Potential Neogene diagnostic diatoms from the western Snake River Basin, Idaho and Oregon

Sam L. VanLandingham
Consulting Geologist/Environmentalist, 3741 Woodsong Drive, Cincinnati, Ohio 45239

ABSTRACT: A recent biostratigraphic list composed of the diatoms *Coscinodiscus gorbunovii, C. miocaenicus, Melosira jouseana, Cyclotella pygmaea* (= *C. hannaites*), *Stephanodiscus carconensis*, and *C. elgeri* from the western Snake River Basin of Oregon and Idaho is considered to be of limited value. Field and literature observations have revealed that most of these taxa are either modern forms or forms with long stratigraphic ranges. An alternate list is proposed; it employs the following western Snake River Basin diatoms: *Tetracyclus ellipticus* var. *latissimus* f. *minor, Opephora cantalense* var. *obesa, T. stellare* var. *eximia, Gomphonema occidentale, Fragilariopsis* (*Fragilaria*?) sp. 1, *O. glangeaudi, Rhoicosphenia curvata* f. *minor* and *G. cholnokyites.*

INTRODUCTION

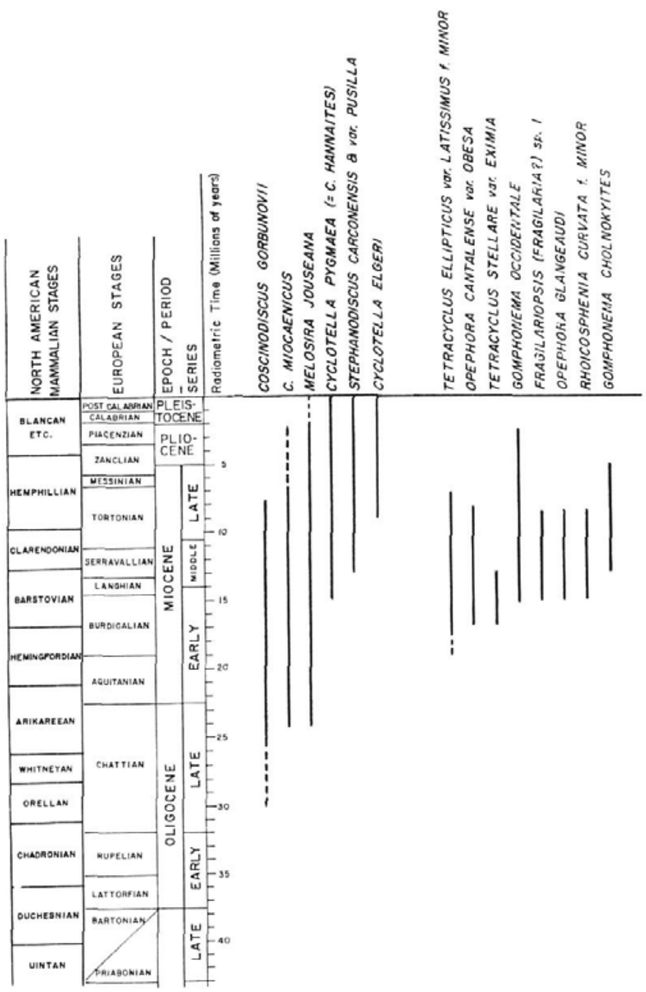
Although there are several brief, scattered reports dealing with the fossil diatoms and diatomites of the western Snake River Basin, the first detailed report was published by Bradbury and Krebs (1982). These authors proposed that the following six taxa might provide "important support to the concept of a world-wide Neogene lacustrine diatom biochronology": *Coscinodiscus gorbunovii* Moiseyeva, *C. miocaenicus* Krasske, *Melosira jouseana* Moiseyeva, *Cyclotella pygmaea* Pantocsek (= *C. hannaites* VanLandingham), *Stephanodiscus carconensis* Grunow, and *C. elgeri* Hustedt. In addition they suggested that *S. carconensis* var. *pusilla* Grunow might be useful stratigraphically.

The assumed value of the diatoms in Bradbury and Krebs's list apparently is not consistent with the ranges reported from the classic literature, even when adjusted to conform with current time schemes, and does not reflect my unpublished observations in the western Snake River Basin and in the western United States. Because most of these taxa have either modern representatives or long stratigraphic ranges, it is likely that the list of diatoms mentioned by Bradbury and Krebs may be of only limited use.

OBSERVATIONS

The apparent time of extinction of *Coscinodiscus gorbunovii* = *Pontodiscus gorbunovii* (Moiseyeva) Moiseyeva and Sheshukova-Poretskaya (text-fig. 1), including the synonym *C. gorbunovii* var. *ethmodiscoidus* Moiseyeva (pl. 1, figs. 25–27) is somewhat earlier than that of the other taxa Bradbury and Krebs utilized in their 1982 study and probably is the only one that has much potential as an indicator in diatom stratigraphy. Recent work (MS) by Bradbury indicates that both *C. gorbunovii* and *C. miocaenicus* should be in the genus *Actinocyclus*. The range of *C. gorbunovii*, from about the Orellan to the middle of the Hemphillian, is supported by the following localities and references: eastern slope of the Urals in Zaural'ya, USSR (Krotov and Shibkova 1961); western Siberia and Dal'nii Vostok, USSR (Sheshukova-Poretskaya, in Sheshukova-Poretskaya and Moiseyeva 1964); Esmeralda Formation at Cedar Mountain, Nevada, USA (VanLandingham 1966); clay beds of Tim River, western Siberia, USSR (Jousé 1966a); approximately Early to Late Miocene (Jousé 1966b); Primor'e, USSR (Moiseyeva 1965, 1967, 1968); Turtasskaya Group, western Siberian Depression, USSR (Rubina 1968, 1970); Pribaikal, USSR (Tscheremissinova 1968); near mouth of Kedrovki River in the Krasnyi Yar region, Koppi River near mouth of Topty River in Khabarovsk Territory, on eastern slope of Ural Mountains, and in Tyma Basin, USSR (Moiseyeva 1971); Neogene of Pribaikal and Uglenosnaya Group of Tunkinskaya Hollow, USSR (Tscheremissinova 1973); western Siberia, Pribaikal, and southern Dal'nii Vostok, USSR (Glezer et al. 1974): Upper Oligocene to Upper Miocene (Sheshukova-Poretskaya, Moiseyeva and Korotkevich 1981); Miocene of Ma'anshan and Sanguande areas, Jilin Province, China (Huang, Wang and Sun 1983); and middle member of the Juntura Formation near Juntura, Oregon; lower Idaho Group of Mann Creek district, Idaho; Esmeralda Formation at Cedar Mountain, Nevada; and Truckee Formation at Eagles House, Nevada, USA (VanLandingham unpublished).

There are numerous reports of *Coscinodiscus miocaenicus* = *Pontodiscus miocaenicus* (Krasske) Moiseyeva and Sheshukova-Poretskaya to confirm the age from Arikareean to about Blancan (text-fig. 1): Kieselgurlager of Beuern, Germany (Krasske 1934); Verkhnetretichnye deposits, Primorskoi Krai, USSR (Moiseyeva 1960); Velyi Yar, western Siberia, and Suifunskaya Group of east Dal'nii Vostok, Krasnyi Yar region, Primor'e Territory, USSR (Sheshukova-Poretskaya and Moiseyeva 1964); Yakima Basalt of Yakima and Grant counties, Washington, USA (VanLandingham 1964); Neogene of the Far East, USSR (Nikolaev 1965); clay beds of Tim River, western Siberia, USSR (Jousé 1966a); Middle to Late Miocene (Jousé 1966b); Bully Creek Formation near Keating, in Lower Powder Valley, Oregon, USA (VanLandingham 1966); Primorskoi Krai, USSR (Moiseyeva 1967, 1968); Pribaikal, USSR (Tscheremissinova 1968); south Bohemian Basin (Řeháková 1969); Zabaikal, USSR (Endrikhinskii and Tscheremissinova 1970); Tyma River Basin of western Siberia and Suifunskaya Group near mouth of Kedrovki River, Krasnyi Yar region (Primor'e), USSR (Moiseyeva 1971); Uglenosnaya Group at Tunkinskaya Hollow, USSR (Tscheremissi-



TEXT-FIGURE 1
Comprehensive (world) stratigraphic ranges of diatoms found in western Snake River Basin. First six vertical lines represent ranges of taxa mentioned by Bradbury and Krebs (1982) and the last eight are of taxa examined in the present study. Lines are broken where ranges are uncertain.

nova 1971, 1973); Bully Creek Formation near Harper, Oregon (Abbott and VanLandingham 1972); Helvetian, Tortonian, and Sarmatian of Mecsek Mountains, Hungary (Hajós 1973); western Siberia, southern Far East, Suifunskaya Group of Primor'e, and Uglenosnaya Group at Tunkinskaya Hollow in Pribaikal, USSR (Glezer et al. 1974); Evropeiskaya USSR (Loginova 1978); Early Miocene to Late Miocene (Sheshukova-Poretskaya, Moiseyeva and Korotkevich 1981); and lower Idaho Group near Mann Creek, Idaho, and Middlegate Formation near Middlegate and Ione Road, Nevada, USA (VanLandingham unpublished).

A range from approximately Late Oligocene through Late Pliocene and perhaps Pleistocene can be inferred for *Melosira jouseana* (text-fig. 1). Jousé (1966a, 1966b) and Moiseyeva (1965, 1971) found it in areas ranging from Late Oligocene to Late Miocene. I have observed *M. jouseana* from diatomaceous deposits of the lower Idaho Group in the Mann Creek district, Washington Co., Idaho; Bully Creek or Chalk Butte Formation or equivalents near Bridge Gulch, Malheur Co., Oregon; Yonna Formation of the Sprague River Valley, Klamath Co., Oregon; and middle member of the Truckee Formation near Brady's Hot Springs, Nevada. Apparently it has been figured by VanLandingham (1964, pl. 42, fig. 1) as *Melosira* sp. from the Squaw Creek Diatomite, Yakima Co., Washington. This species may even extend into the Pleistocene or Recent, as is indicated by its occurrence in Swan Lake, Klamath Co., Oregon. Its range apparently is so long that it would be of only limited use in a comprehensive chronostratigraphic scheme.

The problems encountered in the paper by Bradbury and Krebs (1982) aid in emphasizing the plea for a critical examination of identifications and ages of taxa mentioned in the older literature, so that a more complete and careful examination of the distributional records can be utilized in preparing current publications on both marine and lacustrine fossil diatoms. A case in point is Schrader (1978), who reported that *Cyclotella pygmaea* is "found only in freshwater material from Bodos, Kopecz, and Bibarezfalva," which, in fact, has been reported as fossil by the following: Pantocsek (1903) from andesite tuffs (Sarmatic) of Szliács, Hungary; Fukushima (1957) from Nishise Village, Kumamoto Prefecture, Kyushu, Japan; Lohman (1937) from the Klamath Falls district, Klamath Co., Oregon; Lohman (1938, 1940) from the Tulare Formation, North Dome, Kettleman Hills, Fresno Co., California; and Servant-Vildary (1973) from ancient Lake Chad, central Africa. Frenguelli (1945) described *C. pygmaea* from the Platense of Argentina in Holocene sediments. A questionable occurrence was recorded by Belevich (1961) from Quaternary deposits of Ust'-Port, USSR. Deposits from the lower Idaho Group near Weiser, Idaho, Yonna Formation near Dorris, California; Truckee Formation near Reno, Nevada; Juntura Formation near Juntura, Oregon; and a modern spring stream near Philadelphia, Pennsylvania all contain diatoms that I observed (unpublished manuscript) to closely resemble the specimen illustrated by Frenguelli (1945). The range of *C. pygmaea* is probably Barstovian to Recent (text-fig. 1). *Cyclotella pygmaea* seems to display a great deal of variation; it is also likely that *C. hannaites* is a synonym, as Bradbury and Krebs (1982) suggested.

Such investigators as Hustedt (1939) and Lohman (1937, 1938) have indicated that *Stephanodiscus carconensis* is known only as a fossil. However, the following references, among others, have reported this species to be in modern populations: Swan Lake, Klamath Co., Oregon (Tempère and Peragallo 1909); Devils Lake, North Dakota (Elmore 1921); Biwa Lake, Honshu, Japan (Skvortzov 1936; Negoro 1954a, 1954b, 1956; Fukushima 1957); Imarera, Algeria (Amossé 1941; Baudrimont 1974); Koubé Basso, North Chad, central Africa (Compère 1970); Delta du Chari, bassin de l'El Béid, Lake Chad, central Africa (Compère 1975); Laurentian Great Lakes of North America (Stoermer and Kreis 1978); Aïr Mountains of southern Sahara, Niger Republic (Compère 1980); wet cliff walls in Zion National Park, Utah (Johansen et al. 1983); and Lake Tahoe, California-Nevada (Mahood, Thomson and Goldman 1984). Negoro (1960) noted that *Melosira solida* Eulenstein and *Stephanodiscus carconensis* are the most noticeable planktonic forms in Lake Biwa, the latter being dominant in January through March. According to Negoro's experience (1967), "in the main basin of Lake Biwa, *Melosira solida* and *Stephanodiscus carconensis* used to appear in winter at the same time in enormous quantity as main plankters." Negoro (1968) reported that *S. carconensis* appears as abundantly in Lake Yogo-ko as in Lake Biwa (1.5 km to the south). In a 197.2-m core from Lake Biwa, Mori (1974, 1975) and Mori and Horie (1975) showed that *M. solida, S. carconensis,* and *S. carconensis* var. *pusilla* dominated the A zone (the top 76 m) and that the prominence of the three forms corresponded well to the situation found in Recent times in the same lake. Even in publications dealing primarily with fossil assemblages, *S. carconensis* has been acknowledged to be present in modern lakes (VanLandingham 1964, 1967; Gasse 1977). Mc Farland (unpublished) commented as follows on Hustedt's Pit River ("Oregon") slide from the California Academy of Sciences, "... although it [*S. carconensis*] is generally regarded as a fossil, it has been found in plankton and periphyton samples from the northwestern United States and possibly may still be living there." Mahood (personal communication) indicated that *S. carconensis* was present in Clear Lake, California, at least 20,000 years ago and perhaps earlier, although it was not in the lake in Recent sediments. Edwards (1893) noticed it in late Glacial deposits of the Littoral Plain of New Jersey. In addition, there are other reports of this species in Late Quaternary sediments. In view of this controversy, the possibility of misidentification or confusion may be considered. On the other hand, it is interesting to note that Compère (1975) mentioned that representatives of *S. carconensis* from modern Lake Chad corresponded perfectly to Hustedt's material from the collection at Bremerhaven. These observations, combined with the fact that *S. carconensis* has been reported as fossil as early as the Barstovian-Clarendonian boundary (VanLandingham unpublished) and as late as 10,000–20,000 yr BP, bring to an end the idea that *S. carconensis* is extinct and/or it can be used effectively in comprehensive diatom stratigraphic work (text-fig. 1). The same holds true for *S. carconensis* var. *pusilla,* which has been reported as modern from the following localities: Big Lake and Arlington, Washington (Tempère and Peragallo 1909; Hanna 1930); Biwa Lake, Honshu, Japan (Iwahashi 1935; Skvortzov 1936; Fukushima 1957; Negoro 1967); Ikeda Lake, Kyusyu, Japan (Skvortzov 1937; Fukushima 1957); Imarera, Algeria (Amossé 1941; Baudrimont 1974); and Laurentian Great Lakes, North America (Stoermer and Kreis 1978). Mori (1974, 1975) and Mori and Horie (1975) showed that this variety was present in a core from Lake Biwa-ko from a depth of about 100 m up to the present level. *Stephanodiscus carconensis* var. *pusilla* was reported to be present in the Quaternary as well as in modern lakes by Gasse (1977) and from a Holocene peat bog on the east side of Badda Mountain in Ethiopia by Gasse (1978).

Some problems involved in using *Cyclotella elgeri* in comprehensive chronostratigraphy are: 1) possible occurrence of this species more than once in lake bottoms in Siskiyou Co., California, and Klamath Co., Oregon; 2) the original description of Hustedt (1952) indicating that its occurrence in the fossil or living state was not known; 3) the validity of the assumption that the type locality was in the Yonna Formation; and 4) its possible occurrence as an extreme variation form of the *C. comta-bodanica* complex. The stratigraphic range is most likely from Hemphillian to Recent (text-fig. 1). Apparently the oldest record of it is by Bradbury and Krebs (1982) from the Chalk Hills Formation of Idaho.

My detailed studies on diatomaceous rocks from localities in the western Snake River Basin have revealed several diatoms, not mentioned by Bradbury and Krebs (1982), which may be utilized in certain chronostratigraphic studies (text-fig. 1). These include *Tetracyclus ellipticus* var. *latissimus* f. *minor* Hustedt, *Opephora cantalense* var. *obesa* Héribaud, *T. stellare* var. *eximia* (Héribaud and M. Peragallo) Hustedt, *Gomphonema occidentale* M. Schmidt, *Fragilariopsis* (*Fragilaria*?) sp. 1 VanLandingham, *O. glangeaudi* Héribaud, *Rhoicosphenia curvata* f. *minor* M. Schmidt, and *G. cholnokyites* VanLandingham. Some of these are fairly uncommon or rare, however all but *T. stellare* var. *eximia* and *Rhoicosphenia curvata* f. *minor* probably are common enough for some use in correlation work.

Tetracyclus ellipticus var. *latissimus* f. *minor* (pl. 1, figs. 13–18) probably arose sometime around the upper Hemmingfordian and became extinct in the Hemphillian (text-fig. 1). In the Snake River Basin this form occurs in the lower Idaho Group of the Crane Creek deposits, Washington Co., Idaho, and in the Banbury Basalt of the Clover Creek district, Gooding Co., Idaho. Other occurrences were reported by: VanLandingham (1964), as *Diatoma hiemale* abnormal form and *D. hiemale* var. *mesodon,* from the Yakima Basalt of south central Washington; Hustedt in Schmidt (1912) from the Dalles or Mascall Formation (or equivalents) of the Columbia River district, Oregon; and VanLandingham (unpublished) from the Esmeralda Formation in the Black Spring, Gilbert, and Cedar Mountain districts of Nevada and Bully Creek Formation near Durkee, Oregon. The type locality of the synonym *Stylobiblium haradaae* Pantocsek is Sentenai (Setana), Japan (Pantocsek 1892). Okuno (1952, 1959) and Fukushima (1957) are other notices of *S. haradaae* from the Setana deposit in the Kunnui Group (Early to Middle Miocene).

Opephora cantalense var. *obesa* Héribaud (pl. 1, figs. 10–12) ranges from Barstovian to lower Hemphillian (text-fig. 1). In addition to European occurrences from the Lugarde deposits, Cantal, France, in reports by Héribaud (1908), Lauby (1910a, 1910b) and Tempère and Peragallo (1913), it has been found by VanLandingham (unpublished) in the lower Idaho Group of the Mann Creek district of Idaho and middle member of the Truckee Formation in the Brady's Hot Springs and Hot Springs Mountains districts, Nevada.

Tetracyclus stellare var. *eximia* (pl. 1, fig. 9) apparently is restricted to the Barstovian and its equivalents or nearly so (text-fig. 1). This form has been found in the present study in the lower Idaho Group of the Mann Creek district, Washington Co., Idaho. Outside of the Snake River Basin, evidently this variety has been reported only from the Celles deposits, Cantal, France, by Héribaud (1902, 1903b), Tempère and Peragallo (1908) and Lauby (1910a).

The stratigraphic range of *Gomphonema occidentale* (pl. 1, figs. 1–4) tentatively has been determined to be from Barstovian to Blancan (text-fig. 1). M. Schmidt in A. Schmidt (1899) and Tempère and Peragallo (1912) listed this species as a freshwater fossil from Washington Co., Idaho. In the

Snake River Basin it was encountered in the present study in the lower Idaho Group in the Mann Creek deposits of Washington Co., Idaho. It has been found also by Hanna (1933) in the Trout Creek Formation, Harney Co., Oregon; and by VanLandingham (unpublished) in the Yonna Formation of the Klamath River and Lost River valleys, Klamath Co., Oregon, and Truckee Formation (or equivalents) of the Velvet district, Pershing Co., Nevada. *Gomphonema occidentale* var. *abbreviata* M. Schmidt (pl. 1, figs. 5–6) has been listed by M. Schmidt in A. Schmidt (1899) and Tempère and Peragallo (1912) as occurring in the Washington Co., Idaho, locality; however, not enough information is presently available for plotting its range.

VanLandingham (1964) reported *Fragilariopsis* (*Fragilaria*?) sp. 1 (pl. 1, figs. 22–23) from the Yakima Basalt of south central Washington. Its range of middle Barstovian through lower Hemphillian (text-fig. 1) is supported by its occurrence in the lower Idaho Group at Mann Creek, Washington Co., Idaho, and the Truckee Formation (or equivalents) in the Velvet district, Pershing Co., Nevada, by VanLandingham (unpublished). Some of these *Fragilariopsis* (*Fragilaria*?) sp. 1 frustules may be *Fragilaria bicapitata* var. *lineolata* Moiseyeva which ranges from about upper Barstovian to lower Blancan.

Opephora glangeaudi (pl. 1, figs. 28–29) ranges from middle Barstovian into lower Hemphillian (text-fig. 1). With the exception of the reported occurrences in the La Garde deposits, Cantal, France, by Héribaud (1908), Lauby (1910a) and Tempère and Peragallo (1912), the only other occurrences seem to be in the lower Idaho Group from the Mann Creek deposits of Washington Co., Idaho and in the middle member of the Truckee Formation from the Brady's Hot Springs, Hot Springs Mountains and Green Hill areas of Nevada (VanLandingham unpublished).

Little can be inferred at present about the range of *Rhoicosphenia curvata* f. *minor* (pl. 1, figs. 19–21) but current information suggests a range from at least lower Barstovian to lower Hemphillian (text-fig. 1). In addition to the type locality in Washington County, Idaho (lower Idaho Group), this form has been found in several localities in the Esmeralda Formation or its equivalents in the Basalt and Pinchot Creek districts of Nevada (VanLandingham unpublished).

VanLandingham (1964) originally described *Gomphonema cholnokyites* (pl. 1, figs. 7–8) from the Yakima Basalt of Grant

PLATE I

All magnifications × 1000 except 1, 3–6 which are approximately × 910

1, 3–4 *Gomphonema occidentale*
Washington Co., Idaho (after M. Schmidt in A. Schmidt 1899).

2 *Gomphonema occidentale*
Truckee Formation or equivalents, Pershing Co., Nevada.

5–6 *Gomphonema occidentale* var. *abbreviata*
Washington Co., Idaho (after M. Schmidt in A. Schmidt 1899).

7 *Gomphonema cholnokyites*
Banbury Basalt in Clover Creek region, Gooding Co., Idaho.

8 *Gomphonema cholnokyites*
Bully Creek Formation or equivalents at Bridge Gulch, Malheur Co., Oregon.

9 *Tetracyclus stellare* var. *eximia*
Lower Idaho Group in Mann Creek district, Washington Co., Idaho.

10 *Opephora cantalense* var. *obesa*
Lower Idaho Group, Mann Creek district, Washington Co., Idaho.

11–12 *Opephora cantalense* var. *obesa*
Middle member of Truckee Formation in Brady's Hot Springs district, Churchill Co., Nevada.

13 *Tetracyclus ellipticus* var. *latissimus* f. *minor*?
Intercalary band. Banbury Basalt in Clover Creek region, Gooding Co., Idaho.

14–15 *Tetracyclus ellipticus* var. *latissimus* f. *minor*
Intercalary bands. Banbury Basalt in Clover Creek region, Gooding Co., Idaho.

16–18 *Tetracyclus ellipticus* var. *latissimus* f. *minor*
Frustules. Banbury Basalt in Clover Creek region, Gooding Co., Idaho.

19 *Rhoicosphenia curvata* f. *minor*
Valve view. Esmeralda Formation or equivalents in Basalt district, Nevada.

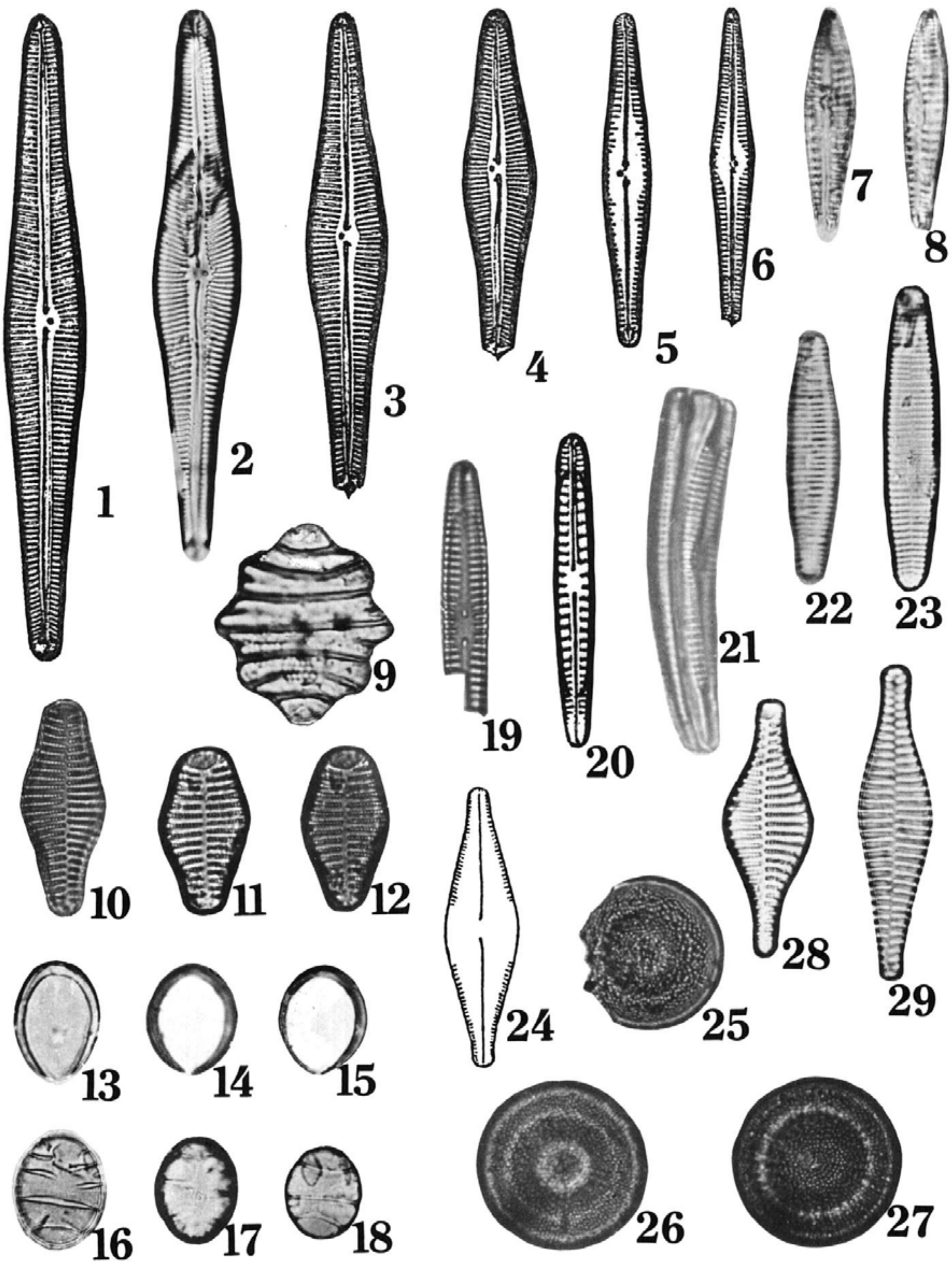
20–21 *Rhoicosphenia curvata* f. *minor*
Lower Idaho Group, Washington Co., Idaho. 20, valve view (after M. Schmidt in A. Schmidt 1899). 21, girdle view.

22–23 *Fragilariopsis* (*Fragilaria*?) sp. 1
Of VanLandingham (1964) from lower Idaho Group, Mann Creek district, Washington Co., Idaho.

24 *Pinnularia hagelsteinii*
Glenns Ferry Formation in the Bliss district of Idaho (after Boyer 1920).

25–27 *Coscinodiscus* (*Actinocyclus*) *gorbunovii* var. *ethmodiscoidus* = *Pontodiscus gorbunovii*
Lower Idaho Group, Washington Co., Idaho. 25, broken valve. 26–27, frustule at two different focal planes.

28–29 *Opephora glangeaudi*
Lower Idaho Group, Mann Creek district, Washington Co., Idaho.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Co., Washington. Its stratigraphic range is from upper Barstovian through middle Hemphillian (text-fig. 1). In the Snake River Basin I found it in the Bully Creek or Chalk Butte Formation near Bridge Gulch, Malheur Co., Oregon, and in the Banbury Basalt of the Clover Creek district, Gooding Co., Idaho. Other occurrences include the Bully Creek Formation at Keating (Lower Powder Valley), Oregon (VanLandingham 1966) and Truckee Formation (or equivalents) in the Desert Peak, Green Hill and Nightingale districts of Nevada (VanLandingham unpublished).

Although *Pinnularia hagelsteinii* Boyer (pl. 1, fig. 24) is rare and has not been found outside the Snake River Basin (known at present only in the region around Bliss, Idaho, apparently in the Glenns Ferry Formation), it may be useful in local stratigraphic work.

CONCLUSIONS AND DISCUSSION

The present study corroborates the growing evidence that there are many noteworthy nonmarine fossil diatoms of potential value in marking local horizons, but few occurring commonly enough for use in broad, regional correlations or general use. Of all the taxa from the Snake River Basin listed by Bradbury and Krebs (1982) only *Coscinodiscus gorbunovii* and perhaps *C. miocaenicus* have ranges that might be suitable for general stratigraphic use. Bradbury and Krebs (1982) utilized centric taxa which they considered to be extinct. The alternate plan proposed in the present work seems to be more useful in stratigraphic work and emphasizes the extinct pennate taxa, which outnumber the extinct centric taxa more than 7 to 1 in nonmarine deposition.

For many years it has been known that the pennate genus, *Tetracyclus* (including the synonym *Stylobiblium*) is one of the most important diatom genera in nonmarine diatom stratigraphy. Not only are its species apparently exclusively nonmarine, but many of these species have short stratigraphic ranges and could be utilized well in a region such as the Snake River Basin. It would be unfortunate to ignore or omit this genus in any detailed stratigraphic study of regions where its species are known to occur commonly. A recent stratigraphic work on *Tetracyclus* by Li (1983) stressed the importance of the study of this genus in detail and used it not only to differentiate typical diatom complexes of Miocene and Pliocene deposits of Jiling, Inner Mongolia, but also to provide standards in age determination of adjacent regions.

The proposal by Bradbury and Krebs (1982) that the long sequence of diatomaceous rocks in the western Snake River Basin can be used "as a standard of comparison for other diatomaceous rocks of the western United States and perhaps other parts of the world" may not be as appropriate as the use of other regions in the western United States for this purpose. The greatest diatomite complex in the world is situated in California, Nevada and Oregon. Not only does California have the most complete and representative marine and lacustrine diatom-bearing sections of any comparably sized area in the world but it also probably has the most economically significant marine diatomite deposit and lacustrine diatomite deposit in the world (Taylor 1981). Lacustrine deposits of comparable size are found in Nevada, although their value and importance are often difficult to assess. Nevada probably has the most complete and representative lacustrine diatom-bearing sections of any area of equal size in the world; only the rare pre-Oligocene representation is conspicuously absent. Many years of field experience and study of over 3000 publications directly or indirectly related to such matters as taxonomy, geology, distribution and age of lacustrine diatomaceous deposits occurring in California, Nevada, Washington, and Oregon do not corroborate the suggestion by Bradbury and Krebs (1982) that, "in general the diatom floras of these deposits are not well known" and that their ages have not been clearly defined by radiometric dates or paleontological collections. California, Nevada, and Oregon deposits probably have been studied in more detail and are accompanied by more K/Ar, fauna and flora age determinations than those deposits from the Snake River Basin studied by Bradbury and Krebs (1982). Deposits of adjacent central and eastern Oregon, some of which have been treated in comprehensive monographs, probably would serve as a better "standard of comparison" than the Snake River Basin deposits included by Bradbury and Krebs. No detailed monographs ever have been published on the diatom floras of the Snake River Basin, whereas even some of the central Washington diatom floras have been so monographed.

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