THE SPECIES AND STRATIGRAPHIC DISTRIBUTION OF
CAUCASINA AND AEOLOMORPHELla, NEW GENUS (FORAMINIFERIDA)

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I. Abstract
Species of Caucasina are described and figured. Two Austrian Miocene species, Balimina elongata and B. subulata, are transferred to Caucasina and new Californian species erected: C. minuta (Paleocene, Dos Palos Shale) and C. khalilovi (Oligocene, Rincon Formation). Aeolomorphella, a new genus, is based on the new species, A. plecostilis (north Alaskan Upper Cretaceous). Caucasina ranges from Upper Cretaceous (Campanian) to Miocene, occurring in both Old and New Worlds. Paleoecologic implications, as well as familial and phylogenetic relationships of the Caucasinae also are discussed.

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II. INTRODUCTION
The genus Caucasina was defined by Khalilov in 1951, and since has been widely reported in the Soviet Union from strata of Oligocene and Miocene age. The monotypic Cretaceous genus Aeolostreptis Loeblich and Tappan (1957) was described from the American Upper Cretaceous, but later regarded by us as a junior synonym of Caucasina, thus extending the geographic and geologic range to include the Upper Cretaceous of the American Gulf Coast (Loeblich and Tappan, 1961, p. 314). Eocene and Oligocene species of Caucasina were described by Khalilov (1958), and a new species was referred to the genus from the Eocene of France in 1961. The genus also has been reported from Yugoslavia by Sikic (1962).

Because of the distinctive morphological characters of the genus, the very limited records of its occurrence are somewhat surprising. The present compilation of previously described species is accompanied by the description of two new Californian species (of Paleocene and Oligocene age, respectively) and transfer to the genus Caucasina of two previously described species from the Austrian Miocene.

Because the species recorded to date have proved to be of considerable stratigraphic value, the present summary of the generic occurrence may aid in the recognition of these and additional species, in strata of other areas, and thus further increase their usefulness.

III. KNOWN GEOLOGIC AND GEOGRAPHIC DISTRIBUTION
The earliest reported occurrence of Caucasina is in the Campanian, by which time the genus was present in both North America and Eurasia (fig. 1). Caucasina tuzkoensis was described from the Campanian of the region of the Amu Darya River and Bukhara, in Uzbek SSR, and the Kyzyl Kum of Uzbek and Kazakh SSR, central Asia (Suleymanov, 1962), and Caucasina vitrea (Cushman and Parker) occurs in the Selma Chalk of nearly equivalent age in Mississippi. Of nearly the same age, and perhaps derived from Caucasina, is the north Alaskan form Aeolomorphella plectilis, new species.

No Maastrichtian records are known as yet (fig. 2), but a new Danian (Paleocene) species is here described from the Dos Palos Shale of California. Another gap in the known record represents the Landenian (upper Paleocene) and lower and middle Eocene (Ypresian, Lutetian), although the nomen nudum C. "suzakensis" is reported from the Paleocene (Pg1) of Fergana, central Asia (Bykova, 1960). Two species have been recorded from the upper Eocene of Azerbaijan SSR: C. eocaenica from the Lesser Caucasus, east Azerbaijan and the Azov Kuban basin (Khalilov, 1958; Nikitina, 1962), and C. aziderensis from the upper Eocene-Oligocene of

Figure 1. Occurrence of Caucasininae.
### DISTRIBUTION OF THE CAUCASININAE

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**Figure 2**
the Lesser Caucasus. An upper Eocene species, *C. alpina*, also has been described from France (Éspitalié and Sigal, 1961).

Additional Oligocene species are the type species *C. oltogocenica* (here regarded as a synonym of *C. schischkinikayae*, as it has been by various workers, although recognized as a subspecies or distinct species by others), *C. schischkinikayae*, *C. tenebricosa*, and the apparently undescribed *C. "buliminoides."* *Caucasina schischkinikayae* has been widely reported from the Oligocene of the Crimea (Ukrainian SSR), Caucasus (Azerbaijan SSR), Armenian SSR, and the Kopet Dag (Turkmen SSR) (Samoylova, 1947; Khalilov, 1951, 1962; N. K. Bykova, 1953, 1959; Myatlyuk, 1960; Bogdanovich, 1960; Merklin, Morozova and Stolyarov, 1960; Chernyak, Bogaets, Voloshina and Khadikin, 1961; Kaptarenko-Chernousova, Golyak, Zernetskiy, Kraeva and Lipnik, 1963; Nosovskiy and Savenko, 1963; and Dmitriev and Kozhevnikova, 1963). It also has been reported from the lower Miocene of Abkhazia (northern Georgian SSR) by Dzhanidelize (1956).

*Caucasina tenebricosa* occurs in the Oligocene and in the mid-Miocene (Stebnikskoy beds) of the pre-Carpathians (Subbotina, Pishvanova and Ivanova, 1960, and Didkovskiy, 1963). References to two apparently undescribed species also occur frequently in the literature: *Caucasina "buliminoides"* has been reported from the Maykopian beds (upper Oliuroene) of the Crimea and Caucasus of the Ukrainian SSR and the Azov Kaban basin (Nikitina, 1962: Nosovskiy and Savenko, 1963) and from the Miocene (Burdigalian) of the northern Caucasus. Another form, *Caucasina "lucera,"* has been reported in the upper Tortonian (Tychchevskaya beds) of the trans-Carpathian area and Ukrainian SSR (Vyalov, Pishvanova, Petrushkevich and Grishkevich, 1962; Ivanova, 1962).

*Bulimina elongata* d’Orbigny from the Vienna Basin is widely reported in the Miocene of Europe and is here regarded as belonging to *Caucasina*. It has been referred to as *Neobulimina elongata* and as "*Caucasinella,"* in various publications, but the latter generic name has not been validated by a description, and the basis for its separation is not clear (N. K. Bykova, 1959; Myatlyuk, 1960; Nikitina, 1962).

An additional Austrian Miocene species, originally described as the "variety" *subulata* of *Bulimina elongata* is now regarded as a separate species and is here transferred to *Caucasina*. This basally spinose form also occurs in the trans-Carpathian region of the Ukrainian SSR, although there referred to *C. schischkinikayae* (Venglinsky, 1958).

*Caucasina* also has been reported from the Tortonian of Croatia, Yugoslavia (Sikić, 1962).

Because of the recognition of eleven valid species and three as yet undescribed, within the dozen years since the genus was described, it seems probable that additional species also will be found in other regions and strata, when their distinctive characters are noted.

IV. ECologic Relationships

In some regions the abundance of specimens of *Caucasina* has led to recognition of a characteristic *Caucasina* complex. Other foraminifers commonly occurring with *Caucasina* include representatives of various agglutinated genera (*Bathyrisphen*, *Spiroplectammia*, *Textularia*, *Haplophragmoides*) and *Rotalia*, *Valvulineria*, *Gyroidina*, *Heterolepta*, *Bulimina*, *Bolvina*, *Uvigerina* and *Nonion*. Ostracodes also may be present, as are such molluscan genera as *Leda*, *Tornatella*, *Ostreia*, *Natica*, *Planorbella* and *Dentalium*.

According to N. K. Bykova (1953, p. 270) the *Caucasina* complex in the Paleocene of Fergana occurs in a fine red clay deposit of very slight CaCO₃ content, formed under calm conditions in relatively shallow quiet waters, which may have been somewhat brackish. The sea bottom appears to have had an oxidizing environment. In some regions the *Caucasina* facies is associated with greenish-brown glauconitic clays (Kaptarenko-Chernousova, Golyak, Zernetskiy, Kraeva, and Lipnik, 1963). In nearly all regions radiolarians are found in association with the *Caucasina* complex or in nearby strata, and pelagic foraminifers may also be present.

The dominance of short low spired tests in some species, for example *Caucasina minuta*, new species, is in contrast to the much more elongated test and higher spire of *C. elongata*. Such differences in proportion may in fact be related to the temperature conditions, as suggested by N. K. Bykova (1960), the short compact Paleocene forms thus being characteristic of relatively lower
temperatures, and the more elongate forms having appeared with the warmer conditions of the Oligocene-lower Miocene.

There is apparently a general correlation of occurrence of the Caucasina complex with moderate to warm temperature, as the genus has not been reported in cold water deposits. Although widespread and abundant in the Paleogene and Miocene, none has yet been recorded from the Pliocene, Pleistocene, or Recent.

V. Familial and Phylogenetic Relationships

The Subfamily Caucasinae was proposed within the Family Buliminidae by N. K. Bykova (in Rauzer-Chernousova and Fursenko, 1959, p. 328). Genera included were Neobulimina, Caucasina, Uvigerinella, Hopkinsina, and Bitubulogenerina. These were regarded as having in common a rotaloid base, later and dominantly triserial development which might become irregular or even biserial, and a loop-shaped subterminal aperture which nevertheless connects to the base of the apertural face. No neck is present, but an apertural flange was said to occur.

The subfamily was elevated to family rank (Loeblich and Tappan, 1961, p. 314), and removed from the Buliminidae because of the granular wall microstructure of Caucasina as contrasted with the radially crystalline wall of the Buliminidae. Of the genera originally placed in the subfamily, Neobulimina is now referred to the Family Turritilinidae, Subfamily Turritilininae, and Uvigerinella, Hopkinsina, and Bitubulogenerina (a junior synonym of Sagrina) to the Uvigerinidae, all with similar radially crystalline walls (Loeblich and Tappan, 1964). Caucasina was the single remaining genus in the subfamily until the Recent genus Francesita Loeblich and Tappan, 1963, was placed therein. In addition to the type species, Virgulina? advena Cushman, which occurs in the North Atlantic Ocean and Gulf of Mexico, the Recent Bulimina torta Cushman from the Pacific Ocean also appears referable to Francesita, and the genus may occur in Miocene deposits.

N. K. Bykova (1959, 1960) observed small rotaliform tests, described as similar to Pseudoparrella, associated with Caucasina in the Russian Paleocene. These "Pseudoparrella" were believed to have migrated from boreal regions into the Fergana Basin during the Paleocene (Pg1). With progressive rise in temperature, the population became high-spired, and a reduction in number of chambers per whorl gave rise to Caucasina. A contemporary branch from "Pseudoparrella" was said to have led to species of Turritina and then Bulimina. By mid-Eocene time Caucasina developed some nearly biserial forms. The lineage proposed by Bykova led from "Pseudoparrella" to Caucasina to "Causcinella" (a nomen nudum), then to Uvigerinella, Hopkinsina, and finally Uvigerina.

Caucasina attained maximum development in Oligocene time according to Bykova, with three main groups appearing: an elongate form with well developed rotaloid early coil; another group of shortened and swollen tests, with obsolescent triserial stage; and a third group in which the number of chambers and number of whorls is greater than three, and with deeply incised sutures. These groups may be separate lineages, but may equally well represent different generations of the species.

Although originally agreeing with the facts known, the hypothesis of a Paleocene derivation of Caucasina from Pseudoparrella is no longer credible, as Caucasina is now known to have a longer geologic history, occurring in the Campanian (Upper Cretaceous). Pseudoparrella has a radially crystalline wall, similar to that of the Buliminidae and Uvigerinidae but unlike the granular-walled Caucasina, hence a relationship appears quite unlikely.

Normal variation within a local population may include numerous juvenile individuals, which may be erroneously regarded as distinct species or genera, and thus suggest different generic interrelationships. Although much remains to be learned before many lineages and interrelationships can be determined, it seems to us most probable that the origin of a given genus is most likely to be among those of similar biochemical constitution, as shown by the type of test secreted, and its chemical composition and microstructure. Thus the Caucasininae and Fursenkoininae are regarded as closely related, both groups of genera being characterized by calcite tests of perforate granular microstructure and monolamellar septa. Perhaps their origin may be found in such rotaliform genera of similar composition and microstructure as Alabamina.
VI. ACKNOWLEDGMENTS

We are indebted to D. M. Khalilov, Institute of Geology, Academy of Sciences, Azerbaijan SSR, Baku, for type specimens of *Caucasina oligocenica* and to N. K. Bykova, VNIGRI, Leningrad, USSR, for specimens of *Caucasina schischkinskayae*. Specimens of *Aeolomorphella plectilis* are from a sample collected by C. A. Hall, Department of Geology, University of California, Los Angeles. Richard Cifelli, of the U. S. National Museum, loaned type specimens of paleontological collections of Tulane University, New Orleans. The Rincon material for foraminiferal studies. All figured specimens are deposited in the paleontological collections at the University of California, Los Angeles. A duplicate set of hypotypes and paratypes is in the paleontological collections of Tulane University, New Orleans. The illustrations consist of shaded camera lucida drawings by Helen Tappan Loeblich.

VII. SYSTEMATIC DESCRIPTIONS

Family CAUCASINIDAE N. K. Bykova, 1959

Subfamily CAUCASININAE N. K. Bykova, 1959

A. Genus CAUCASINA Khalilov, 1951


*Type Species: Caucasina oligocenica Khalilov, 1951 = Bulimina schischkinskayae Samoylova, 1947 (recte B. schischkinskayae)*. Fixed by original designation.

Test free, elongate, base bluntly rounded, early portion in low discorbine coil with up to 8 chambers per whorl, later portion high-spired with fewer chambers per whorl, becoming triserial in the later stage; early chambers low, later of approximately equal breadth and height and may be inflated; sutures distinct, commonly depressed in the later stages, may be flush in the early spiral portion; wall calcareous, finely perforate, microgranular in structure, surface smooth or may be coarsely spinose in the early stages; aperture an elongate loop at the inner margin of the final chamber, with narrow bordering lip, posterior apertural margin strongly infolded and flaring internally to form a distinct toothplate.

Remarks: Most later publications have erroneously cited the type species as *C. schischkinskayae*. The type was originally designated as *C. oligocenica*, hence cannot be changed. *Caucasina oligocenica* has been regarded by some later workers as a synonym of *C. schischkinskayae*, but by others is regarded as a variety (=subspecies} or as a distinct species, hence the type should be cited as *C. oligocenica*. If regarded as a synonym, the prior name (*C. schischkinskayae*) may be added as an equivalent, as given above, in type citations.

Occurrence: Upper Cretaceous (Campanian), USA, Asia; Paleocene, USA, USSR; Eocene, USSR, France; Oligocene, USSR, USA; Miocene, USSR, Austria, Croatia.

Described from the Oligocene, the geologic range of the type species was soon extended to include Miocene strata, and another species of this age was recently described (*C. tenuibriza* Pishvanova, 1960). In 1958, Khalilov extended the range to include the new Eocene-Oligocene species *C. aziderensis* and *C. evocenica*, and an additional Eocene species, *C. alpina*, was described from France in 1961. In 1957, Loeblich and Tappan described the genus *Aeolostreptis*, with *Buliminella vitrea*, from the Upper Cretaceous of the American Gulf Coast, as type species. The genus was later regarded (Loeblich & Tappan, 1961, p. 314) as synonymous with *Caucasina*, extending the generic range into the Upper Cretaceous. The following year *Caucasina tuzkoensis* was described from the Upper Cretaceous of Soviet Asia.
In the present study two additional Miocene species are transferred to *Caucasina* (*C. elongata* and *C. subulata*), a new Oligocene species is described from California (*C. khalilovi*), and the first lower Paleocene (Danian) occurrence noted with the description of *C. minuta*.

1. Upper Cretaceous Species

**CAUCASINA TUZKOENSIS** Suleymanov, 1962

Pl. 1, fig. 7

*Caucasina tuzkoensis* Suleymanov, 1962, Paleontologicheskiy Zhurnal, no. 2, p. 163, text-fig. 1a, b.

Test small, elongate, cylindrical, early trochospiral stage of two whorls, 6 small subquadrangular chambers in the first whorl, and 5 in second, later development in a high trochospiral coil of which the first whorl contains 4 chambers and the final whorl three, test tending to uncoil in the later stage; sutures simple, straight and oblique, nearly flush with the surface; wall calcareous, perforate, microgranular, surface smooth; aperture a broad loop in the face of the final chamber, somewhat narrowed at the base.

Length 0.22-0.24 mm; breadth 0.1-0.15 mm.

**Types and Occurrence:** Holotype (VNI GRI, Leningrad, No. 517-3), Upper Cretaceous (upper Campanian), Tashkuduk Formation, in core hole in the Selma Group, 11.5 miles east of Blue Springs, Mississippi. It also has been reported from the Upper Cretaceous (upper Austin) of Texas.

2. Paleocene Species

**CAUCASINA MINUTA** Loeblich and Tappan, n. sp.

Pl. 1, figs. 8-11

Test free, tiny, elongate, base broadly rounded, early portion consisting of a low trochospiral coil of about 3 volutions and 5 to 6 chambers per whorl, later portion subcylindrical and high spired; sutures distinct, slightly depressed; wall calcareous, finely perforate, surface smooth; aperture a loop shaped arch with posterior margin forming an infolded toothplate.

Length of holotype 0.18 mm, breadth 0.10 mm. Other specimens range between 0.11 and 0.15 mm in length.

**Remarks:** This species is the smallest yet described, somewhat resembling the Oligo-Miocene *C. schischkinskayae* in general form and proportions, but with less inflated chambers and less depressed sutures, and is less than one-half as large. It also has a more gradual change from trochospiral to triserial development.

**Types and Occurrence:** Holotype (UCLA 34220) from depth of 255 feet, figured paratypes (UCLA 34221-34223) from depth of 260 feet, Dos Palos Shale Member of Moreno Formation, in core hole in Panoche Hills, Sec. 8, T. 15S., R. 12E., M.D.M., Fresno Co., Calif.; collected by A. R. Loeblich, Jr.

3. Eocene Species

**CAUCASINA ALPINA** Espitalié and Sigal, 1961

Pl. 1, figs. 14-15

*Caucasina alpina* Espitalié and Sigal, 1961, Rev. Micropaléontologie, v. 3, no. 4, p. 204, pl. 1, figs. 9a-d.

Test very small, base obtuse, rapidly increasing in breadth, final whorl occupying at least ¾ test length; earliest 1½ whorls low spired with 5 to 5½ chambers per whorl,
then high spired with 3 strongly inflated chambers per whorl; sutures deeply incised, curved; wall calcareous, vitreous, finely perforate; aperture in a large buliminoid depression.

Length 0.30 to 0.39 mm; breadth 0.18 to 0.24 mm.

Remarks: This species was separated on the basis of the rapid enlargement of the test, relative importance of the final whorl, and in having 5 to $5\frac{1}{2}$ chambers in the early whorl.

Types and Occurrence: Upper Eocene (Upper Priabonian), Blue Marls, Clouet, near Clumanc (Basses-Alpes), France.

**Caucasina aziderensis** Khalilov, 1958

*Pl. 1, fig. 12*


Test elongate, flaring, high trochospiral; following the globular proloculus the first whorl consists of 4 to $4\frac{1}{2}$ semicircular chambers, later whorls reduced to 3½ to 4 chambers each, final 2 or 3 whorls each with 2 to 3 subglobular chambers; sutures narrow, curved, incised; wall calcareous, surface distinctly perforate; aperture elongate-ovate, a high loop with bordering lip, extending up the final chamber face.

Length 0.4 mm; greatest thickness 0.24 mm.


**Caucasina eocaenica** Khalilov, 1958

*Pl. 1, fig. 13*

PLATE 1
Caucasina Schischkinskaya

4. Oligocene Species

**Caucasina Schischkinskae** Loeblich and Tappan, n. sp.


**Caucasina Tenebricosa** Pishvanova in

Pl. 2, figs. 5-6


Types and Occurrence: Holotype (VNI GRI, Leningrad, No. 5197), from Oligocene (lower Vorotyshchensky beds), in the Pre-Carpathians, Dzvinyach village, USSR. Also occurs in middle Miocene (Slebnisky beds) of the Pre-Carpathians.

5. Oligo-Miocene Species

**Caucasina Schischkinkskyae** (Samoylova), 1947

Pl. 2, figs. 1-4


**Bulimina Schischkinskii** Samoylova, 1946, ibid., v. 21, no. 2, p. 54 (nom. nud.).

**Bulimina Schischkinksyae** Samoylova, 1947, ibid., v. 22, no. 4, p. 82, text-fig. 10; Gabrielyan, 1954, Geol. Obshch. SSR, Sbornik, Lvo6skogo Geol. Obschch. t. 1, p. 140; N. K. Bykova and Voloshinova in Raizer-Chernousova and Fursenko, 1959, Osnovy Paleontologii, Obschchaya Chast', Prosteyshie, p. 328 (nom. imperf.).

**Caucasina oligocenica** Khalilov, 1951, Akad. Nauk Azerbaydzhan'skoy SSR, Izvestiya, no. 3, p. 58, pl. 4, fig. 4.

**Caucasina Schischkinkskyae** (Samoylova). N. K. Bykova, 1953, Trudy VNIGRI, n. ser., vyp. 73, p. 223-267, table 8; N. K. Bykova, 1960, Geol. Sbornik, no. 5, Trudy VNIGRI, vyp. 163, p. 316, pl. 2, B 1-8; N. K. By-

Caucasina aff. schischkinae (Samoylova). Dzhanelidze, 1956, Akad. Nauk Gruzinskoy SSR, Trudy Sektora Paleobiol., v. 3, p. 92, 93, 121, pl. 3, figs. 7a, b (nom. impf.).

Koval and Azriel', 1962, Geol. Sbornik, no. 7, Trudy VNIGRI, vyp. 190, p. 377, 381 (table), 385 (fig. 2), 387, 388, 390, 391, 393 (table) (nom. impf.).


Caucasina aff. schischkinae (Samoylova). Nikitina, 1958, Izvest. Vysshikh Uchebnykh Zavedeniy Geol. i Razvedka, no. 7, p. 52 (nom. impf.).

Caucasina aff. schischkinae (Samoylova). N. K. Bykova and Voloshinova in Rauzer-Chernousova and Furseko, 1959, Osnovy Paleontologii, Obschchaya Chast', Prosteyshie, text-fig. 799a, b (nom. impf.).


Caucasina aff. schischkinae (Samoylova). Yaneshin, Volanov, Dolgopolov and Menner, 1960, ibid., table 2 (opposite p. 9) (nom. impf.).


Caucasina aff. schischkinae (Samoylova). Sulemanov, 1962, Paleontologicheskiy Zhurnal, v. 2, no. 163 (nom. impf.).

Test free, robust, subcylindrical, base broadly rounded; early stage in low trochospiral coil of about 3 whorls, with 5 to 7 chambers per whorl, later portion of test of somewhat lesser diameter and higher spired in microspheric form, slightly flaring in megaspheric generation, later portion triserial; chambers of early portion broad and low, in adult stage much inflated and of about equal breadth and height; sutures distinct, depressed, spiral suture nearly horizontal with septal sutures gently curved; wall calcareous, finely perforate, granular, surface smooth; aperture a high loop-shaped opening extending up final chamber face, forward apertural margin somewhat overlapping posterior margin near the chamber base, inner posterior margin infolded to form an apertural toothplate.

Length of juvenile specimen, showing only the trochospiral coiled stage, 0.11 mm; breadth 0.14 mm. Length of larger specimen 0.37 mm; breadth 0.18 mm. Length of specimen of fig. 4, 0.50 mm.

Remarks: This species has been widely recorded (see above synonymy) in the Oligocene-Miocene of the USSR, where it

**Plate 2**

**Figures**

1-4 *Caucasina schischkinskayae* (Samoylova). 1-3, hypotypes of *C. oligocenica* (UCLA 34227-34229), Oligocene Azerbaijan SSR. 4, hypotype of *C. schischkinskayae* (UCLA 34230), Oligocene, Mangyshlak well, USSR. 1a-c, side, top and basal views of large hypotype. 2a, b, side and top views of juvenile specimens. 3, side view. All x 115. 4, side view of large specimen, x 80

5-6 *Caucasina tenebricosa* Pishvanova. Lower Vorotyshchensky beds, Oligocene, pre-Carpathians, USSR. 5a-c, opposite sides and base of microspheric holotype, redrawn from Subbotina, Pishvanova and Ivanova, x 85. 6a-c, opposite sides and base of megaspheric specimen, redrawn from Subbotina, x 120

7-9 *Caucasina khalilovi* Loeblich and Tappan, n. sp. Rincon Formation, Oligocene, California. 7a-c, side, top and basal views of holotype (UCLA 34224). 8, 9, side and basal views of paratypes (UCLA 34225-34226). All x 120

10-13 *Caucasina subulata* (Cushman and Parker). Badener Tegel, Tortonian, Miocene, Austria. 10a-c, side, top and basal views of large topotype with slightly spinose base (UCLA 34233). 11a, c, side and base of topotype with few spines (UCLA 34234). 12a, b, side and base of strongly spinose topotype (UCLA 34235). All x 60. 11b, enlarged view of apertural region to show overlapping basal margin and narrow lip. 13a, side view of apertural region of topotype (UCLA 34236) with outer apertural rim broken to show infolded toothplate which broadens internally (compare to fig. 11b). 13b, top view of same viewed in partially transmitted light, showing the infolded toothplate within the final chamber, just above the apertural margin as oriented in the figure. Figs. 11b, 13a, b, x 180

14-15 *Caucasina elongata* (d'Orbigny). Badener Tegel, Tortonian, Miocene, Austria. 14a, b, side and basal views of hypotype (UCLA 34231). 15a-c, side, top and basal views of hypotype (UCLA 34232). Both x 60
is regarded as a zonal index fossil. The above cited record of *C. aff. schischkinskai* by N. K. Bykova (1953) from the Paleocene Suzaksky beds of Fergana is not this species, but may be the same as *C. suzakensis*, cited in recent publications but apparently not yet described.

Originally described as *Bulimina schischkinskai*, the species had been listed earlier as *B. schischkinskii* (*nomen nudum*), but as a feminine patronymic required correction to *schischkinskayai*, as was done by Khalilov, 1958. The type species of the genus, *Caucasina oligocenica*, is regarded by many as a synonym of *B. schischkinskayai*, as it is here. Some 30 different combinations and variant spellings (including misprints and erroneous emendations) have been used for this species during the past 17 years.

**Types and Occurrence:** Hypotypes (figs. 1-3) of *C. oligocenica* (UCLA 34227-34229) from the Oligocene of Zeiva, Village, Azerbaijan SSR; from D. M. Khalilov. Hypotype (fig. 4) of *C. schischkinskayai* (UCLA 34230) from Mangyshlak well, USSR; from N. K. Bykova.

6. Miocene Species

**CAUCASINA ELONGATA (d'Orbigny)**

Pl. 2, figs. 14-15


Test elongate, varying from slightly tapering throughout to tapered only in early trochospiral portion and nearly cylindrical in later portion; chambers at first trochospiral, later reducing in number of chambers per whorl to become triserial, chambers slightly inflated, of nearly equal breadth and height; sutures slightly depressed; wall calcareous, finely perforate, polished, smooth; aperture an elongate loop with narrow bordering lip, forward apertural margin somewhat overlapping base of opposite margin which is infolded and flaring to form the apertural toothplate.

Length of figured specimens, 0.50 and 0.52 mm; breadth 0.24 and 0.28 mm. Cushman and Parker state that the species ranges from 0.28 to 0.67 mm in length and from 0.14 to 0.22 mm in diameter.

**Remarks:** Cushman and Parker, (1937, p. 49) regard *Bulimina inconstans* Egger, from the Miocene of Bavaria, and *B. scabriuscula* Reuss, from the Belgian Pliocene, as synonymous with the present species. We have not compared the primary types of these latter species, but *B. inconstans* is a short flaring foraminifer with few, but inflated and subglobular chambers, and *B. scabriuscula* is a narrow elongate form with narrow elevated chambers. Apparently, neither has an early trochospiral coil, hence we do not regard them as synonymous.

This species also has been reported from the Miocene of the Carpathians (Ukrainian SSR) and the Caucasus of Georgian SSR and Azerbaijan SSR.

**Types and Occurrence:** Hypotypes (UCLA 34231-34232) from the Miocene (Tortonian) Badener Tegel, Baden, Austria; collected by W. W. Hay.
CAUCASINA SUBULATA (Cushman and Parker)  
Pl. 2, figs. 10-13  

_Bulimina elongata_ d’Orbigny var. _subulata_  

_Bulimina elongata_ d’Orbigny var. _lappa_  
CUSHMAN and PARKER, 1937, Cushman Lab. Foram. Res., Contr., v. 13, p. 61, pl. 7, fig. 8; CUSHMAN and PARKER, 1947, U. S. Geol. Survey, Prof. Paper 210-D, p. 109, pl. 25, fig. 19.


Test free, elongate, slightly flaring, base bluntly rounded, early portion in low trochospiral coil of about 3 whorls, with 6 to 7 chambers per whorl, then becoming higher spired and reduced to 3 chambers per whorl; sutures distinct, strongly depressed; wall calcareous, finely perforate, granular, surface smooth, but early chambers with one to 5 or 6 solid blunt spines, varying from relatively long spines to a mere roughened base, the typical _subulata_ being distinctly spinose. In a large number of topotypic specimens a gradation occurs between specimens of these extremes, partly because of breakage of the spines and partly a dimorphism between the more elongate and tapering microspheric and blunter megalospheric specimens. They are regarded as identical, being merely variants within a single population.

The species figured by Brady (1884, pl. 51, fig. 1) from the North Atlantic, northwest of Ireland, as _Bulimina elongata_, and that (pl. 51, fig. 2) considered to be intermediate between _B. elongata_ and _B. ovata_ d’Orbigny, were regarded by Cushman (1942, p. 11) as _B. elongata_ var. _subulata_. Although of similar outline and size, the Recent specimens need restudy, and refiguring in basal view in order to determine whether or not they are referable to _Caucasina subulata_ or _C. elongata_—or even to the present genus.

_Caucasina subulata_ also has been reported from the Miocene of Rumania, Albania and the pre-Carpathians of the Ukrainian SSR.  

_Types and Occurrence:_ Topotypes (UCLA 54235-54236) of _C. subulata_ (Cushman and Parker) from the Miocene (Tortonian) Badener regel, Baden, Austria; collected by W. W. Hay. The species appears to be widespread in Sarmatian-Tortonian deposits of central Europe, but we have not seen younger specimens that we regard as conspecific.

7. **Nomina Nuda**  
The following specific names have appeared in Soviet publications, but we have been unable to locate published descriptions. They are therefore regarded as _nomina nuda._

**CAUCASINA BULIMINOIDES** Bogdanovich  
no. 2, p. 98 (in list) Burdigalian (Miocene) of northern Caucasus.

_Caucasina lucera_ Pishvanova


This species may have been described in an unpublished dissertation from L'vov University (1960): Pishvanova, L. S., Foraminifera miotsena predkarpat'ya i ikh stratigraficheskoe znachenie: Avtoreferat. Rand. dis. L'vov, 1960.

_Caucasina schischkinskayae_ var. doliella Ivanova, 1956

_Caucasina schischkinskayae_ (Samoylova) var. doliella Ivanova, 1956, Geol. Sbornik, no. 2-3, p. 327 (err. cit.; recte _C. schischkinskayae_ var. doliella).

_Caucasina suzakensis_ N. K. Bykova, 1960


**8. Nomenclatura aperta**

_Caucasina_ sp. Bignot, 1962


_Eocene_ (Cuisian), _Cap d'Ailly_, Seine Maritime, France.

_Caucasina_ sp. nov. (?) Bogdanovich, 1960

_Caucasina_ sp. nov. (?) Bogdanovich, 1960, Trudy VNII, Krasnodarskiy filial, Trudy, vyp. 4, Geol. Sbornik, p. 240, pl. 3, fgs. 4, 5.

_Assinsky_ beds, middle Maykopian (upper Oligocene), Urukhskiy region, N. Osetiya, USSR.

_B. Genus Aeolomorphella_ Loeblich and Tappan, n. gen.

_Type species:_ _Aeolomorphella_ plectilis, n. sp.

Test free, elongate, early stage in close discorbine coil, up to 6 chambers per whorl, later becoming high spired with rapid reduction in number of chambers per whorl, finally biserial; chambers broad and low in early stage, later of nearly equal breadth and height and somewhat inflated; sutures distinct, depressed; wall calcareous, finely perforate, granular; surface smooth; aperture a high loop shaped opening extending up the apertural face from its base, with posterior margin infolded to form a toothplate.

**Remarks:** _Aeolomorphella_ differs from _Caucasina_ in being biserial rather than triserial in the later stage.

**Occurrence:** Upper Cretaceous (Campanian) of northern Alaska.

_Aeolomorphella_ plectilis Loeblich and Tappan, n. sp.

Pl. 1, fgs. 1-4


_non Buliminella vitrea_ CUSHMAN and PARKER, 1936, Cushman Lab. Foram. Research, Contr., v. 12, pt. 1, p. 7, pl. 2, figs. 4a-c.


Test free, elongate, base bluntly rounded, early portion close coiled with 6 low chambers per whorl, later reducing to triserial and finally biserial, with chambers of nearly equal breadth and height; sutures distinct, depressed, becoming more constricted in later stages; wall calcareous, finely perforate, surface smooth; aperture an arched slit extending up the face from inner margin of final chamber, with narrow lip at the forward margin.

Length of holotype 0.26 mm; breadth 0.13 mm. Other specimens range from 0.10 to 0.28 mm in length.

**Remarks:** The present species was formerly regarded by us as conspecific with _Caucasina vitrea_ from the Upper Cretaceous of Mississippi, but it differs in the more elongate test, less rapid flaring, final biserial chamber arrangement, more incised sutures and chambers of nearly equal breadth and height. It differs from _Caucasina inzkoensis_, from the Upper Cretaceous (Campanian) of central Asia (Kyzylkumy), in having a slightly flaring test instead of parallel sides, in the more incised sutures and in the more equidimensional, biserially arranged chambers.

**Types and Occurrence:** Holotype (UCLA 34237) and figured paratypes (UCLA 34238-34239) from the Sentinel Hill member of the Schrader Bluff formation, in bank of river at Ocean Point on the Colville River, northern Alaska; collected by C. A. Hall.

The species was previously reported (as
Caucasina vitrea) from cores in the Sentinel Hill Member of the Schrader Bluff Formation, in Sentinel Hill Core Test 1 on the west bank of the Colville River, lat. 69°35'48"N., long. 151°28'09"W., northwest of Umiat, northern Alaska.

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TER-GRIGOR’YANTS, L. S., 1961, Stratigrafi­cheskie raschleneniy maykopskikh otlo­zheniy severnogo stavropol’y; in Geologi­giya i neftegazonosnosti’ sredney azii, Volgo-Ural’skoy oblasti, Predkavkaz’ya i prikaspia: Trudy VNIGRI, vyp. 20, p. 263-273. [Stratigraphic subdivision of the Maykopian deposits of northern Stavropol’: in Geology and Natural Gas of central Asia, Volga-Ural district, the Caucasus and Caspian].


