

A consideration of *Gomphonema parvulum* Kutz

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The *Butler University Botanical Studies* journal was published by the Botany Department of Butler University, Indianapolis, Indiana, from 1929 to 1964. The scientific journal featured original papers primarily on plant ecology, taxonomy, and microbiology. The papers contain valuable historical studies, especially floristic surveys that document Indiana's vegetation in past decades. Authors were Butler faculty, current and former master's degree students and undergraduates, and other Indiana botanists. The journal was started by Stanley Cain, noted conservation biologist, and edited through most of its years of production by Ray C. Friesner, Butler's first botanist and founder of the department in 1919. The journal was distributed to learned societies and libraries through exchange.

During the years of the journal's publication, the Butler University Botany Department had an active program of research and student training. 201 bachelor's degrees and 75 master's degrees in Botany were conferred during this period. Thirty-five of these graduates went on to earn doctorates at other institutions.

The Botany Department attracted many notable faculty members and students. Distinguished faculty, in addition to Cain and Friesner, included John E. Potzger, a forest ecologist and palynologist, Willard Nelson Clute, co-founder of the American Fern Society, Marion T. Hall, former director of the Morton Arboretum, C. Mervin Palmer, Rex Webster, and John Pelton. Some of the former undergraduate and master's students who made active contributions to the fields of botany and ecology include Dwight W. Billings, Fay Kenoyer Daily, William A. Daily, Rexford Daudenmire, Francis Hueber, Frank McCormick, Scott McCoy, Robert Petty, Potzger, Helene Starcs, and Theodore Sperry. Cain, Daudenmire, Potzger, and Billings served as Presidents of the Ecological Society of America.

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A CONSIDERATION OF *GOMPHONEMA PARVULUM* KÜTZ

By JOHN H. WALLACE¹ AND RUTH PATRICK¹

This is a study of the variability of *Gomphonema parvulum* Kütz.

During the summer of 1948, a biological survey of the Conestoga River Basin in eastern Pennsylvania was conducted by the Academy of Natural Sciences of Philadelphia which aimed at the establishment of biological standards for determining the health of a stream.

In all, over 600 collections of diatoms were made. From the study of these collections, new evidences of affinities between several species were found and the wide variability of certain species especially was noted. *G. parvulum* Kütz. was particularly troublesome because of its high degree of variability and exceedingly common occurrence. One collection, taken from a portion of a diatom bloom on one rock in Muddy Creek below Adamstown, Pennsylvania, showed an almost unialgal, highly variable, intergrading population, of *G. parvulum* Kütz., the range of variation being so great as to embrace five named varieties. This type of variation was found not only here, but in most of the exsiccatae and slides which the authors examined labeled as *G. parvulum* Kütz., or one of its named varieties. In each case, the designated variety showed a great deal of variation which intergraded into the typical form of the species and often intergraded into other species of *Gomphonema*.

The origin of such a highly variable taxon can only be conjecture. However, some mechanism must exist whereby the variants are able to continue as a mixed population. Assuming that a morphological variation implies physiological differences, the expected result over a period of time would be that one variant should be able to gain dominance over another variant. Considering light conditions to be similar throughout the habitat, one plausible explanation of the maintenance of such a highly variable taxon is that the constant flow of water over the habitat insures a continuous replenishment of nutrients, thus eliminating any competition of the variants for nutrients.

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While it is true that in no stream is the concentration of the various nutrients constant, it nevertheless varies about a mean, and the nutrient requirements of all forms must lie within the limits of variation or the individuals would be eliminated from the habitat. Furthermore, this variation of nutrients would mean that conditions at one time would be more favorable to one variant, and at some other time, more favorable to another. Thus the number of individuals of a given variant might vary from time to time, but the variant would always remain as a part of the population. The importance of this continual renewal of nutrients, varying somewhat in concentration, in the maintenance of a highly variable taxon is further substantiated by the fact that almost all the highly variable taxons are usually found in streams and not in still waters.

At first an attempt was made to delimit or define the named varieties of *G. parvulum* Kütz. In so doing, all original descriptions of the varieties were checked, using isotype material wherever possible. A separation of the varieties along clear-cut lines proved impossible for several reasons. For one, in identification of varieties, authors often did not go back to original descriptions. For example, *G. micropus* Kütz. had become completely divergent from Kützing's original (1844) description and illustration. Secondly, the great amount of diatom literature and the difficulty in obtaining it often resulted in the same entity being described twice. In point, while Cleve (1893) never pictured *G. parvulum* var. *subelliptica*, his description so closely fits the description and picture of *G. parvulum* var. *curta* R. d'Aub. apud Heribaud (1920) that it is very evident that the latter should be considered synonymous with the former.

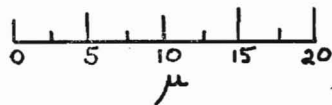
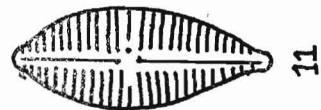
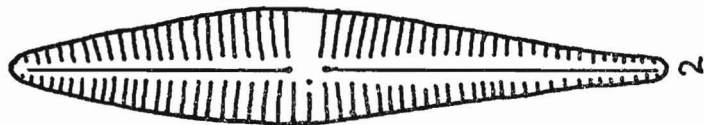
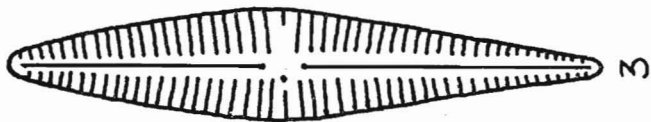
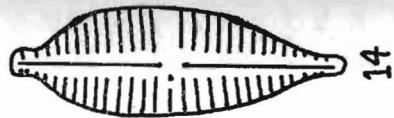
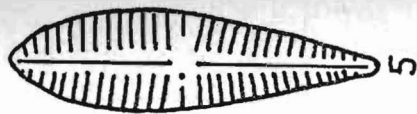
A study was made of all slides at the Academy of Natural Sciences of Philadelphia which were designated as having on them specimens of *G. parvulum* Kütz. or its varieties. It was found that one or more of the varieties generally occurred with the type. Hustedt, 1938, (Archiv. Hydrobiol. Suppl. Bd. 15, Bd. 7:434) has noted this variation in the case of two varieties of *G. parvulum* Kütz.

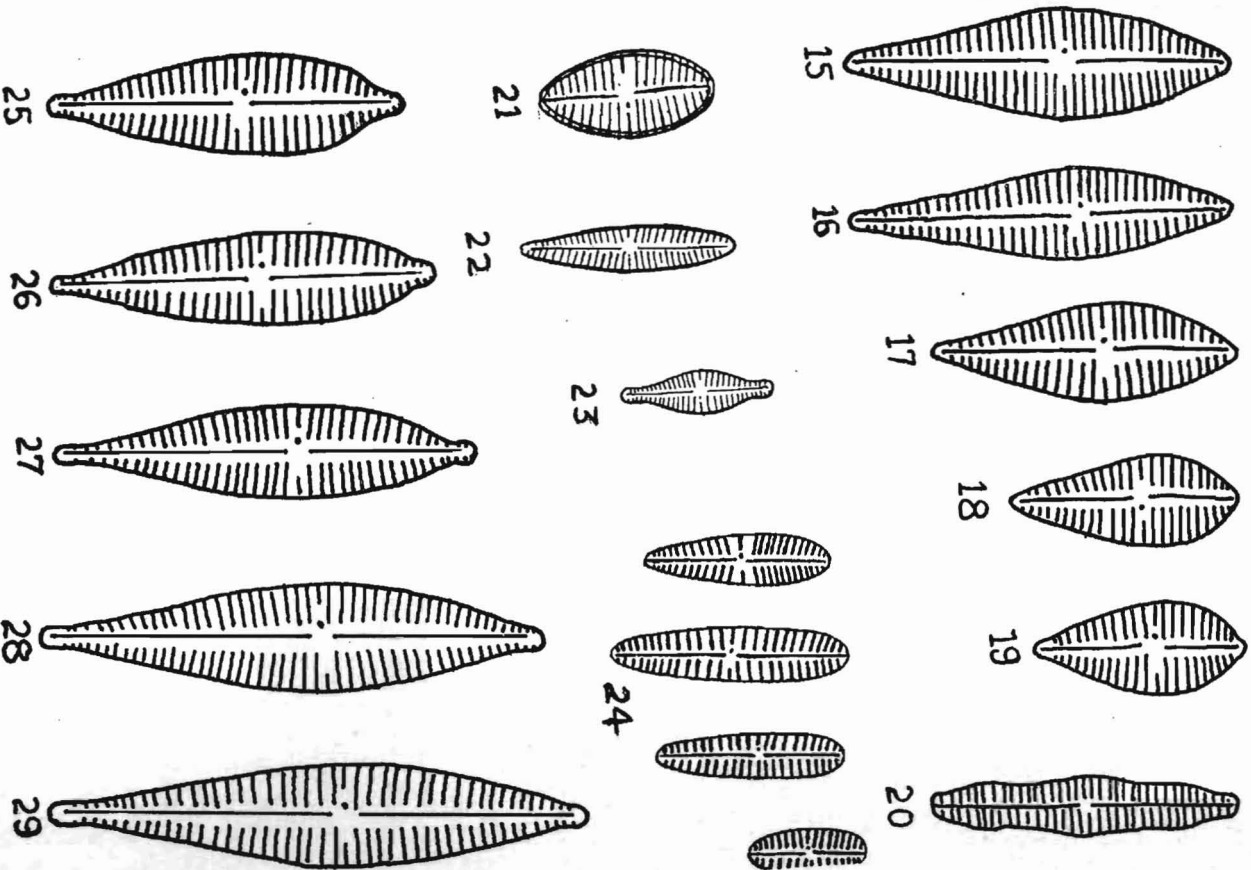
The named varieties almost always occurred as extremes of variation around the type, and the direction of variation seemed to have no geographical or ecological correlation. In the absence, on one hand, of demonstrable discontinuity between variants, and, on the other hand, of ecological or geographical correlations, the following varieties are reduced to synonymy.

Sphenella ? parvula was first described by Kützing in 1844. In 1849 Kützing recognized *Sphenella parvula* but also described *Gomphonema parvulum*, differentiating the latter on the manner of growth. Rabenhorst, 1853, placed *Sphenella parvula* under *Gomphonella parvula* and states it occurs in a jelly mass. Rabenhorst, 1864, Flora Europaea Algarum, p. 291, combined *Sphenella parvula* and *Gomphonema parvulum* of Kützing under the name *Gomphonema parvulum* and included also his *Gomphonella parvula*.

GOMPHONEMA PARVULUM KÜTZ. var. PARVULUM

- Sphenella ? parvula* Kütz., 1844, Bacill., p. 83, pl. 30, fig. 63.
Gomphonella parvula Rabenh., 1853, Sussw. Diat., p. 61.
Gomphonema parvulum Kütz., 1849, Sp. Algarum, p. 65.
Gomphonema parvulum var. *curta* R. d'Aub. apud Heribaud, 1920, Ann. Biol. Lacustre. 10:73, pl. V, fig. 15.
Gomphonema parvulum var. *exilis* Grun., 1878, Naturwiss. Beitr. Kenntniss Kaukasus. by O. Schneider, p. 107.
Gomphonema micropus var. *exilis* Grun. apud Van Heurck, 1880, Syn. Diat. Belgique, pl. XXV, fig. 6.
Gomphonema parvulum var. *exillissima* Grun. apud Van Heurck, 1880, Syn. Diat. Belgique, pl. XXV, fig. 12.
Gomphonema parvulum var. *genuinum* f. *semiaperta* A. Mayer, 1928, Denkschr. Bayer Bot. Ges. Regensburg. 17 NF 11: 104, pl. II, fig. 24.
Gomphonema parvulum var. *lagenula* Freng., 1923, Bol. Acad. Nacion Ciencias Cordoba. 27 : 68, pl. VI, fig. 16.
Gomphonema lagenula Kütz., 1844, Bacill., p. 85, pl. 30, fig. 60.
Gomphonema parvulum var. *lanceolata* Grun. apud Van Heurck, 1880, Syn. Diat. Belgique, p. 125, pl. XXV, fig. 10.
Gomphonema parvulum var. *micropus* Cl., 1894, K. Sv. Vet. Akad. Handl. 26(2) : 180.
Gomphonema micropus Kütz., 1844, Bacill., p. 84, pl. 8, fig. XII.





- Gomphonema micropus* var. *minor* Grun. apud Van Heurck, 1880, Syn. Diat. Belgique, pl. XXV, fig. 5.
- Gomphonema micropus* var. *major* Herib., 1903, Diat. Fossiles d'Auvergne, 2nd Mem., p. 21.
- Gomphonema micropus* forma *major* Grun. apud Van Heurck, 1880, Syn. Diat. Belgique, pl. XXV, fig. 4.
- Gomphonema parvulum* var. *subelliptica* Cl., 1894, K. Sv. Vet. Akad. Handl. 26(2) : 180.
- Gomphonema parvulum* var. *subcapitata* Grun. apud Van Heurck, 1880, Syn. Diat. Belgique, p. 125, pl. XXV, fig. 11.

This taxon includes all the variation in shape and striae number which occur around the more "typical" *G. parvulum* Kütz. One extreme of this variation seems to terminate in the short, elliptical *G. parvulum* var. *subelliptica* Cl. Figures No. 8, No. 9, and No. 19 would fit the description of this variety.

Another direction of variation is represented by *G. parvulum* var. *exillissima* Grun. as seen on Van Heurck Type Slide No. 220. This thin form with subcapitate bas and apex is merely an extreme in variation of *G. parvulum* var. *subcapitata* Grun. On Van Heurck Type Slide No. 17, Grunow lists both *G. parvulum* var. *subcapitata* Grun. and *G. parvulum* var. *exillissima* Grun.; the only discernable difference being that *G. parvulum* var. *exillissima* Grun. has a slightly greater length to breadth ratio.

Another extreme would appear to terminate in a form (Fig. No. 1) identical with *G. naviculoides* W. Sm., 1856, Brit. Diat. 2: 98, as seen on slide No. 3438 of the Febiger Collection labeled "*Gomph. naviculoides*, Victoria Tank, Edinb. Botanic Garden, no. 332" which is the type locality of this species and which probably is some of William Smith's material. Since this diatom has an oblique raphe and since it is almost symmetrical, it is the authors' opinion that this should remain a variety of *G. gracile* Ehr. where it was placed by Cleve, 1894, K. Sv. Vet. Akad. Handl. 26(2) : 183. In other words, this extreme represents the connecting link between *G. parvulum* Kütz. and *G. gracile* Ehr. and the actual limit of *G. parvulum* Kütz.

var. *parvulum* should be that form which approaches *G. gracile* var. *naviculoides* Cl. but which is distinctly asymmetrical to the transverse axis and which does not show the oblique raphe (Fig. No. 2). Slide No. 1925 of the General Collection shows the same limit of variation, i.e., *G. gracile* var. *naviculoides* Cl., but in this case the variation goes through what appears to be *G. parvulum* var. *lanceolata* Grun. (Fig. 16). The variation, on the other hand, in Station 139, Collection No. 3, passes through a form which rather agrees with Kützing's original description of *G. micropus* (Fig. 5). It should be noted that Kützing's original description of *G. micropus* differs considerably from *G. parvulum* var. *micropus* Cl. which is supposed to be based on Kützing's species. Cleve and Grunow and subsequent authors have described and pictured a somewhat rostrate form, which is not the form pictured or described by Kützing. According to Grunow, Van Heurck Type Slide No. 218 shows "*Gomph. micropus* passant au *G. angustatum*." *G. angustatum* Kütz. is on the slide, but no diatom similar to *G. micropus* Kütz. as pictured in Van Heurck's Syn. Diat. Belgique can be found. We have been unable to find any authenticated specimen of Grunow's, but on the basis of his illustrations, it is evident that some mistake was made. *G. angustatum* Kütz. does intergrade into *G. parvulum* Kütz. var. *parvulum*, but the presence of the much broader capitate apex of *G. angustatum* Kütz. and the wide spaces around the central striae are distinctive enough characters on which to base a separation of the two species.

We have placed in synonymy *G. parvulum* var. *genuinum* forma *semiapertura* A. Mayer because the character, lack of shortened stria opposite the stigma, is to be found now and then on almost all forms of the *G. parvulum* var. *genuinum* A. Mayer taxon.

We have not seen material of the following varieties and the descriptions do not adequately treat the variability. We are unable to state with any certainty where they belong in this complex, and they are therefore merely listed below.

GOMPHONEMA PARVULUM var. AEQUALIS A. Mayer, 1928, Denkschr. Bayer Bot. Ges. Regensburg. 17 NF 11: 104, pl. II, fig. 28.

A. Mayer's description of this variety is, "Schalen lanzettlich, Fuss- u. Kopfende geschnabelt-kopfig, 16-20 μ lang, 5-6 μ breit, fast symmetrisch zur Querachse." As pictured, this variety is so symmetrical that the authors certainly would not include it under *G.*

parvulum Kütz. var. *parvulum*. Our Fig. No. 23 is a photostat of the original figure.

GOMPHONEMA PARVULUM var. DESERTA Skvortzow, 1935, Publ. Mus. Hoangho Paiho de Tien Tsin. 36: 34, pl. 8, fig. 21.

This diatom is 15μ long, 6.8μ wide, with 15 striae in 10μ . Fig. No. 21 is a photostat of the original figure.

GOMPHONEMA PARVULUM var. FOSSILIS Lenoble, 1948, Mem. Acad. Malgache. p. 145, pl. I, fig. 11.

This variety is published without a description, but the picture is adequate, the shape and striae being distinctive. It was found in the fossil deposit of Aquitanien, which Lenoble dates as Pliocene. Fig. No. 24 is a photostat of the original figures.

GOMPHONEMA PARVULUM var. SINICA Skvortzow, 1935, Publ. Mus. Hoangho Paiho de Tien Tsin. 36 :26, pl. 6, fig. 11.

This diatom is described as being 25μ long, 6.8μ wide, and the striae 12 in 10μ . Fig. No. 22 is a photostat of the original figure.

GOMPHONEMA PARVULUM var. UNULATA A. Cleve, 1895, Bihang Till K. Sv. Vet. Akad. Handl. 21 Afd. III(2) :21, pl. I, fig. 18.

Astrid Cleve-Euler's description of this variety is: "Valve tri-undulate, with rostrate ends, 0.02 mm. in length, 0.004 mm. in breadth. Axial and central areas indistinct. Striae 16 in 0.01 mm." The locality is Kvikkjokk. The authors have never seen a slide of this diatom, but there can be no question that it is not a member of the large *G. parvulum* Kütz. var. *parvulum* taxon. Fig. No. 20 was re-drawn to scale from the original drawing.