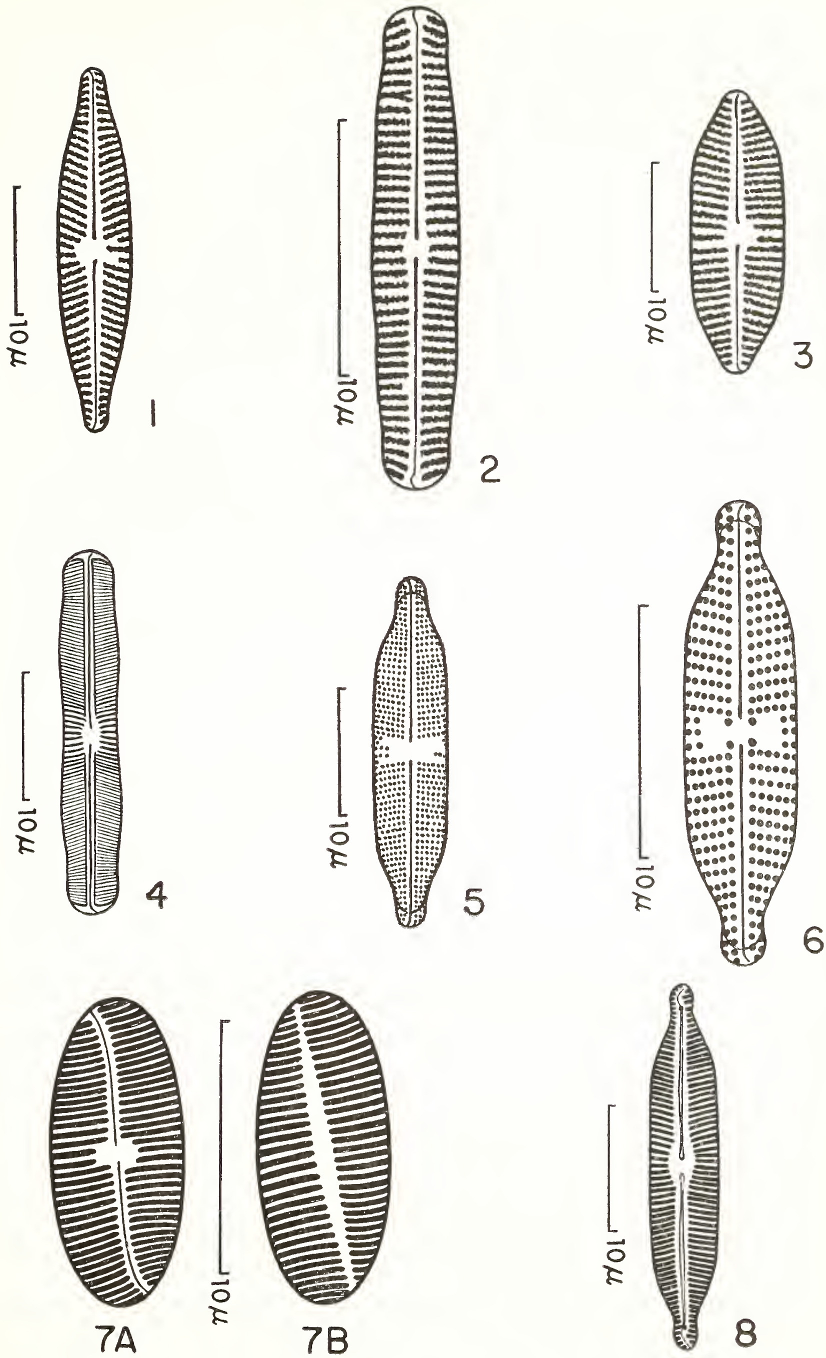

PLATE I

Sciences of Philadelphia to whom I express my great appreciation for having stimulated my interest in diatoms. Dr. Patrick also very kindly reviewed this manuscript and offered several helpful suggestions.

Sub-order: *Biraphidineae*
Family: *Naviculaceae*
Sub-family: *Naviculoideae*

Navicula cincta var. *rostrata* var. nov. pl. 1, fig. 1

Apicibus angustis, protractis, rostratis. Longitudo 28-32 mu, latitudo 6 mu, striis 14 in 10 mu.

Valve with narrow, protracted-rostrate ends. Length 28-32 mu; width 6 mu, striae 14 in 10 mu.

The nominate variety has attenuate ends not distinctly set-off from the valve body which makes it easily distinguishable from var. *rostrata*. The var. *leptocephala* has some suggestion of distinct ends but they are not protracted and rostrate as in this variety.

Navicula dailyi sp. nov. pl. 1, fig. 3

Valva lineari, apicibus cuneatis. Area axiali angusta, lineari. Area centrali parva aut non clare dissimili ab area axiali. Raphe filiformi, apicibus distalibus versis in eodem cursu. Striis lineatis tenuiter, parallelis in media parte valvae, radiatis ad apices. Longitudo 20-22 mu, latitudo circa 8 mu, striis 11 in 10 mu ad 15 in 10 mu prope apices.

Valve linear with cuneate ends. Axial area narrow, linear. Central area very small, irregular, or lacking completely. Raphe filiform, distal ends curving in same direction. Striae parallel in center becoming radiate toward ends, finely lineate. Length 20-22 mu, width about 8 mu, striae 11 in 10 mu at center, 15 in 10 mu near ends.

This taxon is most similar in shape to *N. ocallii* Hohn (11), but is distinguished by the much smaller central area, parallel central striae and radiate terminal striae, the opposite of which is true of *N. ocallii*.

It is best distinguished from *N. destricta* Hust (20) by the coarse striae (Hustedt gives 24 in 10 mu). It differs from *N. gradata* Hust (18) by having more narrow, pointed ends and being about one-half as wide. The extremely radiate striae of *N. medica* Skv. (40) eliminate it from that taxon.

This diatom is named for the well known Indiana phycologist and former president of the Indiana Academy, Mr. W. A. Daily, who made the collections from Cabin Creek Raised Bog which formed a basis for this paper. I wish to express my thanks to him for his many kindnesses.

Navicula friesneri sp. nov. pl. 1, fig. 2

Valva lineari, margine undulata exliter; apicibus valvae latis rostratis vel subcapitatis. Area axiali angusta, lineari. Area centrali parva, orbiculari aut non clare dissimili ab area axiali. Raphe filiformi, apicibus proximalibus propinquis, apicibus distalibus versus in eodem cursu. Striis punctatis-lineatis, parallelis, convenientibus prope apicibus. Longitudo 19-24 mu, latitudo 3.5 mu, striis 22-24 in 10 mu.

Valve linear with slightly undulate margins and broadly rounded rostrate to sub-capitate ends. Axial area narrow, linear. Central area very small, circular, or lacking completely. Raphe filiform, proximal ends close, distal ends hooking slightly in same direction. Striae punctate-lineate, parallel except at the ends where they become convergent. Length 19-24 mu, width 3.5 mu, striae 22-24 in 10 mu.

This taxon is similar to *N. nympharum* Hust. (18) in general appearance. It does not, however, have longitudinal axial furrows characteristic of *N. nympharum*. In *N. friesneri* the striae are coarser (Hustedt gives 30 in 10 mu for his species), convergent at the ends and parallel throughout the remainder of the valve, not radiate at the ends and near the center as in Hustedt's species.

This diatom is named in honor of the late Dr. R. C. Friesner, former Head of the Botany Department, Butler University, under whom I was privileged to study. Dr. Friesner and Dr. J. E. Potzger were the first to make an intensive botanical investigation of this raised bog.

Navicula indianensis sp. nov. pl. 1, fig. 4

Valva lineari, margine triundulata subtiliter, apicibus latis, obtuse rotundatis. Area axiali angusta, lineari. Costa longitudinali axiali manifeste, intermissis ad area centraliam. Area centrali parva, oblonga. Raphe filiformi, apicibus distalibus versus in eodem cursu. Striis radiatis in media parte valvae, convenientibus prope apices. Costis transversalibus in apices inter se *N. pupula*. Longitudo 25-29 mu, latitudo circa 4.5 mu, striis 24 in 10 mu, in media parte valvae, residuus 36-39 in 10 mu.

Valve linear with slightly undulate sides and blunt, broadly rounded extremities. Axial area narrow-linear with accompanying longitudinal ribs which are interrupted by the central area. Central area small, oblong. Raphe filiform, distal ends curved in same direction. Striae radiate, becoming convergent at the ends. Striae in center of valve distinct, above and below which they become suddenly fine and difficult to resolve. Heavy transverse ribs at the ends as in *N. pupula*. Length 25-29 mu, width about 4.5 mu, striae 24 in 10 mu at center then abruptly 36-39 in 10 mu.

This species resembles *N. micropupula* Choln. (2) but is distinguished by having convergent (not radiate) striae at the ends and longitudinal ribs on either side of the raphe. It is excluded from the *pupula*-complex on the basis of the convergent striae at the ends.

Navicula potzgeri sp. nov. pl. 1, fig. 5

Valva lineari, apicibus protractis, rostratis ad sub-capitatis. Pseudoseptis praesentibus in valvam circa ½ longitudinem apicium. Area axiali angusta, lineari, amplificante ad area centrali. Area media dilatata transverse in fasciam quae paene attingit margines valvae. Raphe filiformi, apicibus distalibus versus in eodem cursu. Striis punctatis, radiatis leniter in media parte valvae, parallelis ad apices. Longitudo 18-30 mu, latitudo 4-4.5 mu, striis 19-22 in 10 mu, puncta 24-26 in 10 mu.

Valve linear with protracted rostrate to sub-capitate ends. Pseudosepta at ends extending barely ½ the length of ends. Axial area narrow, essentially linear, expanding somewhat toward center. Central area transversely expanded, rectangular, irregularly bordered at the margins by a few very short striae. Raphe filiform, distal ends curving in same direction. Striae distinctly punctate, radiate in center becoming parallel at the ends. Length 18-30 mu, width 4-4.5 mu, striae 19-22 in 10 mu, puncta 24-26 in 10 mu.

Hustedt's *N. septata* (20) has the same general features as this diatom but has strongly radiate striae throughout and a smaller central area than *N. potzgeri*. Fusey (10) describes a *N. jurassensis* which is also similar. It has, however, a broad raphe and lacks a pseudoseptum.

This species is named in honor of my former professor, the late Dr. J. E. Potzger, botanist and plant ecologist at Butler University, who pioneered the field of palynology in this country and who, in collaboration with Dr. R. C. Friesner, did a very comprehensive profile study of the Cabin Creek Raised Bog.

Navicula potzgeri var. *quadripunctata* var. nov. pl. 1, fig. 6

Valva margine raphe, striis, area axiali quam descripta speciei. Area centrali cum quattuor punctis distinctis, duo utrobique raphe, ordinatis formare figuram orthogoniam parvam. Longitudo 19-22 mu, latitudo 4 mu, striis 19-20 in 10 mu, puncta 22-24 in 10 mu.

Differs from the nominate variety by the presence of four isolated puncta at the center, one each on both sides of the proximal raphe-ends forming a rectangle. Length 19-22 mu, width 4 mu, striae 19-20 in 10 mu, puncta 22-24 in 10 mu.

Family: Cymbellaceae
Sub-family: Cymbelloideae

Cymbella cesati var. *linearis* var. nov. pl. 1, fig. 8

Valva linearis, apicibus protractis, capitatis. Longitudo 24-30 mu, latitudo circa 5 mu, striis 20-21 in 10 mu, 24 in 10 mu prope apices.

Valve linear with protracted capitate ends. Length 24-30 mu, width about 5 mu, striae 20-21 in 10 mu, 24 in 10 mu near apices.

This diatom is smaller and has a different shape than var *cesati*. The nominate variety is narrow-lanceolate with indistinctly set-off ends.

There are also certain similarities between this diatom and *C. broenlundensis* Foged (8), but the distal raphe-ends of var. *linearis* make it easily distinguishable from Foged's species and align it closely with *C. cesati* (Rabh.) Grun.

Discussion

In general, the flora observed here is composed of several segments which seem to show up most frequently in certain springs, alkaline lakes and circumneutral to alkaline bogs.

A sample of water taken from Spring #1 in April, 1961 showed a total hardness of 376 ppm and a calcium hardness of 242 ppm. The pH was 6.9. On May 28, 1961 the springs were revisited by Mr. and Mrs. Daily who recorded in the field a pH of 6.9 and a water temperature of 52 degrees F. At about 2 to 3 feet from the bubbling source the pH was 7.2 and at 15 feet from the source the pH was 7.1.

This data, although rather meager, does tie in with the indications from general distribution data that the habitat is a rather stable, neutral to alkaline hard water one. Most of the species in the spring for which data from the literature was available were listed as "alkaliphilous" species.

The relatively low percentage of species in the genus *Nitzschia* is probably indicative of an oligosaprobic-type situation in which very little organic matter is present.

Even from this introductory study, one is tempted to consider that the presence of several more typically lake and lake-shore diatom species in the spring area may have some correlation with the original post-glacial impoundment or lake. Could these forms be remnants of the original open-water area having survived because of an adaptability to the change in environment? The absence of most non-motile and unattached forms might possibly be explained on this basis.

Although present in an open-water situation they would not be able to survive a flowing-water habitat, but the benthic, attached forms and the highly motile ones would. The very few remaining slower water micro-habitats could possibly support some planktonic elements but their numbers in relation to the total growth would be very small. The low percentage of Cabin Creek diatoms found in Silver Springs may bear some relationship to the non-lake origin of the latter.

Hustedt (21) hypothecates that the non-motile forms are very scarce in spring and lake areas in the high mountains of Switzerland because of their inability to invade from downstream. This presents a second possibility which must be considered; that is, that the invasion proceeded on the bog from downstream areas.

This is possible, but seems unlikely for Cabin Creek (into which the bog rivulets drain) does not flow through what can be considered a lake district and so the sources for lacustrine diatoms would not be available.

Summary

1. The diatom flora of Spring #1, Cabin Creek Raised Bog, was studied, approximately 8,300 diatoms being observed.
2. A total of 135 taxa representing 21 genera were recorded from the composite sample.
3. The occurrence of the taxa observed is correlated with other studies. The structure of the diatom population from Spring #1 showed greatest similarity to that of certain other spring areas, neutral to alkaline lakes and circumneutral to alkaline bogs. There was considerably less agreement with the flora of streams, rivers and one spring area in Florida.
4. Floristically the rivulet at Spring #1 reflects a neutral to alkaline hard water situation, in agreement with the chemical data available (pH 6.9-7.1, total hardness 376 ppm., Ca hardness 242 ppm.).
5. The relatively low representation of *Nitzschia* probably indicates an oligosaprobic condition.
6. The diatom association at Spring #1 has no *Centrales* and has but a meager representation of *Araphidineae*. This, together with other ecological evidence for many other species present suggests the possibility that the present diatom flora has remnants of the old open-water area of Cabin Creek Valley which developed after the Early Wisconsin glaciation.
7. Of the total diatom flora reported here there are 5 species and 3 varieties described as new. A total of 117 taxa are new records for Indiana.

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