

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 117, NUMBER 15

Charles D. and Mary Vaux Walcott
Research Fund

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TRIPLASIA REUSS, 1854

(WITH 8 PLATES)

BY
ALFRED R. LOEBLICH, JR.

AND
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U. S. National Museum



(PUBLICATION 4094)

CITY OF WASHINGTON
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THE FORAMINIFERAL GENUS *TRIPLASIA*
REUSS, 1854

BY ALFRED R. LOEBLICH, JR., AND HELEN TAPPAN

U. S. National Museum

(WITH EIGHT PLATES)

INTRODUCTION

Thirty-seven species of *Triplasia*, including nine new species, are described herein, and most of these are figured, from strata ranging in age from Lower Jurassic to Recent. An examination of abundant material shows a definite gradation within many of the species from forms with a triangular section to 4-sided specimens. Furthermore, the early planispiral coil is extremely variable in size and prominence, and it may be lacking entirely. These gradations, which are more fully discussed under the species concerned, are also shown in the illustrations and have led the writers not only to agree with Bartenstein and Brand (1951) in suppressing the genus *Frankeina* as a synonym of *Triplasia* but also similarly to suppress the genera based on quadrate forms, *Centenarina* Majzon and *Tetraplasia* Bartenstein and Brand.

Triplasia Reuss was defined in 1854, the genotype species being *Triplasia murchisoni*. Reuss's original description stated (translation from German) :

Test free, regular, straight, inverted-ovate or somewhat elongate in outline, 3-sided. Chambers placed in a straight line upon each other, identical, somewhat equitant, not separated by constrictions. The final chamber is produced into a short central neck, which carries the round aperture.

Differs from *Nodosaria* in the 3-sided form, with identical unconstricted, somewhat equitant chambers, and the rough, not glassy, shell wall, and from *Orthocerina* by the equitant chambers and the central prolongation of the final chamber.

Before additional species were described, Reuss defined the genus *Rhabdogonium* (1860), placing *Triplasia* in it as a synonym, and stating in part (translation from German) :

The most conspicuous character of *Rhabdogonium* is the presence of sharper longitudinal angles on the straight test. The four first-known forms possessed

only three such angles, were also triangular in section, wherefore I gave the genus the name *Triplasia*. Here belong: *Rh. murchisoni* m., from the Gosauschichten from the Austrian Saltz domain, *Rh. globuliferum*, *roemeri*, and *anomalum* m., which I forthwith describe from the Cretaceous of Westphalia and finally *Rh. acutangulum* m., an as yet unpublished species that I discovered in the Hills of Berklingen.

Later, however, I discovered 4-sided species that, except for the tetragonal cross section, agree fully with the aforementioned in their remaining characteristics, as *Rh. strombecki* and *mertensi* m., both also occurring in the Hills of Berklingen and not as yet published. For these the earlier name *Triplasia* obviously cannot now be employed, and I therefore am compelled to substitute a new one, *Rhabdogonium*. In this way the angled rhabdoidal form of the test would be clearly signified.

Reuss therefore renamed his genus when he discovered quadrate specimens which he thought to be congeneric. This cannot be done, for the Rules of Nomenclature require that the first valid name be kept, regardless of its suitability, and *Triplasia* must therefore be retained for the genus of Foraminifera to which belongs *T. murchisoni*, the genotype species.

Although the first species he mentioned in connection with the name *Rhabdogonium* was *R. murchisoni* (the genotype species of *Triplasia*), Reuss also included in his discussion some triangular calcareous species (*R. globuliferum*, *R. anomalum*, and *R. acutangulum*), all of which are now considered to belong to the genus *Tristix* Macfadyen. Furthermore, and ironically, the two quadrate species, whose discovery led Reuss to rename his genus, also were calcareous and both are now placed in *Tristix*, as intraspecific variations of triangular species.

Because Reuss had so quickly renamed his genus, he was followed by many workers, and the arenaceous triangular and quadrate species were for nearly a century referred either to *Rhabdogonium* or *Haplophragmium*. The first species referred to *Triplasia* (other than the genotype species) was *T. manderstjeni* Costa, 1894. This species, however, was a calcareous, coiled form, and undoubtedly a *Saracenaria*. The next species to be referred to the genus were *T. reussi* Cushman, also a calcareous form and probably a *Trifarina*, and *T. wilcoxensis* Cushman and Ponton, 1932, *T. temirica* Dañ, 1934, and *T. somaliensis* Macfadyen, 1935, which are all calcareous, uniserial, triangular lagenids, now referable to the genus *Tristix*.

Agglutinated and calcareous species were included in the same genus by many of the earlier workers, including Reuss, who had not considered wall characters to be diagnostic. Apparently the later

workers noted the calcareous species referred to *Triplasia* and *Rhabdogonium* by their author and ignored the arenaceous character of the type species.

As late as 1932 Cushman considered *Triplasia* to be a calcareous genus, and Cushman and Ponton described *T. wilcoxensis* in 1932, stating, "It may be referred to Reuss' genus *Triplasia* which was afterward renamed by him *Rhabdogonium* because he later found specimens which had more than three sides . . . It is apparently uniserial throughout and belongs with the Lagenidae." This species now is placed in *Tristix*, as is mentioned above.

The genus *Frankeina* was described by Cushman and Alexander (1929, p. 61) for arenaceous forms with an early coil and triangular uniserial later portion, and was placed in the Lituolidae with the genotype species *F. goodlandensis*, from the Lower Cretaceous (Albian) Goodland formation of Texas (erroneously stated in original publication to be from the "Upper Cretaceous, Upper Middle Goodland formation"). Cushman and Alexander also called attention to the peculiar living South Pacific species, *Verneuilina variabilis* Brady, stating that it might possibly be a living example of *Frankeina*, but further study was necessary to prove this point. It was also pointed out that some Upper Cretaceous triangular forms referred to *Clavulina* might not have an early triserial portion and had their origin in *Frankeina*, by acceleration of development and resultant loss of the early coil.

After a trip to Germany and Austria in 1932 Cushman placed *Triplasia* (and *Rhabdogonium* as a synonym) in the Lituolidae (Foraminifera, 2d ed., 1933), describing it as "triangular or quadrangular in section, early stages in the microspheric form planispirally coiled, in the megalospheric form uniserial throughout; . . . wall rather coarsely arenaceous . . ." He further stated that "Study of type material in Vienna showed that this species is derived from *Frankeina*, by the loss of the coiled stage in the megalospheric form." Later, however, Cushman (1946, p. 26) called attention to this reduction of the coil in the species *Frankeina taylorensis* Cushman and Waters, stating that little more acceleration would eliminate the coil entirely and that it would be difficult to distinguish these forms from *Pseudoclavulina* unless their early portions were sectioned. However, if *Triplasia* represented those species in which the coil is lost in the megalospheric generation, as stated by Cushman in his text, then this species and similar ones should have been referred to *Triplasia*. Had Cushman's

reexamination of the European material occurred before the description of the numerous American species of *Frankeina*, it seems very probable that the latter would have been originally placed in *Triplasia*. However, as the genotype species represented opposite ends of the gradational series of species, *Frankeina goodlandensis* with an exceptionally well-developed coil, and *Triplasia murchisoni* lacking or with a very poorly developed coil, both genera were recognized by Cushman in his texts of 1933, 1940, and 1948.

In practice, however, American workers have apparently referred all species to *Frankeina*, and European workers have recently placed their species in *Triplasia*, a duplication in nomenclature which obviously should be discontinued.

While this paper was being prepared with the intention of suppressing *Frankeina*, *Centenarina*, and *Tetraplasia* all as synonyms of *Triplasia*, the publication of Bartenstein and Brand (1951) appeared, in which for the first time *Frankeina* was suppressed as a synonym of *Triplasia*, although the quadrate forms were separated as species of the genus *Tetraplasia*.

Bartenstein and Brand stated (1951, p. 273, translation from German):

In the foreign literature *Triplasia*-like tests from the Lower and Upper Cretaceous have been placed as a rule in the genus *Frankeina* Cushman and Alexander, 1929 . . . [quoting Cushman's statement that *Triplasia* is derived from *Frankeina* by the loss of the coil in the megalospheric form]. . . . This distinction we do not consider sufficient as both genera agree fully in all other characters of the test. We therefore believe that *Frankeina* must be suppressed as a synonym of *Triplasia*.

Reuss considered the number of angles in the test to be of specific importance, but not generic. Two later workers, Beissel and Brady, described triangular and quadrate specimens as conspecific as well. As the quadrate forms are much less common, little attention was paid to them by most writers, although a few quadrate species and varieties were described. In the past four years two generic names were proposed independently for these quadrate species (*Centenarina* Majzon, 1948, and *Tetraplasia* Bartenstein and Brand, 1949) and in both publications the quadrate specimens figured by either Beissel or Brady were mentioned.

The present writers have examined numerous species of these rhomboid lituolids, and in every instance, whenever a large suite of specimens was available, each species was found to show gradations from triangular to quadrate sections. This is also true for all geologic

horizons, the earliest known species from the Lias, *T. kingakensis*, new species, showing some flattened, some triangular, and some quadrate specimens, and the youngest species, the Recent *T. variabilis* (Brady), showing a similar gradation. The genotype species of *Frankeina*, *F. goodlandensis*, shows the same gradation, and the type species of *Tetraplasia*, *T. georgsdorfensis*, is conspecific with triangular forms from the same strata. The type species of *Triplasia* has not been studied by the present writers, and no quadrate topotypes have been figured (those so placed by Beissel later being referred to a distinct species). However, it is most probable that a large suite of specimens would also show the quadrate character in this species. It is probable that all quadrate species described in the past also have triangular counterparts which in some cases have been described as distinct species, although perhaps others have not yet been noted.

The present writers have examined very large suites of specimens of the majority of species referred to both *Triplasia* and *Frankeina* and have found that in most species there is a variation from straight forms lacking the coil to specimens with a well-coiled base, and a gradation from flattened uniserial portions (*Flabellammina*-like) to triangular and quadrate tests. These gradations are more fully discussed under the specific descriptions, and are also illustrated on the plates, but seem sufficient reason to suppress *Centenarina*, *Tetraplasia*, and *Frankeina* all as synonyms of *Triplasia*.

ACKNOWLEDGMENTS

The writers have been aided immeasurably in this study in having available many of the types of these species through the generosity of Dr. C. I. Alexander, Magnolia Petroleum Corporation, San Antonio, Tex., who presented his entire private collection of types to the U. S. National Museum, including the many types of *Frankeina* described by Alexander and Smith (1932). The large collection of Foraminifera from Arkansas, made by the late Dr. W. H. Deaderick and bequeathed to the National Museum, has supplied abundant specimens of many old and new species.

Dr. Helmut Bartenstein, Deutsche Vacuum Oel, Celle, Germany, generously supplied types of species described by Bartenstein and Brand (1949 and 1951), some of which are here illustrated. Dr. R. W. Harris, University of Oklahoma, lent the writers the types of the Midway species from Arkansas, and Mrs. Billye Jobe, Humble Oil and Refining Co., Tyler, Tex., presented to the National Museum topotype specimens of *T. fundibularis* (Harris and Jobe).

To Cameron D. Ovey, British Museum (Natural History), we are indebted for the fine suite of topotypes of the Recent species *Verneuilina variabilis* Brady.

The remaining Lower Cretaceous specimens here described were obtained by the writers in the course of preparation of a monographic study of American Lower Cretaceous Foraminifera. These collections were financed in part by a grant from the Penrose Bequest of the Geological Society of America.

All illustrations were prepared by Mrs. Sally D. Lee, scientific illustrator, Smithsonian Institution.

SYSTEMATIC DESCRIPTIONS

Family LITUOLIDAE

Genus **TRIPLASIA** Reuss, 1854

Genotype: *Triplasia murchisoni* Reuss, 1854.

Synonyms: *Rhabdogonium* Reuss, 1860 (part).

Verneuilina (part) Brady, 1884 (not d'Orbigny, 1840).

Haplophragmium (part) Andrae, 1890; Beissel, 1891; De Amicis, 1895; Liebus, 1911; Eichenberg, 1934; Keller, 1946 (not Reuss, 1860).

Ammobaculites (part) Franke, 1928 (not Cushman, 1910).

Frankeina Cushman and Alexander, 1929, and others.

Flabellamina (part) Alexander and Smith, 1932 (not Cushman, 1928).

Centenarina Majzon, 1948.

Tetraplasia Bartenstein and Brand, 1949.

Emended diagnosis.—Test free, early portion may be planispiral, later portion uniserial or may be uniserial throughout, uniserial portion rhomboid in section, most commonly triangular, but occasionally quadrate even in the same species; sutures more or less arched on the faces of the test, recurved at the angles; wall arenaceous; aperture terminal, occasionally on a neck, round to elongate. Range: Lower Jurassic to Recent.

Remarks.—All species of *Triplasia* known to the writers are here described, and figures are given for most of these. The earliest-known species is from the upper Lias, and a few species are found in strata of nearly every age from Lias to Recent. Apparently the genus had two periods of climax, the Albian of America (seven species have been described) and the Senonian (five species described from America and three others from Europe).

Geologic occurrence of Triplasia

Quaternary	Recent	<i>T. variabilis</i>
	Pleistocene	
Tertiary	Pliocene	<i>T. wrighti</i>
	Miocene	<i>T. marwicki</i> , <i>T. minutum</i>
	Oligocene	<i>T. hungarica</i> , <i>T. trigona</i>
	Eocene	<i>T. andraei</i>
	Paleocene	<i>T. fundibularis</i> , <i>T. sp.</i>
Upper Cretaceous	Danian	
	Maestrichtian	<i>T. saratogensis</i>
	Senonian	<i>T. abkhasicus</i> , <i>T. beisseli</i> , <i>T. cushmani</i> , <i>T. deadericki</i> , <i>T. plummerae</i> , <i>T. römeri</i> , <i>T. rugosissima</i> , <i>T. taylorensis</i>
	Turonian	<i>T. murchisoni</i>
	Cenomanian	<i>T. nodosa</i>
Lower Cretaceous	Albian	<i>T. acutocarinata</i> , <i>T. glenrosensis</i> , <i>T. goodlandensis</i> , <i>T. incerta</i> , <i>T. insolita</i> , <i>T. rugosa</i> , <i>T. wenoensis</i>
	Aptian	
	Neocomian	<i>T. acuta</i> , <i>T. georgsdorfensis</i> , <i>T. grosserugosa</i> , <i>T. pseudoroemeri</i> , <i>T. mexicana</i>
Jurassic	Malm	<i>T. commutata</i> , <i>T. elegans</i> , <i>T. jurassica</i>
	Dogger	<i>T. bartensteini</i>
	Lias	<i>T. kingakensis</i>

TRIPLASIA KINGAKENSIS Loeblich and Tappan, new species

Plate 1, figures 1-8

Test large, elongate, early portion planispiral, with a comparatively large and well-developed coil of about 6 chambers, followed by 4 or 5 uniserial and triradiate chambers, which increase gradually in size in the megalospheric forms (figs. 3, 5-8) and flare more rapidly in the microspheric form (figs. 1, 4a, b), occasional specimens develop a somewhat weaker fourth angle, so that the test is irregularly quadrate in section (figs. 2a, b), and in addition two specimens were found which never developed the third angle, remaining in the *Flabellammia* stage, whereas other specimens have a poorly developed third angle, showing all gradations between; sutures moderately distinct, depressed, arched on the faces and curving downward at the angles; wall arenaceous, of medium to coarse particles, with considerable cement, smoothly finished; aperture terminal, rounded, on a slight neck.

Length of holotype, 1.53 mm.; greatest breadth, 0.94 mm. Length of paratype of figure 6, 1.74 mm.; greatest breadth, 0.73 mm. Length

of paratype of figure 3, 1.64 mm.; greatest breadth 0.52 mm. Other specimens range from 0.91 to 1.69 mm. in length.

Number of specimens examined, 18.

Remarks.—This species resembles *T. acutocarinata* (Alexander and Smith) in the flaring character of the test but differs in being smaller, in having less-excavated sides and broader and more-rounded angles, and in having a larger initial coil. It is quite variable in shape, ranging from narrow to widely flaring and from flattened to triangular to quadrangular in the later portion. The third and fourth angles are less prominent than the two in the plane of the coil.

Occurrence.—Holotype (U.S.N.M. No. P266), figured paratypes (U.S.N.M. Nos. P267a-g), and unfigured paratypes (U.S.N.M. No. P268) all from the Kingak formation (Lower Toarcian) in a core at 2,028-2,048 feet in South Barrow Test Well No. 3, lat. $71^{\circ} 09' 40''$ N., long. $156^{\circ} 34' 45''$ W., south of Point Barrow, northern Alaska. This species has a very restricted vertical range, as a complete core sequence throughout the Jurassic of this well showed the specimens to be present only in this 20-foot interval.

TRIPLASIA BARTENSTEINI Loeblich and Tappan, new species

Plate 1, figure 9

Triplasia variabilis (Brady) BARTENSTEIN and BRAND, 1937 (not *Verneuilina variabilis* Brady, 1884), Abh. Senckenberg. naturf. Ges., No. 439, p. 185, pl. 14A, fig. 6.

Description from Bartenstein and Brand (translation from German):

Test triangular in section, with rounded angles, greatest breadth in the later portion. The early chambers form a small coil that becomes obscured by the rapidly enlarging angles. Sutures but slightly marked, concealed by the coarsely arenaceous surface of the test. Sides excavated. Aperture a slit at the thickened point of intersection of the angles. Length 1.2 mm, breadth 0.9 mm.

Remarks.—This species differs from *T. variabilis* (Brady) in being smaller and more flaring, with more deeply excavated sides and more bluntly rounded angles. It is the only Middle Jurassic species of *Triplasia* yet described.

Types and occurrence.—Holotype, specimen figured by Bartenstein and Brand (Senckenberg Museum XXVII 644 a 2) from the Middle Jurassic Dogger Epsilon (*Wurttembergicus*-Schichten) from the well Bethel 2 at Bielefeld, Teutoberger Wald, in northwestern Germany. This species was also recorded from the *Parkinsoni*-Schichten.

TRIPLASIA COMMUTATA (Loeblich and Tappan)

Plate 1, figures 12a-16

Frankeina sp. WICKENDEN, 1933, Trans. Roy. Soc. Canada, ser. 3, sect. 4, vol. 27, p. 158, pl. 1, fig. 2.

Frankeina commutata LOEBLICH and TAPPAN, 1950, Journ. Washington Acad. Sci., vol. 40, No. 1, p. 6, pl. 1, figs. 3a-4.

Test free, medium-sized, elongate, compressed and planispiral in the early part, later uniserial and triangular in section, periphery rounded; planispiral chambers strongly compressed, comprising a relatively large portion of the test, about one and two-thirds volutions in the coil; later portion uniserial, chambers increasing slowly in diameter, in the holotype the final chamber being less in diameter than the early coil, sides moderately excavated; sutures generally indistinct, in the coiled part straight or with a very slight backward curve, very slightly depressed in the uniserial portion, but generally indistinct except at peripheral angles; wall medium to coarsely arenaceous, surface roughly finished; aperture rounded, on a slight neck.

Length of holotype, 1.77 mm.; greatest diameter of coiled part, 0.75 mm.; greatest width of uniserial portion, 0.68 mm.; width from center of side through opposite angle, 0.39 mm. Other specimens vary from 0.65 mm. to 1.92 mm. in length, and in diameter of early coiled part from 0.39 to 0.75 mm.

Remarks.—This species is closest to *Triplasia incerta* (Alexander and Smith), from the Lower Cretaceous (Albian) of Texas, both in size and in having a comparatively large coil. The Jurassic form differs in having the pronounced coil of diameter equal to the breadth of the later triangular portion, and in lacking the early *Flabellammina* stage characteristic of *T. incerta*. The chambers do not enlarge as rapidly, the sides are more excavated, and the sutures are more distinct in *T. commutata*.

Types and occurrence.—Holotype (U.S.N.M. No. 106017), unfigured paratypes (U.S.N.M. No. 106018), and unfigured hypotypes (U.S.N.M. No. P878) from 94-99 feet above the base of the Rierdon formation; unfigured paratypes (U.S.N.M. No. 106019) and unfigured hypotypes (U.S.N.M. No. P879) from 99-104 feet above the base of the Rierdon formation; unfigured paratypes (U.S.N.M. No. 106020) from 134 feet above the base of the Rierdon formation; figured hypotype (U.S.N.M. No. P880) from 14-19 feet above the base of the Rierdon formation (Callovian); all from the gorge of the Shoshone River, 2.0 miles west of Cody, Park County, Wyo. Collected by Ralph W. Imlay and Alfred R. Loeblich, Jr.

Figured paratype (U.S.N.M. No. 106021), unfigured paratypes (U.S.N.M. No. 106022) and unfigured hypotypes (U.S.N.M. No. P881) from 81 feet above the base of the Rierdon formation; unfigured paratypes (U.S.N.M. No. 106023) and unfigured hypotypes (U.S.N.M. No. P882) from 33 feet above the base of the Rierdon formation; unfigured hypotypes (U.S.N.M. No. P883) from 55 feet above the base of the Rierdon formation; all from the southwest corner of Red Dome, east of Bridger, in the Pryor Mountains, sec. 19, T. 7 S., R. 24 E., Carbon County, Mont. Collected by Ralph W. Imlay and Alfred R. Loeblich, Jr.

Unfigured paratypes (U.S.N.M. No. 106024) and unfigured hypotypes (U.S.N.M. No. P884) from 47-52 feet above the base of the Stockade Beaver shale (Callovian); figured hypotype (U.S.N.M. No. P885) and unfigured paratype (U.S.N.M. No. P886) from 11-21 feet above the base of the Redwater shale (Oxfordian); all from the east side of Red Gulch, about 2.5 miles south of Little Big Horn River, sec. 22, T. 58 N., R. 89 W., Sheridan County, Wyo. Collected by Ralph W. Imlay and Alfred R. Loeblich, Jr.

Unfigured hypotypes (U.S.N.M. No. P887) from 7 feet above the base of the Rierdon formation, in a gulch east of Swift Reservoir, SW $\frac{1}{4}$, sec. 6, T. 28 N., R. 10 W., Pondera County, Mont. Collected by Ralph W. Imlay and Alfred R. Loeblich, Jr.

Unfigured hypotype (U.S.N.M. No. P888) from the Redwater shale, 28-33 feet above the base, on the west side of Stockade Beaver Creek, 5.0 miles northeast of Newcastle, sec. 18, T. 45 N., R. 60 W., Weston County, Wyo. Collected by Ralph W. Imlay and Alfred R. Loeblich, Jr.

Unfigured hypotype (U.S.N.M. No. P889) from the Redwater shale, 59-69 feet above base, 1.0 mile north-northeast of the center of Spearfish, sec. 3, T. 6 N., R. 2 E., Lawrence County, S. Dak. Collected by Ralph W. Imlay and Alfred R. Loeblich, Jr.

Unfigured hypotype (U.S.N.M. No. P890) from 1 foot above the base; unfigured hypotypes (U.S.N.M. No. P891) from 9 feet above the base; unfigured hypotype (U.S.N.M. No. P892) from 13 feet above the base; unfigured hypotypes (U.S.N.M. No. P893) from 19 feet above the base; figured hypotype (U.S.N.M. No. P894) from 22 feet above the base, and unfigured hypotypes (U.S.N.M. No. P895) 25 feet above the base; all from the Swift formation (Oxfordian), 1.0 mile southwest of Landusky, sec. 32, T. 25 N., R. 24 E., Little Rocky Mountains, Phillips County, Mont. Collected by Ralph W. Imlay and Alfred R. Loeblich, Jr.

TRIPLASIA ELEGANS (Mjatluk)

Plate 1, figure 10

Frankeina elegans MJATLIUK, 1939, Neftianyi Geol. Razved. Inst., Trudy, ser. A, vol. 120, pp. 48 (Russian), 71 (English), pl. 2, fig. 26.

Remarks.—This is a rather narrow species, with comparatively small coil, closest in appearance to *T. glenrosensis*, new species, although with a smaller coil, more excavated sides, and more depressed sutures. The locality description referred to "isolated specimens," but the specific description refers only to the holotype.

Type and occurrence.—Holotype (Geol. Oil Inst. collection, Leningrad) from the Upper Jurassic, Lower Volga series, zone of *Perisphinctes panderi* d'Orbigny at a depth of 9-13 meters in Vostokneft Well No. 1501, near the Station Ozinki on the Ryazan-Uralsk railroad, in the southern part of the Obschiy Syrt, Saratov District, U.S.S.R.

TRIPLASIA JURASSICA (Mjatluk)

Plate 1, figures 11a, b

Flabellamina (*Frankeina*?) *jurassica* MJATLIUK, 1939, Neftianyi Geol. Razved. Inst., Trudy, ser. A, vol. 120, pp. 47 (Russian), 70 (English), pl. 2, figs. 22 a-b.

Translation from Russian (p. 47), from Ellis and Messina (supplement for 1950), states in part:

Test rounded-triangular, in the early stages close-coiled, later becoming uniserial. . . . On one of the lateral surfaces of the test there is a slight ridge, extending from the spire to the base of the last chamber. There is a corresponding depression on the opposite side of the test. . . .

. . . the present species differs [from *Flabellamina alexanderi* Cushman] in its less curved sutures and in the presence of a distinct costa, relating it to the genus *Frankeina*. However, its cross-section not being triangular, we refer it to the genus *Flabellamina*.

Length of holotype is given as 1.22 mm., width 0.66 mm., thickness 0.29 mm.

Remarks.—This species is very similar in character to the Lower Cretaceous *T. incerta*, which also shows a close relationship between *Triplasia* and *Flabellamina*. For this reason, and because the test does develop a distinct third angle, we have here placed this species in *Triplasia*.

Type and occurrence.—Holotype (Geol. Oil Inst. collection, Leningrad) from the Upper Jurassic, Lower Volga series, zone of *Perisphinctes panderi* d'Orbigny, dark gray shaly clay interbedded with

dark brown and dark gray bituminous shales, with layers of dark gray clay, at a depth of 22-24 meters (given on p. 48 as 22-29 meters), in Vostokneft Well No. 1501, near the station Ozinki, on the Ryazan-Uralsk railroad, southern part of the Obschiy Syrt, Saratov District, U.S.S.R. Isolated specimens.

TRIPLASIA ACUTA Bartenstein and Brand

Plate 2, figure 6a, b

Triplasia emslandensis Bartenstein and Brand subsp. *acuta* BARTENSTEIN and BRAND, 1951, Abh. Senckenberg. naturf. Gesell., No. 485, p. 274, pl. 3, fig. 68.

The original description states (translation from German):

Diagnosis: A subspecies of *Triplasia emslandensis* with sharp angles, unequal strongly concave sides and almost completely suppressed coil.

Description: Test free, elongate, older chambers planispirally coiled, however the spire more or less imperceptible, triangular with sharp angles and variable strongly concave sides. Sutures somewhat depressed, strongly arched, wall mostly medium-grained to finely arenaceous. Greatest breadth in the younger part of the test due to slight and uniform enlarging. End chamber truncate above, aperture irregularly elongate, situated on a small neck.

Length of holotype, 1.65 mm.

Remarks.—*T. emslandensis* subsp. *emslandensis* is a synonym for *T. georgsdorfensis* (see discussion under that species). Therefore the name *T. emslandensis* is invalid and if considered only a subspecies, the present form would thus be known as *T. georgsdorfensis* subsp. *acuta*. As the present species seems quite distinct, however, the subspecific name *acuta* is here raised to specific rank.

Types and occurrence.—Holotype (Senckenberg Natur Museums, Frankfurt am Main collections) from Grenzbereich, Upper Valen-dian 3 to 2, in Bohrung Düste (Blatt 1736, neu 3317) K 521.6-526.3 m, northwestern Germany.

TRIPLASIA GEORGSDORFENSIS (Bartenstein and Brand)

Plate 1, figures 17a-21b

Tetraplasia georgsdorfensis BARTENSTEIN and BRAND, 1949, Journ. Paleontol., vol. 23, No. 6, p. 672, text figs. 9a, b; 1951, Abh. Senckenberg. naturf. Gesell., No. 485, p. 275, pl. 11, figs. 70-71.

Triplasia emslandensis emslandensis BARTENSTEIN and BRAND, 1951, *ibid.*, p. 274, pl. 3, figs. 65-67.

not *Haplophragmium murchisoni* Reuss, BEISSEL, 1891, Abh. preuss. geol. Landesanst., Berlin, n.s., No. 3, p. 15, pl. 4, figs. 2, 5, 9.

The following description is from Bartenstein and Brand (1949), the original description of *Tetraplasia georgsdorfensis*:

Test free, elongate, regularly increasing in size. Earliest chambers rarely recognizable but planispirally coiled (often the coiled part is only suggested by the irregularity of the juvenile chambers), later chambers uncoiled, quadrangular, walls depressed with more or less rounded edges; sutures somewhat depressed. Walls rather coarsely arenaceous. Aperture terminal, central, round or somewhat elongate, . . .

The original description of the triangular form, named *Triplasia emslandensis emslandensis* by Bartenstein and Brand, states (translation from German):

Diagnosis: A subspecies of the species *Triplasia emslandensis* n. sp. with broad angles, sharply excavated sides, thick-set chambers and a uniform rate of growth of isolated single chambers.

Description: Test free, elongate stout, older chambers spirally enrolled, generally very thick, younger chambers broader, triangular with concave sides and \pm broadly rounded angles. Test generally very coarse, straight or weakly curved in growth, greatest breadth reached by the youngest chambers, aperture circular or elongate in the center of the short tubular or produced end chamber. Sutures depressed, walls agglutinated, medium- to fine-grained. Often mature single chambers occur that are caused by especially strong constriction of the sutures and ultimate separation of the chambers and whose membership in this species may be assumed.

Two form groups may be distinguished: one form with thicker, although distinct, spire and truncated end chamber (principal occurrence in upper Valendian), another form with long acuminate end chamber lacking a spire and tendency to separation of single chambers (principal occurrence in Lower Hauterivian).

Length of type of *Tetraplasia georgsdorfensis*, 1.25 mm.; length of type (fig. 17) of *Triplasia emslandensis emslandensis*, 1.5 mm. Length of small quadrate hypotype (fig. 18), 0.75 mm.; length of hypotype of figure 20, 1.33 mm.; breadth, 0.83 mm.; length of hypotype (fig. 21), 1.61 mm., greatest breadth, 0.62 mm.

Number of quadrate specimens examined by the present writers, two. We also have three triangular specimens originally referred to *Triplasia emslandensis emslandensis* by Bartenstein and Brand.

Remarks.—*T. georgsdorfensis* is the genotype species for the genus *Tetraplasia* Bartenstein and Brand. However, as stated by Bartenstein and Brand, "close relationship to *Triplasia* is indicated by individuals showing transitional characters." As similar transitional forms are found in nearly every species of *Triplasia* the present writers believe the triangular and quadrangular forms to be congeneric and conspecific as well, as gradations are so frequent in the various species. Furthermore, *T. georgsdorfensis* and *T. emslandensis emslandensis* are similar in other respects, as can be seen from the figures and descriptions, and have almost identical geologic ranges, the triangular forms being somewhat more abundant, as is true of all species yet ob-

served by the writers. The name *Tetraplasia* is thus suppressed as a junior synonym of *Triplasia*, but as *Tetraplasia georgsdorfensis* was the first specific name proposed it has priority over *Triplasia emslandensis* and the species thus becomes known as *Triplasia georgsdorfensis* (Bartenstein and Brand).

Bartenstein and Brand included in their synonymy of *Tetraplasia georgsdorfensis* the Upper Cretaceous *Haplophragmium murchisoni* Reuss of Beissel, 1891, as they noted that three quadrate specimens were figured by Beissel with seven triangular forms. Comparison of topotypes of Beissel's form and topotypes of *T. georgsdorfensis* shows these species to be distinct, and in fact the Upper Cretaceous form has been described as *Frankeina beisseli* Marie (1941).

Types and occurrence.—Holotype of *Tetraplasia georgsdorfensis* and types of *Triplasia emslandensis emslandensis* (Senckenburg Museum collections) all from the upper Valendian in a deep well, Georgsdorf 9, at 625 meters in depth, at Emsland, Germany. The quadrate hypotype specimens here figured (U.S.N.M. Nos. P896a, b) are from the upper Valendian in Georgsdorf 7 well, at a depth of 440 meters; the triangular figured hypotype (U.S.N.M. No. P897) and unfigured triangular hypotypes (U.S.N.M. No. P898) from the lower Hauterivian (*Noricus*-Schichten) Zgl. Spiekerberg, Messtischblatt 1950, Germany.

The triangular forms have been recorded from upper Valendian to upper Hauterivian, from rare to common, and sporadically abundant in the lower *Noricus*-Schichten. The quadrate forms are very rare from upper Valendian to lower Hauterivian.

TRIPLASIA GROSSERUGOSA ten Dam

Plate 2, figures 5a-c

Triplasia grosserugosa TEN DAM, 1946, Journ. Paleontol., vol. 20, p. 571, pl. 87, figs. 6a-c.

Original description:

Test free, elongate, triangular in section. Sides distinctly concave, angles rounded. Initial chamber globular, fairly large, followed by 2 or 3 uniserial chambers, slightly curved backward along the angles. Sutures slightly depressed, faintly curved. Aperture terminal, circular. Wall very coarsely are-naceous, rather roughly finished.

Dimensions.—Length, 1.65 mm.; width, 0.85 mm.; diameter of proloculum, 0.4 mm.

Remarks.—According to ten Dam, "This species is somewhat similar to *Triplasia roemeri* Reuss, but differs in its concave sides and in its smaller number of chambers."

Types and occurrence.—Holotype in Netherlands Geological Survey, Haarlem, from the Hauterivian (Lower Cretaceous), near boundary stone No. 849, in the Glanerheek near the village of Glanerbrug, Overijssel Province, Netherlands.

TRIPLASIA MEXICANA Loeblich and Tappan, new species

Plate 2, figures 21-22b

Test free, flaring, triangular in section, sides excavated, angles subacute; early chambers in a small planispiral coil which may be somewhat obscure, later chambers uniserially arranged, low and broad, up to nine in number, triangular in section; sutures obscured but gently arched on the faces, recurved at the angles; wall moderately coarsely arenaceous, with occasional large grains, rather smoothly finished; aperture terminal, rounded.

Length of holotype, 1.79 mm.; greatest breadth, 0.94 mm. Length of figured paratype, 1.01 mm.; greatest breadth, 0.55 mm. Other paratypes range in length from 0.57 to 2.08 mm.

Remarks.—The writers have examined 55 specimens of this species. It is closest to the Albian species *T. acutocarinata* but is smaller, about one-third to one-half as large, and the sides are less excavated. It is sufficiently similar, however, to suggest that it may be the ancestral form for the Albian species.

Types and occurrence.—Holotype (U.S.N.M. No. P1022), figured paratype (U.S.N.M. No. P1023), and unfigured paratypes (U.S.N.M. No. P1024, and in the Paleontological Laboratory, Gerencia de Exploración of Petroleos Mexicanos, Mexico City, and Instituto de Geología, Mexico City) all from 300 feet below the top of the Lower Cretaceous (Hauterivian) Barril Viejo shale, Potrero Ovallos, in the Sierra Hermanos, lat. 27°27' N., long. 101°28' W., Coahuila, Mexico. Collected by R. W. Imlay.

TRIPLASIA PSEUDOROEMERI Bartenstein and Brand

Plate 2, figures 1a-4b

Haplophragmium sp. (? n. sp.) EICHENBERG, 1934, Niedersächs. geol. Ver. Hannover, Jahrb. 26, p. 151, pl. 17, figs. 2a-b.

Triplasia pseudoroemeri BARTENSTEIN and BRAND, 1951, Abh. Senckenberg. naturf. Gessell., No. 485, p. 274, pl. 3, fig. 69, pl. 13, fig. 362.

Tetraplasia quadrata BARTENSTEIN and BRAND, 1951, *ibid.*, p. 275, pl. 3, fig. 72.

According to Bartenstein and Brand (translation from German):

Test free, uniformly broad, without a coil, with a thickened proloculus, triangular with convex to straight sides (and in the younger part of the test

occasionally also weakly concave) and bluntly rounded corners, few chambers, broader than high (only the final chamber is higher than broad) and gently curved, slightly depressed sutures. Wall finely agglutinated with less-coarse components. Final chamber weakly acuminate to the elongate aperture, which is somewhat eccentric in position.

Remarks: The older chambers are occasionally somewhat irregularly biserial and indicate therefore the beginning of the spiral coiling. A true coil is apparently not evident.

Eichenberg's specimen (figs. 4a, b) is very similar to the type of this species and was described as follows (translation from German): "Shell coarsely arenaceous, with interspersed dark green irregular grains. Three chambers, the first two inflated, ovate; the third larger, rounded in section, elongated, 3-sided. Aperture an elliptical opening."

Bartenstein and Brand separated the very similar quadrate forms as a distinct species (*T. quadrata*) (figs. 2a, b) referred to their genus *Tetraplasia*. Their description and figures (which are here refigured) seem to make it evident that the two "species" are the same, the triangular specimens being more abundant, and the quadrate form very rare. The description of the quadrate forms given by Bartenstein and Brand follows (translation from German):

Test free, uniformly broad, without a coil, in its place the older chambers are somewhat irregularly biserial. Sides only very weakly concave, angles broadly rounded, cross section therefore approximately rectangular. Chambers broader than high, only the end chamber increasing in height, sutures slightly depressed and gently curved, test broadly rounded at the base, the top weakly acuminate with the indication of an apertural neck and more or less rounded aperture. Walls agglutinated, of fine to medium coarseness. The cross section of the test shows broader and narrower sides.

The holotype of *T. pseudoroemeri* (fig. 1) is 1.2 mm. in length, the type of "*Tetraplasia quadrata*" Bartenstein and Brand (fig. 2) is 1.1 mm. in length, and the triangular juvenile specimen of Eichenberg (fig. 4) is 0.97 mm. in length and 0.6 mm. in breadth.

Remarks.—The triangular and quadrate specimens referred to above are similar in having an abortive coil of two large, inflated, adjacent chambers at the base, followed by the angular later chambers with nearly flat sides and broadly rounded angles, and a moderately produced, rounded aperture. Both authors recorded their forms as "very rare," although *T. pseudoroemeri* was stated to be locally frequent, and all are from the Neocomian of northern Germany. Eichenberg's specimen was from the Hauterivian, and Bartenstein and Brand recorded the quadrate form only from the upper Valendian, and the triangular one from the upper Valendian to lower Hauterivian.

This species is not so coarsely arenaceous as the Netherlands

Hauterivian species, *Triplasia grosserugosa* ten Dam, and is slightly larger, but it is otherwise similar in shape; abortive coil, nearly flat sides and rounded angles, low early chambers and much elevated pyriform final chamber. The two may be conspecific, but an examination of the types is necessary for confirmation of this.

Types and occurrence.—Holotype from the subsurface upper Valendian from Bohrung Georgsdorf 6 (Blatt 1 799, neu 3408), K 477 m, in northwestern Germany. Holotype of "*Tetraplasia quadrata*" from the subsurface upper Valendian in Bohrung Georgsdorf 7, at K 450 m, in northwestern Germany.

Triangular juvenile specimen of Eichenberg, from the *Tenuis* zone of the Hauterivian of Wenden on the Mittellandkanal, in northwestern Germany.

TRIPLASIA GLENROSENSIS Loeblich and Tappan, new species

Plate 2, figures 7a-13b

Frankeina goodlandensis Cushman and Alexander, STEAD, 1951 (not Cushman and Alexander, 1929), Texas Journ. Sci., vol. 3, No. 4, p. 589, pl. 1, fig. 6.

Test large, early portion planispiral, later uniserial and triangular or quadrangular in section, 5 or 6 inflated planispiral chambers forming a large coil, followed by 2 to 5 uniserial rectilinear chambers which may be triangular in section with nearly flat sides and broadly rounded angles (figs. 7a, b) or quadrangular (14 percent, as fig. 13), or may lose the third angle so that the later portion is flattened and *Flabellamina*-like (fig. 8) or the later chambers may lose the angularity and become rounded (figs. 9, 11); sutures arched at the center of the faces, lower at the angles, rather obscure, but sometimes slightly depressed; wall finely arenaceous, with considerable cement, very smoothly finished; aperture terminal, slitlike.

Length of holotype (fig. 7), 2.08 mm.; breadth, 0.83 mm. Length of paratype of figure 8, 2.13 mm.; breadth, 0.78 mm. Length of quadrate paratype (fig. 13), 1.27 mm.; breadth, 0.44 mm. Other paratypes vary in length from 0.83 to 2.24 mm. and in breadth from 0.42 to 1.04 mm.

Remarks.—This species resembles *Triplasia commutata* (Loeblich and Tappan) in possessing a large coil and in having a nearly parallel-sided later portion. It differs in having more-rounded angles, in the smoother finish of the wall, and in the planispiral chambers being inflated and subglobular instead of compressed and flattened. It is very similar to *T. georgsdorfensis* (Bartenstein and Brand) but has a much finer-textured wall, less-incised sutures and less-excavated faces. Of the 190 specimens examined, 26 are quadrate in section.

Occurrence.—Holotype (U.S.N.M. No. P899), figured paratypes (U.S.N.M. Nos. P900a-f), and unfigured paratypes (U.S.N.M. No. P901) all from the Glen Rose formation, 520 feet below the top in yellowish-gray *Orbitolina*-bearing marl, in a road cut on the east side of U. S. Highway 281, 2.4 miles north of the junction of U. S. Highway 281 and Texas Highway 46, Comal County, Tex. All specimens collected by Alfred R. Loeblich, Jr.

TRIPLASIA GOODLANDENSIS (Cushman and Alexander)

Plate 2, figures 14a-20

Frankeina goodlandensis CUSHMAN and ALEXANDER, 1929, Contr. Cushman Lab. Foram. Res., vol. 5, p. 62, pl. 10, figs. 1, 2.—ALEXANDER and SMITH, 1932, Journ. Paleontol., vol. 6, No. 4, p. 307, pl. 47, fig. 8; LOZO, 1944, Amer. Midl. Nat., vol. 31, No. 3, p. 542, pl. 3, fig. 8.

Test small for the genus, early portion planispiral and compressed, later rectilinear and triangular (figs. 15-20) or quadrangular (fig. 14) in section (about 3 percent of the specimens), sides concave, the test may flare rapidly (fig. 20) or have nearly parallel sides (figs. 15, 16), periphery subacute; chambers numerous, about 5 in the coil, increasing rapidly in size in the uniserial portion, although the first few uniserial chambers may be of slightly less diameter than the coil, chambers curve strongly backward at the angles, and the final chamber may reach half the distance to the coil at the margins, sides moderately excavated; sutures somewhat obscure, but may be slightly depressed in the later portion, straight and radiate in the coil, but strongly recurved at the angles of the triangular portion, in many specimens the position of the sutures suggested by the alignment of shell fragments such as *Inoceramus* prisms, as they are nearly always placed parallel to the sutures; wall arenaceous, of medium-sized grains with considerable cement, surface smoothly finished; aperture rounded, at the end of the somewhat produced final chamber.

Length of holotype, 1.0 mm.; breadth, 0.40 mm. Length of topotype of figure 19, 1.01 mm.; breadth, 0.42 mm. Length of quadrate topotype (fig. 14), 0.68 mm.; breadth, 0.34 mm. Length of flaring topotype of figure 20, 1.14 mm.; breadth of coil, 0.16 mm.; greatest breadth of triangular portion, 0.65 mm. Length of topotype of figure 15, 0.52 mm. Length of topotype of figure 16, 0.62 mm. Length of topotype of figure 18, 0.73 mm. Length of topotype of figure 17, 0.52 mm.

Remarks.—This was the genotype species of *Frankeina*, and of the 862 specimens examined, 25 (about 3 percent) were quadrate. It can

be distinguished from other species of the genus by its rather small size, sharp angles, and very strongly arched sutures.

Occurrence.—Holotype (Cushman Coll. No. 12030) and paratypes (Cushman Coll. Nos. 12031 and 12032) collected by C. I. Alexander, and figured topotypes (U.S.N.M. Nos. P902a-g) and unfigured topotypes (U.S.N.M. Nos. P910-P914) collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., all from the Goodland formation (blue marls and chalky limestones) at the Lake Worth Dam, west of Fort Worth, Tarrant County, Tex.

Plesiotype (U.S.N.M. No. P915) figured by Alexander and Smith and unfigured hypotypes (U.S.N.M. Nos. P916-P920) all from the upper Goodland formation at "Cragin Knobs" on the old Stove Foundry Road, 3.8 miles west of Montgomery Street, in Fort Worth, Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Unfigured hypotypes (U.S.N.M. No. P921) from the Goodland formation in the east bank of North Fork of Mary's Creek on the Fort Worth-Weatherford highway, 11.5 miles west of Fort Worth, Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Unfigured hypotypes (U.S.N.M. No. P922) from the Goodland formation in the south bank of Clear Creek, 0.2 miles west of Farm Road 425 bridge, 4.9 miles west of U. S. Highway 77 junction, Denton County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Unfigured hypotypes (U.S.N.M. No. P923) from the Goodland formation in a high cliff on the east side of U. S. Highway 77, 3.4 miles north of the main road turning east to Marietta, SE $\frac{1}{4}$ sec. 31, T. 6 S., R. 2 E., Love County, Okla. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

TRIPLASIA ACUTOCARINATA (Alexander and Smith)

Plate 4, figures 1-9

Frankeina acutocarinata ALEXANDER and SMITH, 1932, Journ. Paleontol., vol. 6, No. 4, p. 307, pl. 47, figs. 1, 6.—TAPPAN, 1943, Journ. Paleontol., vol. 17, No. 5, p. 483, pl. 77, figs. 14a, b.—Lozo, 1944, Amer. Midl. Nat., vol. 31, No. 3, p. 542, pl. 1, fig. 7.

Test free, large, elongate, flaring, the early portion a planispiral coil, later uniserial and triangular in section, occasionally quadrangular, periphery angular in the early stages, later the angles are bluntly rounded; chambers recurved at the angles, strongly arched on the

center of each face; sutures radial and indistinct in the coil, but may be reflected by the slightly lobulate periphery, strongly arched on the faces of the polygonal rectilinear portion and slightly depressed; wall medium to coarsely arenaceous, but may be smoothly finished, frequently a number of *Inoceramus* prisms are incorporated into the wall; aperture rounded to elongate, at the end of the slightly produced final chamber.

Length of holotype, figure 6, 3.3 mm.; breadth, 1.4 mm. Length of topotype of figure 5, 2.67 mm.; breadth, 1.14 mm. Length of hypotype of figure 2, 2.94 mm.; breadth, 2.16 mm.

Remarks.—Of the 4,913 specimens examined, 30 specimens (0.6 percent) were found to be quadrate in section. This species is characterized by its large size, extremely excavated sides, and narrow keel-like angles.

Types and occurrence.—This extremely large species is quite abundant in the Lower Cretaceous (Albian) of Texas and Oklahoma. It ranges from the Kiamichi formation (Fredericksburg group) through the Duck Creek, Fort Worth, Denton, and Weno formations (Washita group). Holotype, shown in figures 6a, b (U.S.N.M. No. P903), and unfigured paratype (Cushman coll. 17842) collected by C. I. Alexander; topotype of figures 5a, b (U.S.N.M. No. P904) and unfigured topotypes (U.S.N.M. No. P905) collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.; all from the Duck Creek formation, in the south bank of a small stream, about 15 feet north of the road, 0.1 mile east of the bridge, 0.9 mile east of Fink, Grayson County, Tex.

Hypotype (U.S.N.M. No. P906) of figure 1 from the Kiamichi formation, a 1.3-foot zone of yellow-gray clay marl, 4 feet below the top of the formation, in a road cut 2.6 miles northeast of Mosheim schoolhouse, on the northerly route from Mosheim to Valley Mills, just west of the bridge over Hogg Creek, in the southern part of Bosque County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 3 (U.S.N.M. No. P907) from the basal 4.5 feet of the Duck Creek formation, alternating yellow marls and yellow-white limestone beds, in a low, east-facing cliff of a small tributary creek which flows north into Oliver Creek, just within the eastern edge of Wise County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 9 (U.S.N.M. No. P908) from the basal 3 feet of the exposure of the upper Denton formation, a dark blue and black fissile clay in an exposure along the steep west bank of the north fork

of Noland's River, about 100 feet south of the bridge on the Godley-Joshua road, 1.4 miles northeast of Godley, Johnson County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotypes (U.S.N.M. Nos. 909a-c) of figures 4, 7, and 8 from the upper part of the Weno formation exposed in a road cut on the Fort Worth-Mansfield road, 0.3 mile south of the bridge across Sycamore Creek, southeast of Fort Worth, Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 2 (U.S.N.M. No. P1025) from the Fort Worth formation, in a low road cut near the bend of the road, in the northeastern corner of sec. 28, T. 8 S., R. 2 E., in Love County, Okla. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

TRIPLASIA INCERTA (Alexander and Smith)

Plate 3, figures 1-13

Frankeina incerta ALEXANDER and SMITH, 1932, Journ. Paleontol., vol. 6, No. 4, p. 308, pl. 47, fig. 4.—TAPPAN, 1943, Journ. Paleontol., vol. 17, No. 5, p. 483, pl. 77, figs. 15, 16.

Test free, large, early portion planispirally coiled, flattened, later portion uniserial and *Flabellammina*-like with arched flattened chambers for a variable portion of the test (figs. 2, 11), later portion develops a third angle, usually lower than the two in the plane of coiling, and occasionally a fourth, so that in the later portion the test is triangular (figs. 1-7, 9-13) or quadrangular (fig. 8) sides moderately excavated, periphery subangular; chambers numerous, about four in the coil, later portion with about 8 uniserial chambers, increasing very slowly in size so that sides are nearly parallel, chambers arched at the center of the sides, bending downward at the angles; sutures may be slightly depressed, but usually indistinct; wall coarsely arenaceous, containing numerous shell fragments in a ground mass of finer material, surface somewhat rough; aperture terminal, rounded to elongate, at the end of a short blunt necklike extension of the final chamber.

Length of holotype (fig. 7), 1.7 mm.; breadth, 0.95 mm. Length of hypotype of figure 1, 4.08 mm. Length of hypotype of figure 2, 2.49 mm.; breadth, 0.77 mm.; thickness through *Flabellammina* stage, 0.28 mm.; thickness through triangular portion, 0.34 mm. Length of hypotype of figure 3, 2.78 mm. Length of hypotype of figure 4, 3.07 mm.; length of *Flabellammina* stage, 0.83 mm.; breadth, 0.68 mm. Length of hypotype of figure 5, 4.24 mm. Length of hypo-

type of figure 6, 2.55 mm. Length of quadrangular hypotype of figure 8, 1.61 mm.; breadth, 0.83 mm. Length of hypotype of figure 9, 2.70 mm.; length of *Flabellamina* stage, 1.38 mm.; breadth, 1.07 mm. Length of hypotype of figure 10, 1.09 mm. Length of hypotype of figure 11, 1.14 mm.; breadth, 0.70 mm. Length of hypotype of figure 12, 1.51 mm. Length of hypotype of figure 13, 1.82 mm.

Number of specimens examined, 882, of which 30 (3.4 percent) are quadrate.

Remarks.—This is an extremely variable species with a *Flabellamina* portion of variable length (figs. 3, 11), the third angle developing late and somewhat lower than the other two angles. Occasional specimens develop a fourth angle (fig. 8), and some with a triangular test lose this third angle, and revert to a *Flabellamina* form (fig. 6).

Occurrence.—This species was first described from the Fort Worth and Denton formations (Alexander and Smith, 1932) and later recorded from the Duck Creek formation (Tappan, 1943). The range is here extended downward into the Kiamichi formation and upward to the Weno formation.

Holotype, figure 7 (U.S.N.M. No. P924), and paratypes (Cushman coll. No. 17850) collected by C. I. Alexander, from the upper Fort Worth formation, in an exposure in the east bank of Denton Creek, 1.4 miles east of Justin, Denton County, Tex.

Hypotypes of figures 2 and 11 (U.S.N.M. Nos. P925a, b) from the Duck Creek formation, from a 5.5-foot section of blue-gray shale, about 30 feet above the base of the exposure, in the west bank of the Red River, in SW $\frac{1}{4}$ sec. 22, T. 8 S., R. 2 E., on the southwest side of Horseshoe Bend, Love County, Okla. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 8 (U.S.N.M. No. P926) from the Weno formation, in a road cut exposing about 10 feet of interbedded limestones and yellow-gray marls, on the Fort Worth–Mansfield road, 0.3 mile south of the bridge over Sycamore Creek, southeast of Fort Worth, in Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 10 (U.S.N.M. No. P927) from a 3-foot section of the dark gray and yellow shales of the Fort Worth formation, about 10 feet above the base and 4 feet below the top of the exposure in a deep road cut on the west side of U. S. Highway 75 (the Denison-Durant road), 1,000 feet north of the Calvary Cemetery, 1.6 miles north of the intersection with Main Street in Denison, Grayson

County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotypes of figures 6, 12, 13 (U.S.N.M. Nos. P928a-c) from the upper Denton formation, about 7.5 feet of yellowish and reddish clay, 3 feet above the base and 5 feet below the top of the exposure, along the steep west bank of the north fork of Nolands River, about 100 feet south of the bridge on the Godley-Joshua road, 1.4 miles north-east of Godley, Johnson County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 9 (U.S.N.M. No. P929) from the Kiamichi formation in a 3-foot exposure of bluish-gray clay and nodular limestones, just above the Edwards limestone and immediately below the Georgetown limestone (Duck Creek member) in the eastern bank of Hogg Creek just north of the bridge at Patton, McLennan County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 3 (U.S.N.M. No. P930) from the uppermost 2 feet of the Kiamichi formation, just below the Duck Creek formation in thin shaly layers between ledges of *Gryphaea* shell agglomerate, in a high, north-facing slope on the south bank of the Red River, cleared by excavation at the site of the Denison Dam, north of Denison, Grayson County, Tex. This slope is now covered and grassed over. Collected in July 1940 by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 1 (U.S.N.M. No. P931) from the Fort Worth formation, in a 6-foot exposure of yellowish-gray marls in a road cut on the east side of U. S. Highway 77, 1.4 miles south of the south end of the bridge across the Red River, in Cooke County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 5 (U.S.N.M. No. P932) from the upper 4.5 feet of alternating yellow-gray limes and marly clays of the Fort Worth formation, in a west-facing creek bank, just north of U. S. Highway 70, and across the railroad tracks, in SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 20, T. 6 S., R. 7 E., about 0.9 mile east of Aylesworth, Marshall County, Okla. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 4 (U.S.N.M. No. P933) from the Fort Worth formation, from a 3-foot marl zone between heavy limestone beds, 10 feet above the base of a road cut in the 1700 block of East Lancaster Street, just west of the corner of Riverside Drive and Lancaster Street, in the Fort Worth-Dallas highway, in eastern Fort Worth, Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

TRIPLASIA INSOLITA (Alexander and Smith)

Plate 5, figures 1a-7

Frankeina insolita ALEXANDER and SMITH, 1932, Journ. Paleontol., vol. 6, No. 4, p. 308, pl. 47, figs. 2, 3.—TAPPAN, 1943, Journ. Paleontol., vol. 17, No. 5, p. 483, pl. 77, figs. 17a-18b.

Test free, large, early portion planispiral and compressed, then becoming *Flabellammina*-like for a short distance (figs. 2a, b), or abruptly triangular (figs. 1a, b), or quadrangular (figs. 3a, b), sides of test somewhat excavated, angles bluntly rounded, chambers numerous, at first increasing rapidly in size from the four or five of the tiny planispiral coil, later chambers increase more slowly in size, so that sides of test are nearly parallel; sutures obscure, somewhat more distinct in the planispiral portion; wall coarsely arenaceous, incorporating many shell fragments, such as *Inoceramus* prisms; aperture terminal, rounded.

Length of holotype (fig. 1), 2.7 mm.; breadth, 0.9 mm. Length of topotype of figure 2, 2.60 mm.; breadth, 1.07 mm.; thickness in early portion of test, 0.28 mm.; thickness near aperture, 0.62 mm. Length of topotype of figure 3, 2.00 mm.; breadth, 1.20 mm.; thickness, 1.01 mm.

Number of specimens examined, 328.

Remarks.—This is a large and extremely variable species and shows all gradations between the flattened forms, the triangular and the quadrangular ones.

Types and occurrence.—Although Alexander and Smith state (1932, p. 308) that "*F. insolita* has been found in samples from the Duck Creek formation only, and is thus an excellent marker of basal Washita," the writers have found specimens in the Fort Worth, Weno, and Main Street formations which appear identical in all respects to typical *T. insolita*. It seems probable that this species is characteristic of a limy lithologic facies, and is found where these formations are of similar facies as the Duck Creek limes and marls.

Holotype, figure 1 (U.S.N.M. No. P934), and paratypes (U.S.N.M. No. P935 and Cushman Coll. 17849) collected by C. I. Alexander; and topotypes of figures 2 and 3 (U.S.N.M. Nos. P936a-b) and unfigured topotypes (U.S.N.M. No. P937) collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.; all from the Duck Creek formation, in a low north-facing cliff on the south bank of a small stream north of the road, 0.1 mile east of the bridge, 0.9 mile east of Fink, Grayson County, Tex.

Hypotype of figures 5 and 7 (U.S.N.M. Nos. P938a, b) from the

Main Street formation, in 5.5 feet of section of alternating limes and marls (*Exogyra arietina* zone), 4 feet below the top of the section exposed in a road cut on the road leading eastward to Grayson Bluff, about 1 mile east of the Fort Worth-Denton highway, 3.5 miles north-east of Roanoke, Denton County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 6 (U.S.N.M. No. P939) from the Fort Worth formation, in the lowest 5.5 feet of alternating limestones and light gray marls exposed in a road cut on the east side of U. S. Highway 77, 1 mile west-southwest of the Gainesville courthouse square, just south of a small bridge, in Cooke County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotype of figure 4 (U.S.N.M. No. P940) from the alternating thin limestones and thicker marl beds of the upper Weno formation, in the upper one-half of the lower 5.5 feet exposed, and just under a 1-foot limestone bed, 7 feet below the top of the formation, in a road cut on the west side of the Fort Worth-Burleson highway, where it swings southward near the top of the hill, 0.25 mile southeast of the fork of the Fort Worth-Everman road from the Fort Worth-Burleson highway, southeast of Fort Worth, Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

TRIPLASIA NODOSA Loeblich and Tappan, new species

Plate 5, figures 8-15

Test free, narrow, elongate, base rounded and bulbous, chambers uniserially arranged, varying from somewhat flattened to distinctly triangular or quadrangular in section, or even bifurcated, flattened at first (fig. 11) and developing the third angle late in its growth, or triangular at first and losing the third angle in the later development (fig. 10), the later chambers sometimes inflated and nodular in appearance and separated by definite constrictions (figs. 13, 14); sutures obscure to strongly constricted; wall coarsely arenaceous, incorporating grains and shell fragments of varying sizes, surface very rough and irregular; aperture rounded at the end of a narrow, much-produced neck.

Length of holotype (fig. 12), 1.27 mm.; breadth, 0.60 mm. Length of paratype of figure 8, 0.96 mm.; breadth, 0.49 mm. Length of paratype of figure 10, 1.53 mm.; breadth, 0.70 mm. Length of paratype of figure 11, 1.51 mm.; breadth, 0.60 mm. Length of paratype of figure 13, 1.22 mm.; breadth, 0.44 mm.

Remarks.—This extremely variable species is closest in appearance to the early Washita *Triplasia rugosa* (Alexander and Smith), but differs in the much more elongate neck, absence of a distinct coil, more nodular appearance of the chambers and greater constriction of the sutures. The later chambers are generally widest at their base and taper sharply toward the aperture.

Types and occurrence.—Holotype (fig. 12, U.S.N.M. No. P941), paratypes of figure 9 and 10 (U.S.N.M. Nos. P942a-b), and unfigured paratypes (U.S.N.M. No. P943) all from the Grayson formation, basal 3 feet, just above the Main Street formation, in a road cut on the south bank of Chuckwa Creek, 1.0 mile north of Durant, on U. S. Highway 75, in NE $\frac{1}{4}$ sec. 29, T. 6 S., R. 9 E., Bryan County, Okla. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., 1937.

Paratypes of figures 8, 14, 15 (U.S.N.M. Nos. P944a-c) and unfigured paratypes (U.S.N.M. No. P945) all from the Grayson formation, at Grayson Bluff, a high southwest-facing bluff on Denton Creek, 3.5 miles northeast of Roanoke, Denton County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., 1937.

Unfigured paratypes (U.S.N.M. No. P946) from the Del Rio clay, 15.5 to 21 feet above the base exposed, on the west bank of Shoal Creek, just south of the bridge at 34th Street and just north of a fault, in Austin, Travis County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., July 1940.

Paratypes of figure 13 (U.S.N.M. No. P947) and unfigured paratypes (U.S.N.M. No. P948) from thin marl beds between limestone ledges of the Main Street formation, basal 5.5 feet of section exposed at an underpass of the Atchison, Topeka and Santa Fe Railroad, on the Cleburne-Hillsboro road, just south of the city of Cleburne, in Johnson County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., July 1940.

Paratype of figure 11 (U.S.N.M. No. P949) and unfigured paratype (U.S.N.M. No. P950) from the thin marl seams between projecting limestone ledges of the Main Street formation, in an 8-foot, west-facing bank of a small stream, east of the road leading south one block east of the eastern edge of the campus (Fort Worth-Crowley road), 3.9 miles south of the southeastern edge of the Baptist Seminary Campus, south of Fort Worth, Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., July 1940.

Unfigured paratypes (U.S.N.M. No. P951) from the lower Main Street formation, in thin marl seams between heavy beds of limestone, in a road cut on the north side of the road, at the western edge

of the Federal Narcotic Farm, southeast of Fort Worth, Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., June 1939.

TRIPLASIA RUGOSA (Alexander and Smith)

Plate 3, figures 14-20c

Flabellammina rugosa ALEXANDER and SMITH, 1932, Journ. Paleontol., vol. 6, No. 4, p. 302, pl. 45, figs. 6-7 (not 8-9), text figs. 1, 2c (not 2b).—TAPPAN, 1943, Journ. Paleontol., vol. 17, No. 5, p. 482, pl. 77, figs. 11a-13.
not *Flabellammina rugosa* Alexander and Smith, CUSHMAN, 1946, U. S. Geol. Surv. Prof. Pap. 206, p. 24, pl. 4, figs. 9-10.

Test free, of medium size, elongate, either with a bulbous base (fig. 18) or an obscure coil (figs. 19, 20), later compressed (fig. 20) to subtriangular (fig. 19) or quadrangular (fig. 16) in section; chambers of the early coil usually somewhat obscure (fig. 19), those of the early uncoiled portion slightly arched, later chambers irregular in appearance, of somewhat greater breadth than height, final chamber may be somewhat pyriform in outline (figs. 16, 18, 19); sutures generally indistinct, slightly arched, later ones somewhat constricted and nearly straight; wall coarsely arenaceous, incorporating various-sized grains and *Inoceramus* prisms, surface roughly finished; aperture at the end of a short neck, rounded to somewhat elongate.

Length of holotype, 1.61 mm.; breadth, 0.78 mm.; thickness, 0.34 mm. Length of hypotype of figure 16, 1.82 mm.; breadth, 0.55 mm. Length of hypotype of figure 15, 1.46 mm.; breadth, 0.57 mm. Length of toptype of figure 17, 1.38 mm.; breadth, 0.64 mm.; thickness, 0.37 mm. Length of toptype of figure 18, 1.53 mm.; breadth, 0.62 mm. Length of toptype of figure 19, 1.16 mm.; breadth, 0.38 mm.

Remarks.—This species was originally described as a species of *Flabellammina* and the holotype is somewhat flattened. Nevertheless, because the majority of specimens are much less noticeably flattened, but are triangular to quadrate, the species is here considered to belong to *Triplasia*. It is similar in some respects to *T. incerta* in that there may be an elongate flattened portion before the test becomes triangular or quadrangular.

Alexander and Smith, and later Cushman, also referred Upper Cretaceous specimens to this species. However, their specimens from the Austin chalk are typical *Flabellammina* and may possibly belong to *Flabellammina clava* Alexander and Smith, which was also described from the Austin chalk, and is of similar size, shape, and ap-

pearance. The Austin chalk specimens are much more compressed than the present species, with broader and lower chambers and with strongly arched sutures. They also lack the apertural neck of *T. rugosa*.

Types and occurrence.—Holotype (fig. 20, U.S.N.M. No. P952) and unfigured paratype (U.S.N.M. No. P953) collected by C. I. Alexander, from the lower Duck Creek limestone and marl; and topotypes of figures 17-19 (U.S.N.M. No. P954a-c) collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., June 1939, from the basal 1-foot of alternating limestones and marls of the Duck Creek formation (Lower Cretaceous, Albian), all from the south bank of a small creek, about 15 feet north of the road leading eastward from Fink, 1 mile east of town, in Grayson County, Tex.

Hypotype of figure 14 (U.S.N.M. No. P955) from the blue-gray shales of the Duck Creek formation, from 19 to 24 feet above the base, and hypotypes of figures 15 and 16 (U.S.N.M. Nos. P956a-b) from 24 to 30 feet above the base, on the west bank of the Red River, in SW $\frac{1}{4}$ sec. 22, T. 8 S., R. 2 E., on the southwest side of Horseshoe Bend, Love County, Okla. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., August 1939.

We have recorded this species from many Duck Creek outcrops in Texas and Oklahoma, as well as from the lower Fort Worth limestone of Oklahoma.

TRIPLASIA WENOENSIS (Alexander and Smith)

Plate 4, figures 10-15b

Frankeina wenoensis ALEXANDER and SMITH, 1932, Journ. Paleontol., vol. 6, No. 4, p. 309, pl. 47, fig. 5.

Test free, small for the genus, flaring, early portion planispiral, later uniserial and triangular or very rarely quadrate (fig. 15), sides moderately excavated, angles bluntly rounded; chambers few in number with only 3 or 4 comprising the uniserial portion, rather broad and low; sutures indistinct, occasionally marked by slight indentations at the angles of the test, arched across the center of each side; wall arenaceous, of medium-sized grains in a finer ground mass, very roughly finished; aperture terminal, rounded, on a short blunt neck.

Length of holotype (fig. 14), 1.30 mm.; breadth, 0.78 mm. Length of hypotype of figure 10, 0.91 mm.; breadth, 0.57 mm. Length of hypotype of figure 12, 0.81 mm.; breadth, 0.62 mm. Length of hypotype of figure 13, 1.51 mm.; breadth, 0.99 mm. Length of quadrate

hypotype of figure 15, 1.64 mm.; breadth, 0.78 mm. Other hypotypes range from 0.83 to 1.14 mm. in length.

Remarks.—Alexander and Smith stated that "This species is restricted to the Weno formation, but the fact that it is a rather rare form detracts from its value as an horizon marker. The writers' collections have failed to disclose a locality where individuals occur in abundance." Actually, the species was based on a single specimen, the holotype, which was the only specimen in the Alexander collection (now in the U. S. National Museum). In the large number of Washita samples examined by the present writers, this species is very rare, being represented by a total of eight hypotype specimens. However, it has been found in the Main Street and Georgetown formations, as well as the Weno formation, and its range within the middle Washita was apparently governed by the environment, as all specimens occur in the marly limestone facies of the respective formations. In spite of its rarity, this species is represented by two quadrate specimens, which are otherwise similar to the more typical triangular forms.

This species resembles *T. acutocarinata* (Alexander and Smith) in the somewhat flaring character but is smaller and has less-excavated sides, more-rounded angles, and more-obscure sutures.

Types and occurrence.—Holotype (U.S.N.M. No. P957) from the Weno formation (Lower Cretaceous, Albian) in a roadside ditch on the Fort Worth-Mansfield road, 0.25 mile south of the bridge over Sycamore Creek, Tarrant County, Tex. C. I. Alexander collection.

Hypotype of figure 13 (U.S.N.M. No. P958) from the upper 10 feet exposed of the interbedded light yellow-gray marls and limestones of the Weno formation in a road cut on U. S. Highway 287 (Fort Worth-Mansfield road), 0.3 mile south of the bridge over Sycamore Creek, southeast of Fort Worth, in Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., August 1941.

Hypotypes of figures 10-12 and 15 (U.S.N.M. Nos. P959a-d), from the lower 1-foot marl bed of the Weno formation, exposed beneath a heavy limestone and about 15-20 feet stratigraphically below the Paw Paw formation, in a road cut on the east side of the old Mansfield road, downhill and to the north of the Paw Paw exposure, 0.25 mile south of the bridge over Sycamore Creek, west of the Glen Garden Country Club, 3 miles southeast of Fort Worth, Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., October 1943.

Because of the many changes in the highways over the past 20

years, it is uncertain which of the two preceding localities of the present writers represents the actual type locality of Alexander and Smith. They are only a fraction of a mile distant, however.

Unfigured hypotype (U.S.N.M. No. P960) from the upper 3 feet exposed of the alternating limestones and light gray marls and yellowish and brownish clays of the lower Weno formation, about 8 feet above the contact with the Denton formation, on the south bank of a tributary to Sycamore Creek, which was dammed to form Katy Lake, 0.25 mile east of and below the dam, southeast of Fort Worth, Tarrant County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., September 1938.

Unfigured hypotype (U.S.N.M. No. P961) from the upper 5 feet exposed of the Main Street formation (Lower Cretaceous, Albian) consisting of marl beds between limestone ledges, at an underpass under the Atchison, Topeka and Santa Fe railroad just south of Cleburne, on the Cleburne-Hillsboro road, in Johnson County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., July 1940.

Unfigured hypotype (U.S.N.M. No. P962) from the Georgetown formation (Lower Cretaceous, Albian), in marls between large fucoid-bearing limestone ledges, containing *Macraster elegans* (Shumard), along Smith Branch, the first main creek east of the town of Georgetown, approximately one-half mile northeast (downstream) from Texas State Highway 104, Williamson County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr., 1940.

TRIPLASIA MURCHISONI Reuss

Plate 5, figures 16-17c

Triplasia murchisoni REUSS, 1854, Denkschr. Akad. Wiss. Wien, math.-naturw.

Kl., vol. 7, p. 65, pl. 25, figs. 1a-2.

Ammobaculites variabilis (Brady) FRANKE, 1928 (not Brady, 1884), Abh. preuss. geol. Landesanst., Berlin, N.S., No. 111, p. 166, pl. 15, figs. 6a-b.

not *Triplasia murchisoni* Reuss, EGGER, 1899, Abh. bayer. Akad. Wiss., München,

Kl. 2, vol. 21, pt. 1, p. 42, pl. 15, fig. 24.

Original description (translation from German):

Up to 3.2 mm. high, inverted ovate, more or less elongate, base bluntly pointed, quite sharply triangular, the lateral sides indented along the direction of the long axis, so that the cross section presents an equilateral, quite sharply angled triangle, with concave sides.

Chambers up to 10, increasing gradually in size from base to top, triradiate, attached across their entire breadth with no separating constrictions; each somewhat overlapping the preceding. The sutures only slightly depressed and

descending somewhat obliquely from the middle of each side to the angles of the test. The last chamber elongated in a short, somewhat thickened, central tubular neck, which carries on the apex the round bare aperture. The outer surface of the shell rough.

Remarks.—All attempts by the writers to obtain specimens of this species have been futile. However, Cushman stated (1948, p. 106) that a study of type material in Vienna showed that the microspheric generation possessed a coil, which was not present in the megalospheric form.

This specimen figured by Egger is quite distinct, being much longer and narrower, with higher chambers and horizontal and constricted sutures. It does not even appear to belong to *Triplasia*, but only an examination of the types could prove this.

Franke referred to *Ammobaculites variabilis* (Brady) some rapidly flaring specimens with a triangular section and low, broad chambers. They seem closer in appearance to *T. murchisoni* Reuss which is also from the Senonian (or Turonian) in this general region. Typical *T. variabilis* is larger, has a less flaring test which becomes nearly parallel-sided in the later portion, and has a more slitlike aperture.

Occurrence.—Described from the Turonian, or lower Senonian, Gosaugebilde, Mergel, present at Edelbachgraben, and very rare at Wegscheidgraben in Gosau, Ostalpen (Salzburg), Austria.

TRIPLASIA ABKHASHICUS (Keller)

Plate 7, figure 15

Haplophragmium abkhashicus KELLER, 1946, Bull. Soc. Natur. Moscow, n.s., vol. 51 (Sect. Géol., vol. 21), No. 3, pp. 89 (Russian), 106 (English), pl. 1, fig. 17, pl. 3, fig. 19.

Translation from the Russian, p. 89 (Ellis and Messina, supplement for 1950):

Test very large, tightly coiled in the initial portion, later becoming uniserial. Width of the test in the initial portion about the same as in the final portion. In transverse section the uniserial portion of the test is angular, almost triangular, with a rounded dorsal and a somewhat tapering ventral side. In the spiral portion of the test there are 4 or 5 chambers, forming a single volution. Chambers of the uniserial portion number 2-4, sutures linear, slightly depressed. Aperture poorly defined, apparently complex, terminal. Wall agglutinated, containing prisms of *Inoceramus*, *Pythonellas* and calcareous fragments.

The type specimens measured 2.0 mm. in length, 0.72 mm. in width, and 1.32 mm. in length and 0.70 mm. in width.

Remarks.—According to Keller, the species is related to *Haplo-*

phragmium aequale Roemer, but differs in having slightly depressed sutures and narrower uniserial chambers. It also seems close to *Rhabdogonium römeri* Reuss, from the German upper Senonian, but has a better-developed coil. Possibly Reuss's type is megalospheric and Keller's microspheric. Both species are "very rare."

Types and occurrence.—Types in the State Institute of Sciences, Moscow, from the lower Senonian (Campanian), Upper Cretaceous, on the southern flank of the Dzykhrin anticline on the River Mzymta, environs of Sochi, western Caucasus, Krasnodar, U.S.S.R.

TRIPLASIA BEISSELI (Marie)

Plate 5, figures 18-20b; text figures 1-10

Haplophragmium munchisoni (Reuss) BEISSEL, 1891 (not Reuss, 1854), Abh. preuss. geol. Landesanst., Berlin, N.S., No. 3, p. 15, pl. 4, figs. 1-10.

Ammobaculites munchisoni Beissel (not Reuss) FRANKE, 1928, Abh. preuss. geol. Landesanst., Berlin, N.S., No. 111, p. 165, pl. 15, fig. 5.

Frankeina beisseli MARIE, 1941, Mém. Mus. Nat. Hist. Natur., Paris, N.S., vol. 12, No. 1, p. 23, pl. 2, fig. 12a-c.

not *Frankeina cushmani* ALEXANDER and SMITH, 1932, Journ. Paleontol. vol. 6, No. 4, p. 309, pl. 47, figs. 10, 11.

not *Tetraplasia georgsdorfensis* BARTENSTEIN and BRAND, 1949, Journ. Paleontol. vol. 23, No. 6, p. 672, text figs. 9a, b.

Test free, large, flaring, with a well-developed planispiral coil, followed by a few triangular or quadrate uniserial chambers, sides moderately excavated, angles broadly rounded; sutures distinct, slightly depressed, gently arched on the faces, recurved at the angles; wall coarsely arenaceous, but grains of nearly uniform size, little cement, so that the surface is rough in appearance; aperture a terminal slit, sometimes slightly produced.

Length of hypotype (fig. 18), 2.70 mm.; breadth, 1.30 mm. Length of hypotype of figure 19, 3.17 mm.; breadth, 1.48 mm. Length of hypotype of figure 20, 1.61 mm.; breadth, 0.62 mm. Other hypotypes range from 1.30 to 2.68 mm. in length.

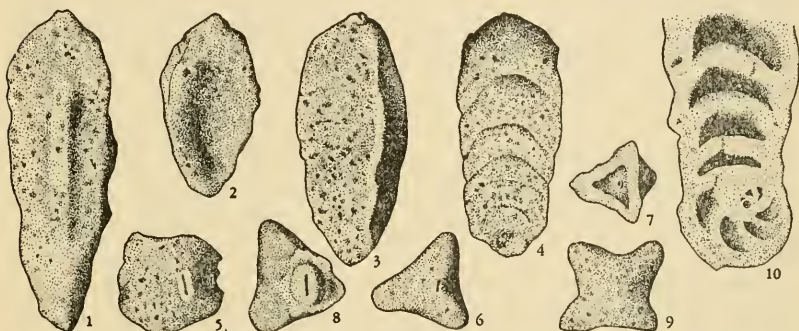
Remarks.—Although referred to *Haplophragmium munchisoni* (Reuss) by Beissel, it differs from Reuss's species in being less flaring, in having a more-prominent coil and less-acute angles, in lacking the neck and in having a slitlike rather than a rounded aperture.

Beissel's reference was also placed in synonymy of *Frankeina cushmani* Alexander and Smith by the authors of that species, but the European species is larger and more flaring and has better-defined and

slightly excavated sutures and a less coarsely arenaceous and more smoothly finished wall.

Bartenstein and Brand (1949, p. 672) considered the quadrate specimens figured by Beissel to belong to their new genus and species *Tetraplasia georgsdorfensis*. The latter does not have as prominent a coil, has less highly arched sutures and more excavated sides, and is a much smaller species.

Types and occurrence.—Holotype in the Marie collection, from the Campanian (Upper Cretaceous), *Belemnitella mucronata* chalk at Montereau, Seine-et-Marne, Paris Basin, France. Paratypes



FIGS. 1-10.—*Triplasia beisseli* (Marie): 1, A bifurcated individual, which is flattened in part and develops a third angle in the central portion of the test. 2, Face view of a quadrate specimen. 3, Side view of a triangular specimen. 4, Face view showing arched sutures. 5, Apertural view of a quadrate specimen. 6, Apertural view of a triangular specimen. 7, Opening of the penultimate chamber. 8, Opening of one of the earliest uncoiled chambers. 9, A more excavated quadrate specimen. 10, Sectional view. (After Beissel.)

(d'Orbigny collections, Muséum Nationale d'Histoire Naturelle, Paris) from Meudon, Seine-et-Oise, France.

Hypotype of figure 18 (U.S.N.M. No. P963), hypotype of figure 19 (U.S.N.M. No. P964), and unfigured hypotype (U.S.N.M. No. P965) all from the *Mucronaten*-Kreide, Friedrichsberg bei Aachen, Germany (topotypes of *Haplophragmium munchisoni* of Beissel, and identified as such by A. Franke), in the Alexander collection deposited in the U. S. National Museum.

Hypotypes (U.S.N.M. No. P966) from the lower Senonian, of Westphalia, Germany. Collected by A. Franke and donated to the U. S. National Museum by C. I. Alexander.

Quadrate hypotype of figure 20 (U.S.N.M. No. P967) and unfigured hypotypes (U.S.N.M. No. P968) from the lower Senonian, between Hannover and Hildesheim, Germany. Collected by A. Franke and donated to the U. S. National Museum by C. I. Alexander.

TRIPLASIA CUSHMANI (Alexander and Smith)

Plate 7, figures 1a-5

Frankeina cushmani ALEXANDER and SMITH, 1932, Journ. Paleontol., vol. 6, No. 4, p. 309, pl. 47, figs. 10-11.—CUSHMAN, 1946, U. S. Geol. Surv. Prof. Pap. 206, p. 25, pl. 4, figs. 11, 12.

Test free, of medium size for the genus, flaring in the early portion, later with nearly parallel margins, planispiral coil large, later uniserial portion triangular to quadrate with moderately excavated sides and acute angles; chambers low and broad, moderately arched on the sides; sutures obscure, discernible largely by the alignment of the larger grains and calcite prisms in the wall, rarely slightly depressed; wall coarsely arenaceous, with large grains and shell fragments in a finer ground mass, roughly finished; aperture a terminal slit, not produced.

Length of holotype (fig. 2), 1.51 mm.; breadth, 0.86 mm. Length of hypotype of figure 1, 1.43 mm.; breadth, 0.81 mm.; thickness, 0.52 mm. Length of quadrate hypotype of figure 3, 2.24 mm. Length of hypotype of figure 4, 0.86 mm. Length of hypotype of figure 5, 0.99 mm.

Remarks.—Of the 232 specimens examined, 4 are quadrate, and the remainder are triangular in section, a percentage of 1.72 quadrate forms.

This species is characterized by the comparatively large coil, parallel sides, and obscure sutures, and the coarsely arenaceous and roughly textured wall. Alexander and Smith placed in the synonymy of this species *Haplophragmium munchisoni* (Reuss) of Beissel, 1891 (not *Triplasia munchisoni* Reuss, 1854). Topotypes of Beissel's form, identified by A. Franke, show that this is a distinct species (described elsewhere in this paper as *T. beisseli* (Marie)). *T. beisseli* is a larger and more flaring species, with better-defined sutures and less coarsely arenaceous and more smoothly finished wall.

Types and occurrence.—Holotype (fig. 2, U.S.N.M. No. P989), paratype figured by Alexander and Smith (U.S.N.M. No. P990), and unfigured paratype (Cushman coll. No. 17852) all from the Pecan Gap (Upper Cretaceous), in an abandoned clay pit, 1.0 mile east of Farmersville, on the Farmersville-Greenville road, Collin County, Tex. Collected by C. I. Alexander.

Hypotype of figure 3 (U.S.N.M. No. P991) and unfigured hypotypes (U.S.N.M. No. P992) from the Upper Cretaceous Annona chalk, about 1 mile north of the quarry of the Arkansas Lime Products Co., on Little River, Ark. Collected by W. H. Deaderick.

Hypotype of figure 1 (U.S.N.M. No. P969) and unfigured hypotypes (U.S.N.M. No. P970) from the Annona chalk about 0.5 mile north of the White Cliffs Post Office, Ark. Collected by W. H. Deaderick.

Hypotypes of figures 4 and 5 (U.S.N.M. Nos. P971a-b) and unfigured hypotypes (U.S.N.M. No. P972) from the Ozan sand (Upper Cretaceous), in natural erosion on the east side of the Arkinda road, 5.0 miles northwest of Foreman, Little River County, Ark. Collected by W. H. Deaderick.

Unfigured hypotypes (U.S.N.M. No. P973) from the Annona chalk, about 0.5 mile west of the Brownstown-White Cliffs road, 1.7 miles south of Brownstown, Ark. Collected by W. H. Deaderick.

Unfigured hypotypes (U.S.N.M. No. P974) from the Annona chalk (at the Ozan contact) on the east side of the road to White Cliffs, 2.8 miles south of the Brownstown crossroads, Ark. Collected by W. H. Deaderick.

Unfigured hypotypes (U.S.N.M. No. P975) from the Annona chalk, on the east side of the road to Columbus, 1.0 mile south of Yancey, Hempstead County, Ark. Collected by W. H. Deaderick.

Unfigured hypotypes (U.S.N.M. No. P976) from the Saratoga chalk, on the south side of the road to Columbus, 2.0 miles east of Saratoga, Howard County, Ark. Collected by W. H. Deaderick.

Unfigured hypotypes (U.S.N.M. No. P977) from the Upper Cretaceous Nacatoch sand, on the north side of Highway 26, 0.5 mile east of Big Decipher Creek, 5.0 miles west of the corner of 10th and Pine Streets in Arkadelphia, in SW $\frac{1}{4}$ sec. 27, T. 7 S., R. 20 W., Clark County, Ark. Collected by W. H. Deaderick.

TRIPLASIA DEADERICKI Loeblich and Tappan, new species

Plate 6, figures 1-5

Test free, of medium size, elongate margins nearly parallel, early portion planispirally coiled, later chambers uniserial and generally triangular in section with somewhat rounded angles and slightly concave sides, occasionally quadrate (fig. 4), and one specimen (fig. 1) was found to have only two angles, and thus *Flabellammina*-like. Occasional additional specimens are flattened in the early uniserial portion, developing the third angle about one-half the distance from the base, chambers numerous, low and broad in the early portion, later ones higher, and final one or two chambers generally of smaller diameter and rounded in section (figs. 1-3), and of approximately equal height and breadth; sutures obscure in the early portion, becom-

ing well marked and constricted in the later portion of the test, radial in the coil, slightly arched in the rhomboid uniserial chambers and horizontal between the later rounded chambers; wall finely arenaceous, with occasional coarser grains, usually rather smoothly finished; aperture terminal, ovate to slitlike, slightly produced.

Length of holotype (fig. 3), 2.18 mm.; breadth, 0.78 mm. Length of paratype of figure 1, 1.77 mm.; breadth, 0.75 mm.; thickness 0.47 mm. Length of paratype of figure 2, 1.90 mm.; breadth, 0.60 mm. Length of paratype of figure 4, 1.01 mm.; breadth, 0.60 mm.

Remarks.—This species resembles *T. glenrosensis*, new species, in the rounded later chambers, large coil, and nearly parallel margins. It differs in being narrower with sharper angles, more coarsely arenaceous, and with a roughened finish.

The species is named in honor of the late Dr. W. H. Deaderick, in recognition of this work in assembling a superb collection of Foraminifera from the Cretaceous strata of Arkansas.

Types and occurrence.—Holotype (fig. 3, U.S.N.M. No. P978), paratypes of figures 2, 4, 5 (U.S.N.M. Nos. P979a-c), and unfigured paratypes (U.S.N.M. No. P980) from the Upper Cretaceous Annona chalk, at the Ozan contact, on the east side of the road to White Cliffs, 2.8 miles south of the Brownstown crossroads, Ark. Collected by W. H. Deaderick.

Paratype of figure 1 (U.S.N.M. No. P981) and unfigured paratypes (U.S.N.M. No. P982) from the Annona chalk, about 0.25 mile north of the White Cliffs Post Office, Ark. Collected by W. H. Deaderick.

TRIPLASIA PLUMMERAE Loeblich and Tappan, new species

Plate 6, figures 14-19b

Test free, large, elongate, triangular or occasionally quadrate in section, angles rounded, sides moderately excavated, slightly flaring to subparallel-sided, uniserial throughout, base occasionally slightly curved; chambers numerous, low, increasing very gradually in height as added, each succeeding chamber overlapping the preceding, final chamber nearly as high as broad, chambers extending sharply downward at the angles; sutures fairly distinct, slightly depressed, especially in the later portion of the test, strongly arched on the faces of the test, recurved at the angles; wall arenaceous, with grains of medium size in a ground mass of finer material and occasionally incorporating tests of smaller species of Foraminifera; aperture terminal, a narrow slit, occasionally slightly produced on a short neck.

Length of holotype (fig. 19), 5.46 mm.; breadth, 1.74 mm. Length of quadrate paratype of figure 17, 4.34 mm.; breadth, 1.46 mm. Other paratypes range from 2.21 to 5.41 mm. in length and from 0.86 to 2.29 mm. in breadth.

Remarks.—This species is somewhat variable in character, two specimens from the Saratoga chalk of Arkansas showing a compressed *Flabellamina*-like early portion, although no distinct coil is present, and the third angle is only developed in the latter half of the test. The majority of specimens are regularly triangular in section, but four of the paratypes are quadrate, two of these from the Taylor marl of Texas being figured, the other two occurring in the Saratoga chalk of Arkansas. As 156 specimens of this species were examined, approximately 2.6 percent of the specimens are quadrate and about 1.3 percent are flattened, lacking the third angle in the early stage.

Although a few specimens show a slight curve at the base (fig. 14) there is no definite coil.

The present species differs from *Triplasia murchisoni* Reuss in being less flaring, with less-excavated sides and more-rounded final chambers. *T. murchisoni* Reuss is approximately three-fifths as large as the present species and has a rounded rather than elongate aperture.

Triplasia taylorensis (Cushman and Waters), which occurs with this species, has a more flaring test with a definite coil at the base and more deeply excavated sides, and tends to be more coarsely arenaceous, incorporating larger fragments in the wall.

Types and occurrence.—Holotype (fig. 19, U.S.N.M. No. P983), paratypes of figures 14-18 (U.S.N.M. Nos. P984a-e), and unfigured paratypes (U.S.N.M. No. P985) all from the greenish-gray marls of the upper Taylor, on the right bank of Onion Creek, just downstream from the bridge at Moore and Berry's Crossing, 8.5 miles southeast of the State Capitol building in Austin, Travis County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Paratype (U.S.N.M. No. P986) from the Saratoga chalk, on U. S. Highway 51, 10.5 miles southwest of Wright's store at the junction of highways 26 and 51, 3.1 miles northeast of Okalona, on the northeast side of the road, Clark County, Ark. W. H. Deaderick collection in the U. S. National Museum.

Paratypes (U.S.N.M. No. P987) from the Saratoga chalk, 2.0 miles east of Saratoga, on the south side of the road to Columbus, Howard County, Ark. W. H. Deaderick collection in the U. S. National Museum.

TRIPLASIA RÖMERI (Reuss)

Plate 5, figures 21a-22b

Rhabdogonium römeri REUSS, 1860, Sitzb. Akad. Wiss. Wien, math.-naturw. Kl., vol. 40, p. 201, pl. 6, figs. 7a-c.

Ammobaculites roemeri (Reuss) FRANKE, 1928, Abh. preuss. geol. Landesanst., Berlin, N.S., No. 111, p. 166, pl. 15, fig. 8.

Original description (translated from German):

Test elongate, 1.97 mm. in length by 0.643 mm. in breadth, occasionally somewhat curved, of almost equal breadth for the entire length, at the upper end short and bluntly acuminate, sharply rounded below or tapering to a blunt end, sharply triangular, with nearly equal sides. Three to six 3-sided chambers, uniform, with shallow, very weakly curved sutures and sharp angles; only the last chamber shows somewhat convex faces and rounded angles. They have the form of a 3-sided pyramid, whose rounded apex bears the round simple aperture. Surface of the test rough. Very rare.

Remarks.—This species somewhat resembles *T. deadericki*, new species, from the Annona chalk of Arkansas, in general shape and the relatively high and somewhat rounded later chambers. It differs in having more distinct angles and somewhat convex sides instead of the slightly concave sides and broadly rounded angles of the American species.

Types and occurrence.—Originally described from the upper Senonian (Mucronatenkreide) marl at Hilgenberg bei Hamm, Westphalia, Germany. It was also recorded from the upper Senonian of Westphalia by Franke.

Hypotype of figure 22 (U.S.N.M. No. P988) from the upper Senonian, Dasbeck bei Hamm, Germany. Collected by A. Franke and given to the U. S. National Museum by C. I. Alexander.

TRIPLASIA RUGOSISSIMA (Alexander and Smith)

Plate 7, figures 6a-9

Frankina rugosissima ALEXANDER and SMITH, 1932, Journ. Paleontol., vol. 6, No. 4, p. 311, pl. 47, figs. 12-13.—CUSHMAN, 1946, U. S. Geol. Surv. Prof. Pap. 206, p. 25, pl. 4, figs. 13-14.

Test free, large, flaring from the base, later with nearly parallel sides, with a small planispiral coil at the base which is apparently obsolete in some specimens (fig. 9), the major portion of the test uniserial and triangular in section, occasionally quadrate (fig. 6), angles sharp, sides moderately excavated; chambers broad, gently arched; sutures obscure, but discernible on some specimens; wall coarsely arenaceous, surface rough with many fragments of shells, fish bones,

occasional ostracod carapaces, glauconite and other dark mineral grains mixed with the large quartz grains, in a ground mass of finer material; aperture terminal, elongate.

Length of holotype (fig. 7), 3.75 mm.; breadth, 1.85 mm. Length of quadrate hypotype of figure 6, 2.47 mm.; breadth, 1.12 mm. Length of hypotype of figure 9, 3.59 mm.; breadth, 1.61 mm. Other hypotypes range in length from 0.96 to 3.85 mm.

Remarks.—Alexander and Smith stated that this species occurred only in the lower middle Taylor and was geographically restricted to southern Texas. We have specimens that are identical in all characteristics from the Saratoga and Annona chalks of Arkansas. This is one of the largest and most coarsely agglutinated species of this genus.

Types and occurrence.—Holotype (fig. 7, U.S.N.M. No. P993), paratypes figured by Alexander and Smith (1932, pl. 47, fig. 12; U.S.N.M. No. P994), and unfigured paratypes (Cushman coll. No. 17851) all from about 150 feet above the base of the Upper Cretaceous Taylor clay, in a gully north of the Austin-Manor highway, near the east end of the long bridge over Walnut Creek, 6.0 miles northeast of Austin, Travis County, Tex. Collected by C. I. Alexander.

Unfigured hypotypes (U.S.N.M. No. P995) from the Upper Cretaceous Saratoga chalk from the top of Devil's Backbone, Howard County, Ark. Collected by W. H. Deaderick.

Unfigured hypotypes (U.S.N.M. No. P996) from the Annona chalk at the Ozan contact, 2.8 miles south of the Brownstown cross-roads on the east side of the road to White Cliffs, Ark. Collected by W. H. Deaderick.

Hypotypes of figures 6, 8, 9 (U.S.N.M. Nos. P997a-c) and unfigured hypotypes (U.S.N.M. No. P998) from a natural erosion of the Annona chalk about 0.5 mile north of the White Cliffs Post Office, Ark. Collected by W. H. Deaderick.

TRIPLASIA TAYLORENSIS (Cushman and Waters)

Plate 6, figures 6-13

Frankeina taylorensis CUSHMAN and WATERS, 1929, Contr. Cushman Lab. Foram. Res., vol. 5, p. 63, pl. 10, figs. 3a-b.—ALEXANDER and SMITH, 1932, Journ. Paleontol., vol. 6, No. 4, p. 310, pl. 47, figs. 7, 9.—CUSHMAN, 1946, U.S. Geol. Surv. Prof. Pap. 206, p. 25, pl. 5, figs. 1-2.

Test free, large, elongate, somewhat flaring, planispiral coil very small or obsolete, uniserial portion generally triangular, occasionally quadrate (about 0.9 percent of the specimens observed), sides moderately excavated, angles acute; chambers numerous, low and broad,

increasing very little in height but increasing somewhat in breadth in the early portion so that the test is flaring at first, but later has nearly parallel sides, final chamber somewhat higher than the preceding; sutures distinct, slightly depressed, gently arched on the sides, recurved at the angles; wall arenaceous, of uniformly sized, moderately coarse grains of quartz with a scattering of dark mineral grains, surface even, but very granular in appearance; aperture terminal, slitlike, not produced.

Length of holotype (fig. 8), 2.13 mm.; breadth, 0.96 mm. Length of hypotype of figure 6, 3.61 mm.; breadth, 1.56 mm.; thickness, 1.51 mm. Length of hypotype of figure 7, 3.46 mm.; breadth, 1.40 mm. Length of hypotype of figure 9, 1.51 mm.; breadth, 0.62 mm. Length of hypotype of figure 10, 3.17 mm. Length of hypotype of figure 11, 3.77 mm.

Remarks.—Among the holotype, three paratypes, and 437 hypotypes, there are four quadrate specimens, the remainder being triangular. The species is characterized by its large size, acute angles, excavated faces, low chambers and reduced early coil.

Types and occurrence.—Holotype (fig. 8, Cushman coll. No. 12033) and paratype (Cushman coll. No. 12034) from the Upper Cretaceous Taylor marl at 360 feet depth, and paratypes (Cushman coll. No. 12035) from the Taylor marl at a depth of 365 feet, all from the Sun Oil Company, Martindale D 10, in Caldwell County, Tex.

Hypotypes figured by Alexander and Smith, 1932 (U.S.N.M. No. P999) from the upper Taylor marls, in the bank of a small stream 200 yards south of the bridge on Pierce's Lane, 1.5 miles southeast of Del Valle, in Travis County, Tex. Collected by C. I. Alexander.

Hypotypes of figures 6, 7, 9-13 (U.S.N.M. Nos. P1000a-g) and unfigured hypotypes (U.S.N.M. No. P1001) from the upper Taylor marl, in the right bank of Onion Creek, just downstream from the bridge at Moore and Berry's Crossing, 8.5 miles southeast of the State Capitol building, in Austin, Travis County, Tex. Collected by Helen Tappan Loeblich and Alfred R. Loeblich, Jr.

Hypotypes (U.S.N.M. No. P1002) from the Upper Cretaceous Annona chalk, about 0.5 mile north of the White Cliffs Post Office, Ark. Collected by W. H. Deaderick.

Hypotypes (U.S.N.M. No. P1003) from the Annona chalk, about 0.5 mile west of the road between Brownstown and White Cliffs, and about 1.7 miles south of Brownstown, Ark. Collected by W. H. Deaderick.

Hypotypes (U.S.N.M. No. P1004) from the Annona chalk, 1.0 mile south of Yancey, on the east side of the road to Columbus, in Hempstead County, Ark. Collected by W. H. Deaderick.

TRIPLASIA SARATOGENSIS Loeblich and Tappan, new species

Plate 7, figures 10a-11b

Test free, narrow and elongate, of nearly uniform breadth for most of its length, triangular to quadrate in section, sides nearly flat to slightly concave, angles broadly rounded; chambers usually indistinct, with a coil of about three chambers at the base, followed by uniserial chambers, final chamber slightly produced to the aperture; sutures indistinct, occasionally visible and gently arched on the faces of the test; wall arenaceous, of medium to coarse grains in a finer ground mass, surface moderately rough in appearance; aperture terminal, ovate.

Length of holotype, 2.47 mm.; breadth, 0.91 mm. Length of quadrate paratype, 2.76 mm.; breadth, 0.75 mm. Other paratypes range from 1.01 to 3.25 mm. in length.

Remarks.—This species differs from *Triplasia cushmani* (Alexander and Smith) in being longer and comparatively more narrow, and in having a less well-defined coil and less-depressed sutures. The sides are also flat, while those of *T. cushmani* are excavated and the angles sharper. *Triplasia rugosissima* (Alexander and Smith) has a larger, much broader and more flaring test. *T. deadericki*, new species, has a smaller test, with higher chambers and much more constricted sutures.

Types and occurrence.—Holotype, figure 10 (U.S.N.M. No. P1005), quadrate paratype of figure 11 (U.S.N.M. No. P1006), and unfigured paratypes (U.S.N.M. No. P1007) from the Saratoga chalk, at the top of Devil's Backbone, in Howard County, Ark. Collected by W. H. Deaderick.

Unfigured paratypes (U.S.N.M. No. P1008) from the Saratoga chalk, in natural erosion just west of Saratoga, Howard County, Ark. Collected by W. H. Deaderick.

Unfigured paratypes (U.S.N.M. No. P1009) from the Saratoga chalk, on the north side of the road, at the top of a high hill, 2.0 miles east of the junction of Highways 73 and 55 in Saratoga, Howard County, Ark. Collected by W. H. Deaderick.

Unfigured paratypes (U.S.N.M. No. P1010) from the Saratoga

chalk, on the east side of the road, just north of Saratoga, Howard County, Ark. Collected by W. H. Deaderick.

Unfigured paratypes (U.S.N.M. No. P1011) from the Saratoga chalk, on the south side of the road to Columbus, 2.0 miles east of Saratoga, Howard County, Ark. Collected by W. H. Deaderick.

Unfigured paratypes (U.S.N.M. No. P1012) from the Saratoga chalk, on the east side of Highway 29, 1.8 miles south of Blevins, 13.5 miles north of Hope, Hempstead County, Ark. Collected by W. H. Deaderick.

Unfigured paratypes (U.S.N.M. No. P1013) from the Saratoga chalk, on the east side of Highway 4, on the road to Ozan, 3.1 miles north of Washington, Hempstead County, Ark. Collected by W. H. Deaderick.

TRIPLASIA species

Plate 7, figures 12a, b

Frankina sp. ISRAELSKY, 1951, U. S. Geol. Surv. Prof. Pap. 240-A, p. 12, pl. 3, figs. 5-8.

Test free, of medium size, with a large planispiral coil of about five chambers, followed by a few uniserial chambers with nearly parallel margins and triangular in section, the two angles in the plane of coiling more prominent and the third angle less elevated, sides flat, angles rounded; chambers low and broad; sutures radiate in the coil, slightly arched on the faces of the triangular portion, distinct and slightly depressed; wall coarsely arenaceous, with occasional dark mineral grains, surface rough in appearance; aperture terminal, elongate.

Length of figured specimen, 1.69 mm.; breadth of coil, 0.73 mm.; greatest breadth of triserial portion, 0.68 mm.

Remarks.—This species resembles *T. glenrosensis*, new species, in the large coil and less prominent third angle. It differs in having lower chambers, more acute angles and more coarsely arenaceous and more roughly finished wall. The species is represented by a single specimen, and because a single specimen often is not representative of the complete species of this variable genus, this form has not been named.

Types and occurrence.—Figured specimen (U.S.N.M. No. 560500) from the Lodo formation (Paleocene and Eocene in age), greenish-gray, silty calcareous claystone, 960 feet below the Middle Eocene Domengine formation, sec. 29, T. 15 S., R. 12 E., northwest Tumey Hills, Fresno County, Calif. Collected by M. C. Israelky.

TRIPLASIA FUNDIBULARIS (Harris and Jobe)

Plate 7, figures 13a-14b

Frankeina fundibularis HARRIS and JOBE, 1951, Microfauna of basal Midway outcrops near Hope, Arkansas, p. 7, pl. 1, figs. 8a-c.

Test free, of medium size for the genus, elongate, with a large early planispiral portion and later triangular portion, sides moderately to deeply excavated, angles acute; chambers increasing in size as added, low and broad, slightly arched on the faces, extending downward at the angles; sutures distinct, slightly depressed; wall very coarsely arenaceous, incorporating smaller Foraminifera and organic fragments with the sand and other mineral grains, surface rough; aperture terminal, rounded.

Length of hypotype of figure 13, 1.87 mm.; breadth, 0.99 mm. Length of hypotype of figure 14, 1.27 mm.; breadth, 0.62 mm. Other hypotypes range from 1.09 to 1.98 mm. in length.

Remarks.—Only a few specimens (seven in all) were available to the writers, and all of these were triangular. It is probable that a very large suite of specimens would show the quadrate or flattened modifications. This species differs from *Triplasia* species, here figured from the Paleocene Lodo formation of California, in being more flaring and more sharply angled, and in having a somewhat smaller planispiral portion and more highly arched sutures.

Types and occurrence.—The holotype (deposited in the University of Oklahoma collection), figured hypotypes (U.S.N.M. Nos. P1014a, b) and unfigured hypotypes (U.S.N.M. No. P1015) are all from the Paleocene Midway formation, 1.25 miles south of Terre Rouge Creek on State Highway 29, 5 miles north of Hope, sec. 9, T. 12 S., R. 24 W., Hempstead County, Ark. Collected by Mrs. Billye Jobe.

TRIPLASIA ANDRAEI (Liebus)

Text figure 11

Haplophragmium andraei LIEBUS, 1911, Sitzb. Akad. Wiss. Wien, math.-naturw. Kl., vol. 120, pt. 1, p. 940, text figs. 5a-c.

Original description (translation from German):

The test is over 1.5 mm. long, and very coarsely agglutinated, so that the chamber arrangement is almost completely obscured from the exterior. The center of the test's breadth is very highly elevated, in certain places so strongly inflated that it has the appearance of padding, extending from about one-eighth of the distance from the base of the test almost six-eighths of the entire length. The ends of this swelling slope very sharply down to the remaining upper surface of the test. At the end of the test is found a short projection, bearing a somewhat broad and distended aperture.

First in the development one observes 5 chambers spirally arranged in the older portion of the test, to which the remaining uniserial ones are then joined; concerning the relationship to *Haplophragmium* there can be no doubt. None of the previously known forms of this genus show a 4-sided cross section caused by the inflated swelling and the flattening of the surrounding area.

The form also varies somewhat, however, and these variations do not show the inflated elevation of the broad side to such a height as the example here

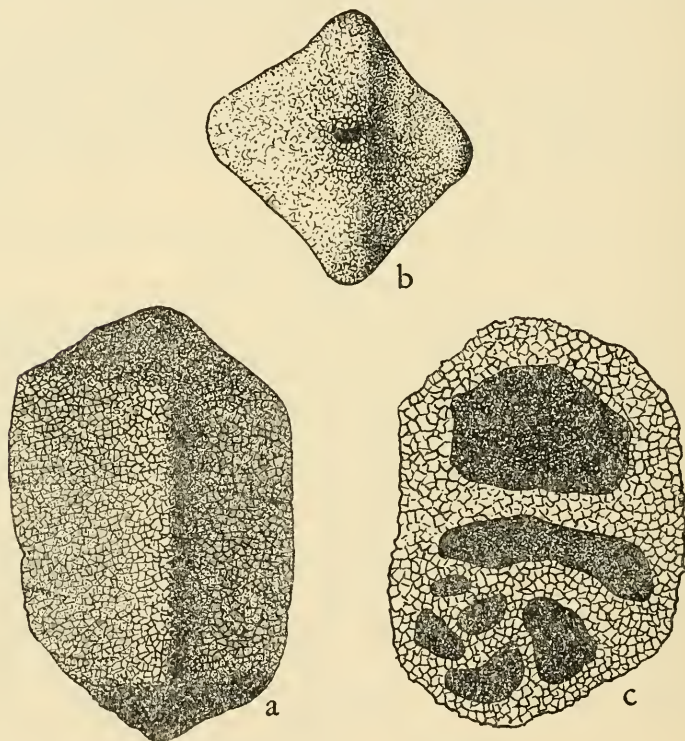


FIG. 11.—*Triplasia andraei* (Liebus): a, Side view of holotype. b, Top view, showing aperture and quadrate section. c, Sectional view, showing early coil followed by uniserial chambers. (After Liebus.)

figured. These specimens tend toward the form that Andrae recorded under the name *Haplophragmium humboldti* Reuss var. *latum*, n. var. A comparison with the former occurrence of *H. humboldti* Reuss shows that an eventual gradation of Andrae's form into the true *H. humboldti* Reuss does not exist. The typical *H. humboldti* Reuss is somewhat compressed in its older portion but has, however, without exception, a round cross section in the younger uniserial portion, whereas in the present form the younger part still earlier demonstrates a strong beveling of the test.

For the present, as long as the material is still rare—there are 4 specimens observed—I consider this species as identical with the form that Andrae de-

scribed as *H. humboldti* Reuss var. *latum* although differing from the true *H. humboldti* Reuss and propose as a new designation *Haplophragmium andraei*.

For these *Haplophragmiums* that at the end are composed of uniserially arranged chambers, Cushman has recently proposed the name *Ammobaculites*, whereas he placed the completely enrolled forms in *Haplophragmoides*. According to this definition the preceding would be known as *Ammobaculites andraei* n. sp.

Remarks.—The nomenclature of this species is quite complicated. As quoted above, Liebus proposed this specific name, figuring a definite quadrate *Triplasia*, but in his description stating that it was identical to *H. humboldti* Reuss var. *latum* Andrae.

On this basis, Ellis and Messina (Catalogue of Foraminifera) refer to the present species as *Haplophragmium andraei* Liebus, 1911, nom. nov. If the species had been so described, the type of Andrae's species would have thus become the type for the new name and Liebus would have had no basis for proposing a new specific name, but should have elevated Andrae's variety *latum* to specific rank. Liebus's name thus would be a synonym for *Haplophragmium latum* (Andrae).

However, Liebus erroneously considered Andrae's variety to be conspecific, as the latter is not angular in section, but ovate, and as it has horizontal sutures in this compressed uniserial portion it should thus be placed in *Ammobaculites*.

Furthermore, Liebus described his species under the heading *n. sp.* and not *nom. nov.*, and his specific description referred to the quadrate specimen he figured (shown here in text figure 11) and not to the specimens of Andrae. Therefore, it was apparently his intent to describe a new species for his quadrate specimen, and in fact in the last paragraph of his discussion he stated that it might belong to *Ammobaculites* and would be known then as *Ammobaculites andraei*, new species. Therefore his name is here recognized as a valid specific name for this quadrate *Triplasia*.

Occurrence.—Middle Eocene beds in a well at the village of Kolarine, northern Dalmatia.

TRIPLASIA HUNGARICA (Majzon)

Plate 8, figures 1a-c

Centenarina hungarica MAJZON, 1948, Földtani Közlöny, vol. 78, p. 24, figs. 1, 1a, 1b.

The following is a free translation from the Hungarian:

In the first stage of development appears a flat planispiral portion of four to five chambers and later there is a uniserial development of arched chambers

which are rectangular in cross section. Their number cannot be determined exactly because of the rough sandy material of the test. They form approximately four concave rectangular prisms that are somewhat produced terminally where the aperture is slit-shaped. The sutures in the coiled portion are radial and in the 4-sided prismatic portion they are somewhat arched.

Length, 1.6 mm. ; width, 0.65 mm.

Remarks.—This species was described as the type species of the genus *Centenarina* Majzon, but the latter name is a junior synonym of *Triplasia* and is here suppressed. *T. hungarica* resembles quadrangular forms of *T. variabilis* (see pl. 8, figs. 5, 9) in shape, excavation of sides, and slitlike aperture, but is only one-half as large and has a more inflated early portion.

Occurrence.—(Translation) “It is found in the Farkasreti cemetery in Budapest, in the fourth foraminiferal horizon of the Rupelian (Oligocene) strata.”

TRIPLASIA TRIGONA (Andrae)

Haplophragmium humboldti (Reuss) var. *trigona* ANDRAE, 1890, Mitt. geol. Landesanst., Alsace-Lorraine, vol. 3, No. 1, p. 116.

The original description (translation from German) states, “This variety differs from the typical form in that the last chambers become triangular, as are many *Clavulinas* and *Tritaxias*.”

Remarks.—As *Spirolina humboldti* Reuss is an *Ammobaculites*, and the triangular section of this “variety” places the present form in *Triplasia*, Andrae’s varietal name is here raised to specific rank. Unfortunately this species has never been figured, and no specimens were available to the writers.

Types and occurrence.—Middle Oligocene, Septarienthon, Lobsann and Sulz unterm Wald, Unter-Elsass. The types are deposited in the collection of the Geologische Landesanstalt of Alsace-Lorraine, Strassbourg, France.

TRIPLASIA MARWICKI Loeblich and Tappan, new species

Plate 8, figures 2-4b

Test free, large, elongate, planispiral coil not evident, early portion flaring, later triangular to quadrate in section, sides flat to slightly excavated, angles rounded; chambers low in the early portion, increasing somewhat in height as added; sutures obscure, gently arched at the center of the faces, recurved at the angles; wall arenaceous, with occasional very large grains incorporated in the main body of

finer-grained material, surface rather smoothly finished; aperture a terminal slit.

Length of holotype (fig. 4), 3.59 mm.; breadth, 1.53 mm. Length of small paratype of figure 2, 1.69 mm.; breadth, 1.33 mm. Length of paratype of figure 3, 3.04 mm.; breadth, 1.51 mm.

Remarks.—This species is named in honor of Dr. J. Marwick, Director of the New Zealand Geological Survey, in recognition of his work on the Upper Cretaceous and Tertiary of New Zealand.

It differs from *T. rugosissima* (Alexander and Smith) in being broader with less concave sides and lower chambers, and in lacking the slight neck of the Cretaceous species.

Types and occurrence.—Holotype (U.S.N.M. No. P1016) and unfigured paratype (U.S.N.M. No. P1017) from the Miocene of Kawhia, New Zealand. Paratypes of figures 2 and 3 (U.S.N.M. Nos. P1018a, b) and unfigured paratype (U.S.N.M. No. P1019) from the Miocene of Motutura, New Zealand.

TRIPLASIA MINUTA (Reuss)

Plate 7, figures 16a-17b

Rhabdognium minutum REUSS, 1867, Sitzb. Akad. Wiss. Wien, math.-naturw. Kl., vol. 55, pt. 1, p. 85, pl. 5, figs. 4a-5b.

not *Rhabdognium minutum* REUSS, BRADY, 1884, Rep. Voy. *Challenger*, Zool., vol. 9, p. 526, pl. 67, figs. 4-6.

Original description (translation from German):

In this species with very fragile margins two very different principal forms may be distinguished. One is larger as a rule, inverted-ovate in side view, wider above than below, quite often considerably elongated, often irregularly twisted. The surface of the shell is rougher above.

Other tests are, on the other hand, often more regularly oval, tapering at both ends, generally regularly formed and with even margins. In all cases, however, the three lateral angles are thin, flangelike, the sides concave. The development of the uniserial chambers lying in a straight line one on another is only sporadically indicated by the very slight, transverse, gently curved furrows. The terminal round aperture is small, often indistinct. From this, in the individuals which are broader above, extend three fine, short furrows which lie upon the upper thicker portion of the angles.

In appearance this species, which is found to be common in Salzhone, is very close to *Tritaxia tricarinata* Reuss from the Upper Cretaceous.

Remarks.—This species has not been seen by the writers, but is here considered to belong to *Triplasia*, on the basis of Reuss's figures and descriptions and because he referred it to *Rhabdognium* (of which he was the author, proposing it to supersede *Triplasia* when

he found some specimens to be quadrate). It is the only Miocene species of this genus previously described.

Occurrence.—Miocene, Salzthone, at Wieliczka, Galizien, Poland.

TRIPLASIA WRIGHTI (De Amicis)

Plate 7, figures 18a-b

Haplophragmium wrighti DE AMICIS, 1895, Natur. Siciliano, Palermo, Ann. 14 (1894-95), Nos. 4-5, p. 58, pl. I, figs. 12a-b.

This species was described as having an initial spire, followed by uniserial triangular chambers. The coil is comparatively large, the sides of the triangular portion flat to slightly convex, and the angles unusually sharp, the uniserial portion has parallel margins and strongly constricted sutures. The aperture is terminal and rounded. The type is 2.8 mm. in length and only a single specimen was found.

Remarks.—This is the only Pliocene species recorded. It somewhat resembles *T. römeri* in the large coil, and rather high, slightly inflated uniserial chambers, with parallel margins. It differs in having much sharper angles, and is about one-third larger.

Type and occurrence.—Type specimen from the Lower Pliocene of Bonfornello, presso Termini-Imerese, Sicilia, Italy.

TRIPLASIA VARIABILIS (Brady)

Plate 8, figures 5-9b

Verneuilina variabilis BRADY, 1884, Rep. Voy. *Challenger*, Zool., vol. 9, p. 385, pl. 47, figs. 21-24.

not *Ammobaculites variabilis* Brady, FRANKE, 1928, Abh. preuss. geol. Landesanst., Berlin, N.S., No. 111, p. 166, pl. 15, figs. 6a-b.

Test large, small specimens or early portion of larger ones flaring, later portion nearly parallel-sided, triangular to quadrangular in section, and a few specimens may lack the third angle and be flattened, angles acute, sides moderately excavated, chambers numerous, broad and low, gently arched; sutures obscure to well marked and slightly depressed; wall coarsely arenaceous, surface rough; aperture a terminal slit, only very slightly produced, if at all.

Brady gave the length as 3 mm. The hypotype here shown in figure 5 is 2.86 mm. in length and 1.43 mm. in breadth. Length of hypotype of figure 7, 3.80 mm., and breadth, 1.85 mm. Length of hypotype of figure 9, 3.77 mm.; breadth, 2.11 mm.

Remarks.—Brady described this species as typically triangular, but stated that it was polymorphic: "Of the numberless modifications of

the typical structure, the most common are . . . those . . . in which the test is more or less quadrate and . . . in which it loses to some extent its ternate character in the other direction and presents during part of its growth only two marginal edges. No specific or even varietal distinction can be drawn between these forms; and . . . every intermediate condition is common." Brady thus figured triangular and quadrate specimens as well as the flattened forms resembling *Flabellammina*. A parallel development is shown in the Lower Cretaceous *Triplasia incerta* (Alexander and Smith), some of which show a *Flabellammina* stage of varying length before the third angle appears, and in the Lower Jurassic *Triplasia kingakensis* which also has flattened, triangular, and quadrate forms.

Franke (1928, p. 166) referred to this species Upper Cretaceous specimens (Senonian) but placed the species in the genus *Ammobaculites*. His specimens seem closer to *Triplasia murchisoni* Reuss, however.

Majzon (1948, p. 24) in describing a 4-sided species as the type for his genus *Centenarina*, stated in footnotes (free translation from the Hungarian), "In my opinion, Brady's *Verneuilina variabilis* is *Frankeina*," and "One of Brady's figures of the above mentioned *V. variabilis* may possibly belong to *Centenarina*."

Thus these specimens figured by Brady have been variously referred to the genera *Verneuilina* (by Brady), *Ammobaculites* (Franke, 1928, p. 166), *Triplasia* (Bartenstein and Brand, 1937, p. 185), *Frankeina* (Majzon, 1948, p. 24), and *Centenarina* (Majzon, 1948, p. 24).

Types and occurrence.—Brady's types from the coral sands of Kandavu, Fiji Islands, at 210 fathoms, are in the British Museum at South Kensington and in the Brady collection in the Museum of Comparative Anatomy at Cambridge, England. Figured hypotypes (U.S.N.M. Nos. P1020a-e) and unfigured hypotypes (U.S.N.M. No. P1021) from *Challenger* station 174-D, from coral sands at 210 fathoms, off Kandavu, Fiji Islands, at lat. 19°6' S., long. 178°14' 20" E., collected March 8, 1874.

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EXPLANATION OF PLATES

PLATE I. Jurassic, Neocomian *Triplasia*

- | | Page |
|--|------|
| Figs. 1-8. <i>Triplasia kingakensis</i> Loeblich and Tappan, new species..... | 7 |
| 1, Side view of flattened paratype (U.S.N.M. No. P267a) showing <i>Flabellammina</i> -like character. 2a, Side view of quadrate megalospheric paratype (U.S.N.M. No. P267b) showing large planispiral coil, and the less-prominent fourth angle. 2b, Top view of quadrate specimen showing rounded aperture and less-prominent fourth angle. 3, Side view of elongate and narrow paratype (U.S.N.M. No. P267c). 4a, Side view of holotype (U.S.N.M. No. P266), showing rapidly flaring test, and small coil of the microspheric generation. 4b, Top view of holotype showing moderately excavated sides, slightly lower third angle, and rounded aperture. 5, Side view of smaller paratype (U.S.N.M. No. P267d) showing large megalospheric coil. 6, Side view of paratype (U.S.N.M. No. P267e) showing loss of third angle in the final chamber with reversion to the <i>Flabellammina</i> type of development. 7, Side view of paratype (U.S.N.M. No. P267f) showing <i>Flabellammina</i> -like form, with a third angle suggested in the terminal chamber. 8, Side view of paratype (U.S.N.M. No. P267g) with well-developed coil and later triangular portion. All $\times 27$. From the Lower Jurassic Kingak formation, northern Alaska. | |
| Fig. 9. <i>Triplasia bartensteini</i> Loeblich and Tappan, new species..... | 8 |
| Side view of holotype, showing deeply excavated sides and flaring test (after Bartenstein and Brand), $\times 30$. Middle Jurassic (Dogger Epsilon) of northwestern Germany. | |
| Fig. 10. <i>Triplasia elegans</i> (Mjatliuk)..... | 11 |
| Side view of holotype, showing narrow, elongate test, slight excavation of sides, and broadly rounded angles (after Mjatliuk), $\times 30$. Upper Jurassic of Saratov District, U.S.S.R. | |
| Figs. 11a, b. <i>Triplasia jurassica</i> (Mjatliuk)..... | 11 |
| 11a, Side view of holotype, showing flattened character, with the third angle developed only in the early portion of the test. 11b, Edge view (after Mjatliuk), $\times 30$. Upper Jurassic of Saratov District, U.S.S.R. | |
| Figs. 12a-16. <i>Triplasia commutata</i> (Loeblich and Tappan)..... | 9 |
| 12a, Side view of holotype (U.S.N.M. No. 106017) showing large planispiral coil and more narrow triangular uniserial portion. 12b, Top view, showing rounded aperture, $\times 27$, from the Rierdon formation (Upper Jurassic, Callovian) of Wyoming. 13, Side view of young paratype (U.S.N.M. No. 106021) showing coil and first triangular chamber, $\times 27$, from the Rierdon formation of Montana. 14, Side view of hypotype (U.S.N.M. No. P885), $\times 22$, from the Redwater formation (Upper Jurassic, Oxfordian) of Wyoming. 15, Side view of narrow microspheric paratype | |

(U.S.N.M. No. P880), $\times 22$, from the Rierdon formation of Wyoming. 16, Side view of hypotype (U.S.N.M. No. P894), $\times 22$, from the Swift formation (Upper Jurassic, Oxfordian) of Montana.

Figs. 17a-21b. *Triplasia georgsdorfensis* (Bartenstein and Brand)..... 12

17a, Side view of "holotype" of *T. emslandensis emslandensis* showing large irregular coil, and triangular later portion. 17b, View of side showing regularly arched sutures. 17c, Cross section (after Bartenstein and Brand), $\times 25$, Upper Valendian of Germany. 18, Side view of small hypotype of "*Tetraplasia georgsdorfensis*" (U.S.N.M. No. P896a) with almost obsolete coil, quadrate section, and slightly tapering final chamber, $\times 22$, from the upper Valendian of Germany. 19a, Side view of paratype of "*Triplasia emslandensis emslandensis*," showing more elongate form, with final chamber tapered as in the preceding quadrate form. 19b, Top view (after Bartenstein and Brand), $\times 35$, from the lower Hauterivian of Germany. 20a, Side view of hypotype of "*Triplasia emslandensis emslandensis*" (U.S.N.M. P897) showing the distinct similarity of the triangular and quadrate specimens. 20b, Top view, $\times 22$, from the lower Hauterivian of Germany. 21a, Side view of quadrate hypotype (U.S.N.M. No. P896b) showing early planispiral coil and quadrate later chambers, gently arched sutures, nearly parallel sides and distinct similarity of shape of chambers to those of the preceding triangular figured specimen. 21b, Top view, showing somewhat less excavation of the sides than figure in 20, but approximately the same as in figure 19, $\times 22$, from the upper Valendian (Lower Cretaceous) of Germany.

PLATE 2. Neocomian, Albian *Triplasia*

Figs. 1a-4b. *Triplasia pseudoroemeri* Bartenstein and Brand..... 15

1a, Side view of holotype, showing straight sides, high chambers, and rounded angles. 1b, Top view, showing nearly flat sides (after Bartenstein and Brand), $\times 30$, from the upper Valendian of Germany. 2a, Side view of quadrate form, the holotype of "*Tetraplasia quadrata*," showing similarity to the triangular form in the much-reduced coil, parallel sides, very slightly arched sutures, broad rounded angles, and nearly flat sides. 2b, Top view, showing ovate aperture (after Bartenstein and Brand), $\times 25$, upper Valendian of Germany. 3a, Side view of paratype of *T. pseudoroemeri*. 3b, Cross section of early portion showing nearly flat to slightly convex sides. 3c, Top view, showing slightly concave sides of the later portion, and ovate aperture (after Bartenstein and Brand), $\times 30$, upper Valendian-lower Hauterivian of Germany. 4a, Side view of juvenile form figured by Eichenberg, showing similarity to the types of this species. 4b, Top view (after Eichenberg), $\times 25$, Hauterivian of Germany.

- | | Page |
|---|------|
| Figs. 5a-c. <i>Triplasia grosserugosa</i> ten Dam..... | 14 |
| 5a, Side view of holotype, showing coarsely arenaceous test. 5b, Face view showing very slightly arched sutures and elevated final chamber. 5c, Top view, showing nearly flat sides and ovate aperture (after ten Dam), $\times 30$, Hauterivian of the Netherlands. | |
| Figs. 6a, b. <i>Triplasia acuta</i> Bartenstein and Brand..... | 12 |
| 6a, Side view of holotype, showing sharp angles, slightly flaring test, and moderately arched sutures. 6b, Top view, showing flange-like angles, excavated sides, and slitlike aperture (after Bartenstein and Brand), $\times 30$, upper Valendian of Germany. | |
| Figs. 7a-13b. <i>Triplasia glenrosensis</i> Loeblich and Tappan, new species.... | 17 |
| 7a, Side view of holotype (U.S.N.M. No. P899), a large triangular specimen. 7b, Top view, showing slitlike aperture. 8, Side view of paratype (U.S.N.M. No. P900a) showing triangular early development of the uniserial chambers and loss of the third angle in the later stages, with reversion to a <i>Flabellammina</i> -type of growth. 9, Side view of paratype (U.S.N.M. No. P900b) showing planispiral coil, triangular development, and rounded terminal chamber which has lost the angularity, showing a tendency toward the <i>Ammobaculites</i> type of growth. 10, Side view of quadrate paratype (U.S.N.M. No. P900c) showing one side somewhat narrower than the opposite. 11, Side view of paratype (U.S.N.M. No. P900d) which has lost the angularity in the final chamber. 12, Side view of small triangular paratype (U.S.N.M. No. P900e). 13a, Side view of quadrate paratype (U.S.N.M. No. P900f). 13b, Top view, showing quadrate section and rounded aperture. All $\times 22$. From the Glen Rose formation (Lower Cretaceous, Albian) of Texas. | |
| Figs. 14a-20. <i>Triplasia goodlandensis</i> (Cushman and Alexander)..... | 18 |
| 14a, Side view of quadrate topotype (U.S.N.M. No. P902a). 14b, Top view, showing moderate excavation of the sides. 15, Side view of small megalospheric topotype (U.S.N.M. No. P902b). 16, Side view of small, narrow, megalospheric topotype (U.S.N.M. No. P902c). 17, Side view of small megalospheric topotype (U.S.N.M. No. P902d) showing large coil. 18, Side view of small microspheric topotype (U.S.N.M. No. P902e) showing more flaring test. 19, Side view of larger microspheric topotype (U.S.N.M. No. P902f) showing early coil, flaring test and very strongly recurved sutures. 20a, Side view of large microspheric topotype (U.S.N.M. No. P902g) showing planispiral coil, with a few flattened <i>Flabellammina</i> chambers before the triangular development and the rapid flaring of the triangular portion. 20b, Top view, showing acute angles and rounded aperture. All $\times 48$. From the Goodland formation (Lower Cretaceous, Albian) of Texas. | |
| Figs. 21-22b. <i>Triplasia mexicana</i> Loeblich and Tappan, new species..... | 15 |
| 21, Side view of small paratype (U.S.N.M. No. P1023) showing small coil and gently arched sutures. 22a, Side view of holotype (U.S.N.M. No. P1022) showing flared test. 22b, Top view, | |

showing moderately excavated sides and ovate aperture. $\times 22$. From the Barrill Viejo shale (Lower Cretaceous, Hauterivian) of Coahuila, Mexico.

PLATE 3. Albian *Triplasia*

- Figs. 1-13. *Triplasia incerta* (Alexander and Smith)..... 21
- 1, Side view of hypotype (U.S.N.M. No. P931), showing typical *Flabellamina*-like early portion, with third angle developed in the last one-third of the test, $\times 10$. From the Fort Worth formation (Lower Cretaceous, Albian) of Texas. 2, Side view of hypotype (U.S.N.M. No. P925a) from the Duck Creek formation (Lower Cretaceous, Albian) of Oklahoma, showing elongate *Flabellamina* stage, $\times 22$. 3, Side view of broad and elongate hypotype (U.S.N.M. No. P930) from the Kiamichi formation (Lower Cretaceous, Albian) of Texas, with very short triangular portion, $\times 22$. 4, Side view of hypotype (U.S.N.M. No. P933) showing an unusually long triangular portion and narrow test, from the Fort Worth formation of Texas, $\times 22$. 5, Side view of hypotype (U.S.N.M. No. P932) from the Fort Worth formation of Oklahoma, $\times 10$. 6, Side view of hypotype (U.S.N.M. No. P928a) from the Denton formation (Lower Cretaceous, Albian) of Texas, $\times 22$. 7a, Side view of holotype (U.S.N.M. No. P924) from the Fort Worth formation of Texas. 7b, Edge view, showing compressed test and low ridgelike third angle. 7c, View of rounded aperture. $\times 22$. 8a, Side view of quadrate hypotype (U.S.N.M. No. P926) from the Weno formation (Lower Cretaceous, Albian) of Texas, showing coil and early development of third angle. 8b, Edge view, showing insertion of fourth angle approximately halfway up the test. 8c, Top view, showing elongate aperture. $\times 22$. 9, Side view of elongate hypotype (U.S.N.M. No. P929) from the Kiamichi formation of Texas, $\times 22$. 10, Side view of small hypotype (U.S.N.M. No. P927) from the Fort Worth formation of Texas, $\times 22$. 11, Side view of small hypotype (U.S.N.M. No. P925b) from the Duck Creek formation of Oklahoma showing more rapid development of third angle, $\times 22$. 12, 13, Side views of hypotypes (U.S.N.M. Nos. P928b, c) from the Denton formation of Texas, $\times 22$.
- Figs. 14-20c. *Triplasia rugosa* (Alexander and Smith)..... 27
- 14, Side view of hypotype (U.S.N.M. No. P955) showing well-developed planispiral coil, later triangular uniserial portion with final chamber tending to become rounded. 15a, Side view of triangular hypotype (U.S.N.M. No. P956a). 15b, Top view. 16a, Side view of quadrate hypotype (U.S.N.M. No. P956b). 16b, Top view. Figures 14-16 $\times 22$. From the Duck Creek formation of Oklahoma. 17a, Side view of compressed topotype (U.S.N.M. No. P954a), showing *Flabellamina*-like character also found in the holotype. 17b, Top view. 18a, Side view of topotype (U.S.N.M. No. P954b) showing triangular development of the final chamber.

18b, Edge view. 19, Side view of topotype (U.S.N.M. No. P954c) with well-defined planispiral coil, followed by a flattened uniserial portion which becomes triangular in the last two chambers. Figures 17-19 $\times 27$. 20a, Side view of holotype (U.S.N.M. No. P952) showing flattened development which led to its original description as a *Flabellammina*. 20b, Edge view showing degree of compression. 20c, Top view, showing slightly elongate aperture. $\times 22$. Figures 17-20 from the Duck Creek formation of Texas.

PLATE 4. Albian *Triplasia*

- Figs. 1-9. *Triplasia acutocarinata* (Alexander and Smith)..... 19
 1, Side view of hypotype (U.S.N.M. No. P906) from the Kiamichi formation of Texas. 2, Side view of unusually broad hypotype (U.S.N.M. No. P1025) from the Fort Worth formation of Oklahoma. 3, Side view of large flaring hypotype (U.S.N.M. No. P907) from the Duck Creek formation of Texas. 4, 7, Side view of hypotypes (U.S.N.M. Nos. P909a,b), from the Weno formation of Texas. 5a, Side view of topotype (U.S.N.M. No. P904), showing early planispiral coil and produced final chamber. 5b, Top view, showing a more elongate aperture than is typical. 6a, Side view of holotype (U.S.N.M. No. P903). 6b, Top view, showing flangelike angles and rounded aperture. Figures 5 and 6 from the Duck Creek formation of Texas. 8a, Side view of quadrate hypotype (U.S.N.M. No. P909c). 8b, Top view, showing the narrow angles typical of the species, and the rounded aperture. From the Weno formation of Texas. 9, Side view of long and narrow hypotype (U.S.N.M. No. P908) from the Denton formation of Texas. All figures $\times 22$.
- Figs. 10-15b. *Triplasia wenoensis* (Alexander and Smith)..... 28
 10-12, Side views of hypotypes (U.S.N.M. Nos. P959 a-c), showing small size, flaring test, and roughly finished wall. 13, Side view of larger hypotype (U.S.N.M. No. P958). 14a, Side view of holotype (U.S.N.M. No. P957), showing small size, rounded angles, and moderately excavated sides. 14b, Top view, showing rounded aperture. 15a, Side view of quadrate hypotype (U.S.N.M. No. P959d). 15b, Top view, showing moderately excavated sides. All figures $\times 22$. From the Weno formation of Texas.

PLATE 5. Albian to Senonian *Triplasia*

- Figs. 1a-7. *Triplasia insolita* (Alexander and Smith)..... 24
 1a, Side view of holotype (U.S.N.M. No. P934), showing triangular character of early portion grading into a quadrate later portion. 1b, Top view, showing rounded aperture. 2a, Side view of topotype (U.S.N.M. No. P936a), showing early planispiral coil and later *Flabellammina*-stage before development of the third angle. 2b, Edge view, showing flattened character of coil and early arched chambers with abrupt thickening in the later development. 3a, Side view of topotype (U.S.N.M. No. P936b), showing quadrate de-

velopment immediately after the planispiral stage. 3b, Edge view, showing compressed early portion and abrupt thickening. Figures 1-3 from the Duck Creek formation (Lower Cretaceous, Albian) of Texas. 4, Side view of small hypotype (U.S.N.M. No. P940) from the Weno formation (Lower Cretaceous, Albian) of Texas. 5, Side view of hypotype (U.S.N.M. No. P938a) from the Main Street formation (Lower Cretaceous, Albian) of Texas. 6, Side view of hypotype (U.S.N.M. No. P939) from the Fort Worth formation (Lower Cretaceous, Albian) of Texas. 7, Side view of hypotype (U.S.N.M. No. P938b) from the Main Street formation of Texas. All figures $\times 22$.

- Figs. 8-15. *Triplasia nodosa* Loeblich and Tappan, new species..... 25
- 8, Small triangular paratype (U.S.N.M. No. P944a) showing early coil and produced final chamber, from the Grayson formation (mid-Cretaceous, Cenomanian) of Texas. 9, 10, Larger triangular paratypes (U.S.N.M. Nos. P942a-b) from the Grayson formation of Oklahoma, with the latter specimen losing the third angle in the later chambers. 11, Paratype (U.S.N.M. No. P949), showing early coil followed by a flattened uniserial portion, the triangular development appearing only in the last half of the test. From the Main Street formation (Lower Cretaceous, Albian) of Texas. 12a, Side view of holotype (U.S.N.M. No. P941), showing typical triangular development and extended neck. 12b, Top view, showing triangular section. From the Grayson formation of Oklahoma. 13a, Quadrate paratype (U.S.N.M. No. P947) showing constricted sutures and nodose appearance of the pyriform later chambers. 13b, Top view, showing quadrate section. From the Main Street formation of Texas. 14, 15, Triangular paratypes (U.S.N.M. Nos. P944b-c), showing angular nodose tests and much-produced neck. From the Grayson formation of Texas. All figures $\times 22$.
- Figs. 16-17c. *Triplasia murchisoni* Reuss..... 30
- 16, Face view of narrow paratype, showing gently arched sutures. 17a, Side view of holotype, a flared specimen. 17b, Face view. 17c, Top view, showing slightly excavated sides, subacute angles, and rounded aperture (after Reuss). Approximately $\times 10$. Lower Senonian or Turonian of Austria.
- Figs. 18-20b. *Triplasia beisseli* (Marie)..... 32
- 18, 19a, Side views of typical triangular hypotypes (topotypes of *Haplophragmium murchisoni* of Beissel (U.S.N.M. Nos. P963, P964), showing regular planispiral coil and gradually enlarging test. 19b, Top view, showing slight excavation of sides, rounded angles, and slit aperture. Both $\times 10$. From the Mucronaten-Kreide (upper Senonian) of Germany. 20a, Side view of quadrate hypotype (U.S.N.M. No. P967), showing basal coil, very slightly enlarging test, and gently arched sutures. 20b, Top view, showing quadrate section, excavated sides, and slit aperture. $\times 22$. From the lower Senonian of Germany.
- Figs. 21a-22b. *Triplasia römeri* (Reuss)..... 38
- 21a, Side view of holotype, showing rounded base, nearly parallel

margins and sharp angles. 21b, Face view, showing weakly curved sutures, and comparatively high chambers. 21c, Top view, showing somewhat convex sides of the later portion and the rounded aperture (after Reuss), approximately $\times 16$. Mucronaten-Kreide (upper Senonian) of Germany. 22a, Side view of hypotype (U.S.N.M. No. P988), showing basal coil, slightly curved test with nearly parallel margins, and high narrow chambers. 22b, Top view. $\times 22$. From the upper Senonian of Germany.

PLATE 6. Senonian *Triplasia*

Figs. 1-5. *Triplasia deadericki* Loeblich and Tappan, new species..... 35

1, Side view of compressed paratype (U.S.N.M. No. P981), which is *Flabellamina* in character, showing low early chambers and the higher and rounded final chamber. 2, Side view of paratype (U.S.N.M. No. P979a) with planispiral early portion, followed by triangular uniserial portion, and last chambers becoming higher and rounded in section. 3a, Side view of holotype (U.S.N.M. No. P978), showing typical triangular form with moderately excavated sides and higher rounded final chamber. 3b, Top view, showing ovate aperture, and excavated sides of triangular portion. 4a, Side view of small quadrate paratype (U.S.N.M. No. P979b), showing early coil and comparatively low early quadrate chambers. 4b, Top view, showing quadrate section. 5, Side view of small paratype (U.S.N.M. No. P979c) with rounded final chamber. All $\times 22$. From the Annona chalk of Arkansas.

Figs. 6-13. *Triplasia taylorensis* (Cushman and Waters)..... 39

6, Side view of hypotype (U.S.N.M. No. P1000a) showing a typical large flaring specimen, with broad low chambers. 7a, Side view of hypotype (U.S.N.M. No. P1000b) which is coiled at the base, then triangular in section, and becomes quadrangular in the last half of the test. 7b, Top view, showing quadrate section. Figures 6-7 $\times 10$. From the upper Taylor marl of Texas. 8, Holotype (Cushman coll. No. 12033), a smaller form, which is otherwise typical of the species, $\times 22$. From the Taylor marl of Texas. 9a, Side view of small quadrate hypotype (U.S.N.M. No. 1000c), showing typical flaring test. 9b, Top view showing sharp angles, excavated sides, and slit aperture. 10a, 11, 12, Side view of regularly flaring triangular hypotypes (U.S.N.M. Nos. P1000d-f). 10b, Top view, showing excavated sides and slit aperture. Figures 9-12, $\times 10$. 13, Side view of small quadrate hypotype (U.S.N.M. No. P1000g), $\times 22$. Figures 9-13 from the upper Taylor marl of Texas.

Figs. 14-19b. *Triplasia plummerae* Loeblich and Tappan, new species..... 36

14, Side view of paratype (U.S.N.M. No. P984a), showing flaring triangular test, broad and low early chambers, and higher and somewhat rounded final chamber. 15a, Side view of quadrate paratype (U.S.N.M. No. P984b), showing gently arched sutures. 15b, Top view, showing flat to moderately excavated sides. 16, Side view of triangular paratype (U.S.N.M. No. P984c). 17a, Side view of quad-

rate paratype (U.S.N.M. No. P984d). 17b, Top view, showing nearly flat sides and slit aperture. 18, Side view of paratype (U.S.N.M. No. P984e). 19a, Side view of holotype (U.S.N.M. No. P983), showing broad and low early chambers, and higher, rounded final chamber with slight neck. 19b, Top view, showing nearly flat sides and slit aperture. All $\times 10$. From the upper Taylor marl of Texas.

PLATE 7. Senonian to Pliocene *Triplasia*

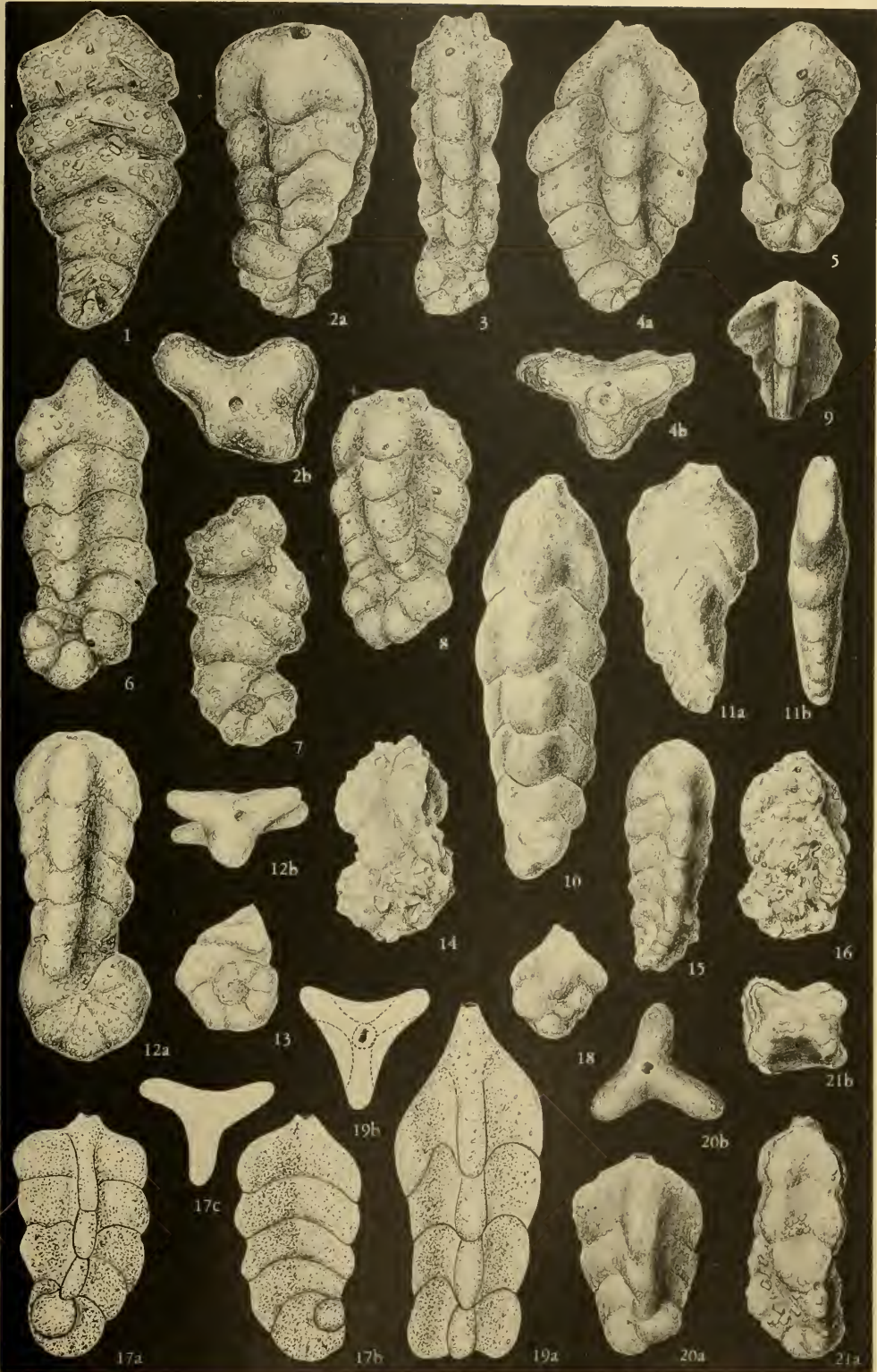
- Figs. 1a-5. *Triplasia cushmani* (Alexander and Smith)..... 34
 1a, Hypotype (U.S.N.M. No. P969) showing early planispiral coil and triangular later portion. 1b, Top view, showing acute angles and excavated sides and slit aperture. From the Annona chalk (Upper Cretaceous, Senonian) of Arkansas. 2, Side view of coarsely arenaceous holotype (U.S.N.M. No. P989), showing early coil and broad low triangular chambers, from the Pecan Gap (Upper Cretaceous, Senonian) of Texas. 3a, Side view of large quadrate hypotype (U.S.N.M. No. P991), 3b, Top view, showing excavated sides and slit aperture. From the Annona chalk of Arkansas. 4, 5, Small hypotypes (U.S.N.M. Nos. P971a-b) from the Ozan sand (Upper Cretaceous, Senonian) of Arkansas. All $\times 22$.
- Figs. 6a-9. *Triplasia rugosissima* (Alexander and Smith)..... 38
 6a, Side view of quadrate hypotype (U.S.N.M. No. P997a). 6b, Top view, showing nearly flat sides and slit aperture. From the Annona chalk of Arkansas. 7a, Side view of holotype (U.S.N.M. No. P993), showing coarsely arenaceous test, triangular uniserial portion, and somewhat flattened final chamber. 7b, Top view, showing slit aperture. From the Taylor clay of Texas. 8, 9, Side view of hypotypes (U.S.N.M. Nos. P997b-c) from the Annona chalk of Arkansas. All $\times 10$.
- Figs. 10a-11b. *Triplasia saratogensis* Loeblich and Tappan, new species.... 41
 10a, Holotype (U.S.N.M. No. P1005), showing typical triangular form, and subparallel margins. 10b, Top view, showing slightly convex sides and broadly rounded angles, and ovate aperture. 11a, Side view of quadrate paratype (U.S.N.M. No. P1006), showing moderately excavated sides in the early portion and nearly flat sides in the later portion. 11b, Top view, showing flattened sides, quadrate section, and ovate aperture. From the Saratoga chalk (Upper Cretaceous, Maestrichtian) of Arkansas. $\times 22$.
- Figs. 12a, b. *Triplasia* species..... 42
 12a, Side view of specimen (U.S.N.M. No. 560500), showing early coil and later triangular portion. 12b, Top view, showing slit aperture. $\times 22$. From the Lodo formation (Paleocene and Eocene) of California.
- Figs. 13a-14b. *Triplasia fundibularis* (Harris and Jobe)..... 43
 13a, Side view of large hypotype (U.S.N.M. No. P1014a), showing broad, low chambers, flaring test, and excavated sides. 13b, Top view. 14a, Side view of smaller hypotype (U.S.N.M. No. P1014b),

showing broadly rounded base and gently arched sutures. 14b, Top view. $\times 27$. Topotypes from the Midway formation (Paleocene) of Arkansas.

- Fig. 15. *Triplasia abkhasicus* (Keller)..... 31
Holotype, showing early planispiral coil and triangular uniserial portion, with rounded angles (after Keller). Approximately $\times 27$. From the lower Senonian (Campanian) of the western Caucasus, U.S.S.R.
- Figs. 16a-17b. *Triplasia minuta* (Reuss)..... 47
16a, Face view of holotype, showing absence of a distinct coil and gently arched uniserial chambers. 16b, Side view, showing grooved angles described by Reuss, but which may be due to breakage of the fragile, very acute angles. 16c, Top view, showing very sharply angled test and deeply excavated sides. 17a, Face view of more flared paratype. 17b, Side view (after Reuss). From the Miocene of Poland.
- Figs. 18a-b. *Triplasia wrighti* (De Amicis)..... 48
18a, Side view of holotype, showing large coil and comparatively narrow triangular uniserial portion with nearly parallel margins and broad, low, slightly arched chambers. 18b, Top view, showing slightly convex sides and ovate aperture (after De Amicis), $\times 16$. From the lower Pliocene of Italy.

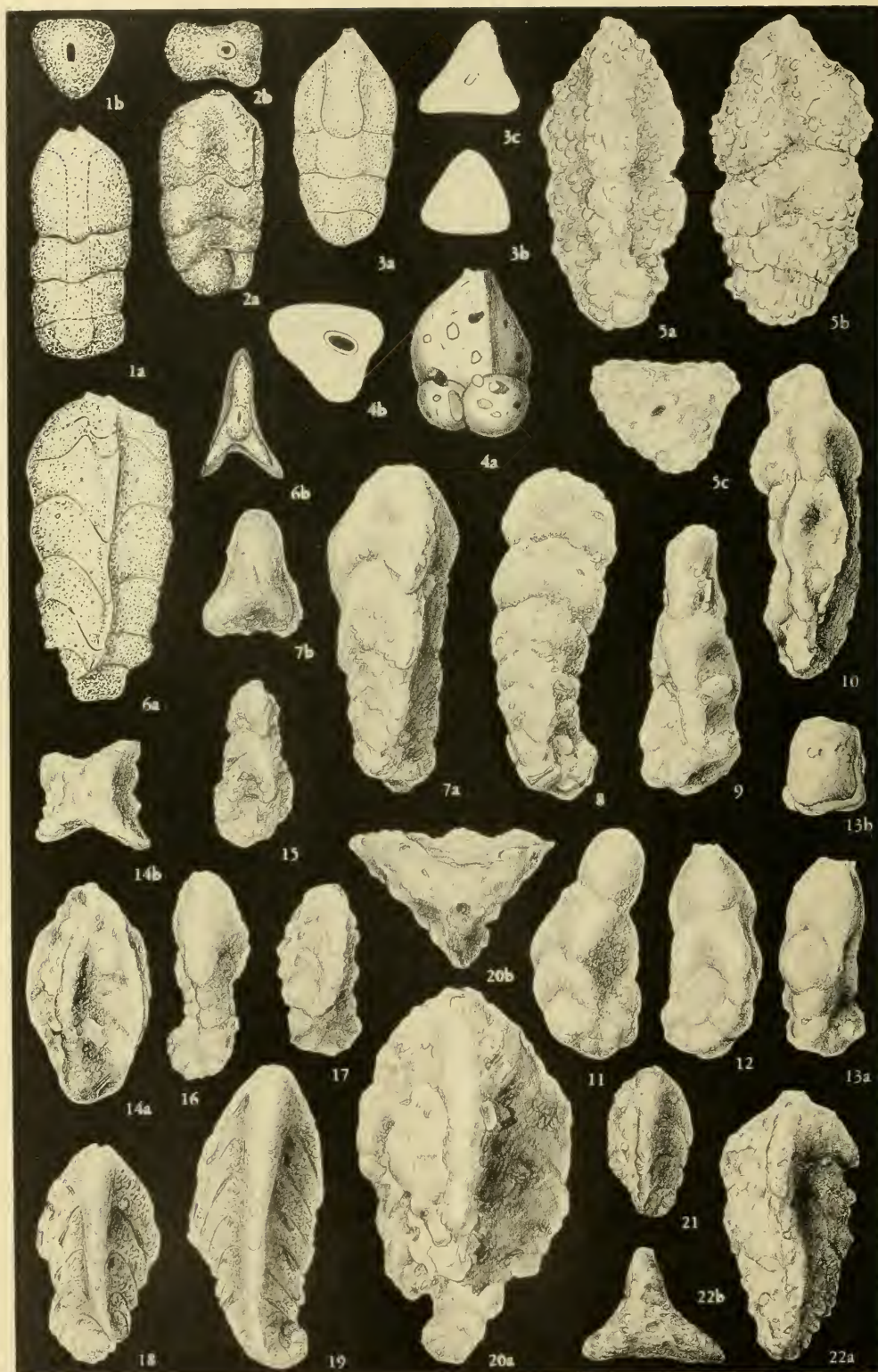
PLATE 8. Oligocene to Recent *Triplasia*

- Figs. 1a-c. *Triplasia hungarica* (Majzon)..... 45
1a, Side view of quadrate holotype, showing large planispiral coil and broad, low, quadrate uniserial chambers. 1b, Face view, showing compression of the planispiral coil and arched sutures of the uniserial portion. 1c, Top view, showing excavated sides and ovate aperture (after Majzon). $\times 28$. From the Oligocene of Hungary.
- Figs. 2-4b. *Triplasia marwicki* Loeblich and Tappan, new species..... 46
2, Side view of small paratype (U.S.N.M. No. 1018a), showing flared test and arched sutures. 3a, Side view of larger paratype (U.S.N.M. No. P1018b). 3b, Top view. Both from the Miocene of Motatura, New Zealand. 4a, Side view of holotype (U.S.N.M. No. P1016). 4b, Top view. From the Miocene of Kawhia, New Zealand. All $\times 15$.
- Figs. 5-9b. *Triplasia variabilis* (Brady)..... 48
5, Side view of small quadrate hypotype (U.S.N.M. No. P1029a). 6, Side view of small triangular hypotype (U.S.N.M. No. P1029b). 7a, Side view of large triangular hypotype (U.S.N.M. No. P1029c). 7b, Top view showing sharp angles, concave sides, and slit aperture. 8, Side view of small hypotype (U.S.N.M. No. P1029d), 9a, Side view of large quadrate hypotype (U.S.N.M. No. P1029e), showing arched sutures. 9b, Top view, showing quadrate section and slit aperture. All $\times 15$. From coral sands at 210 fathoms, off Kandavu, Fiji Islands.



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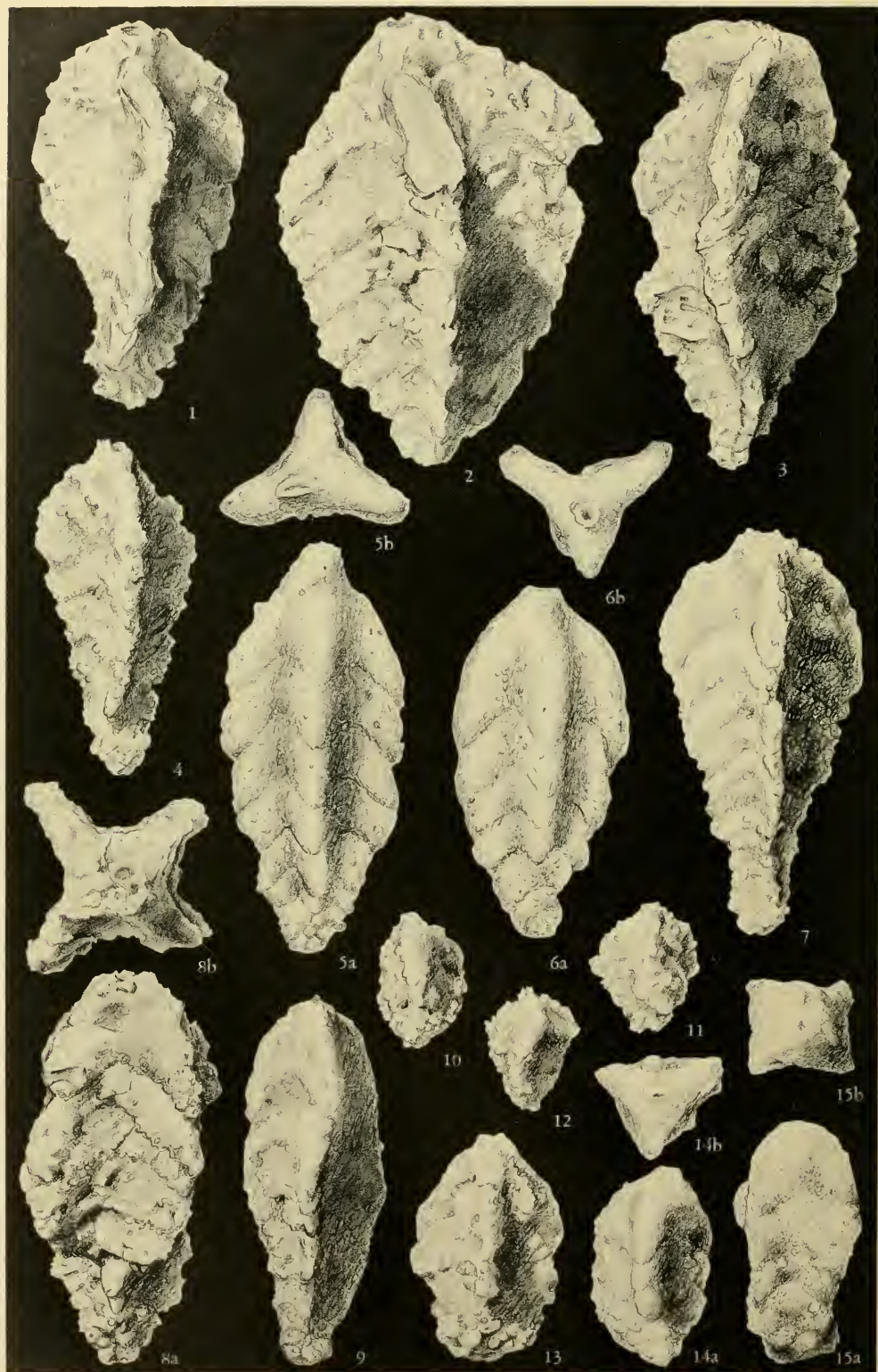


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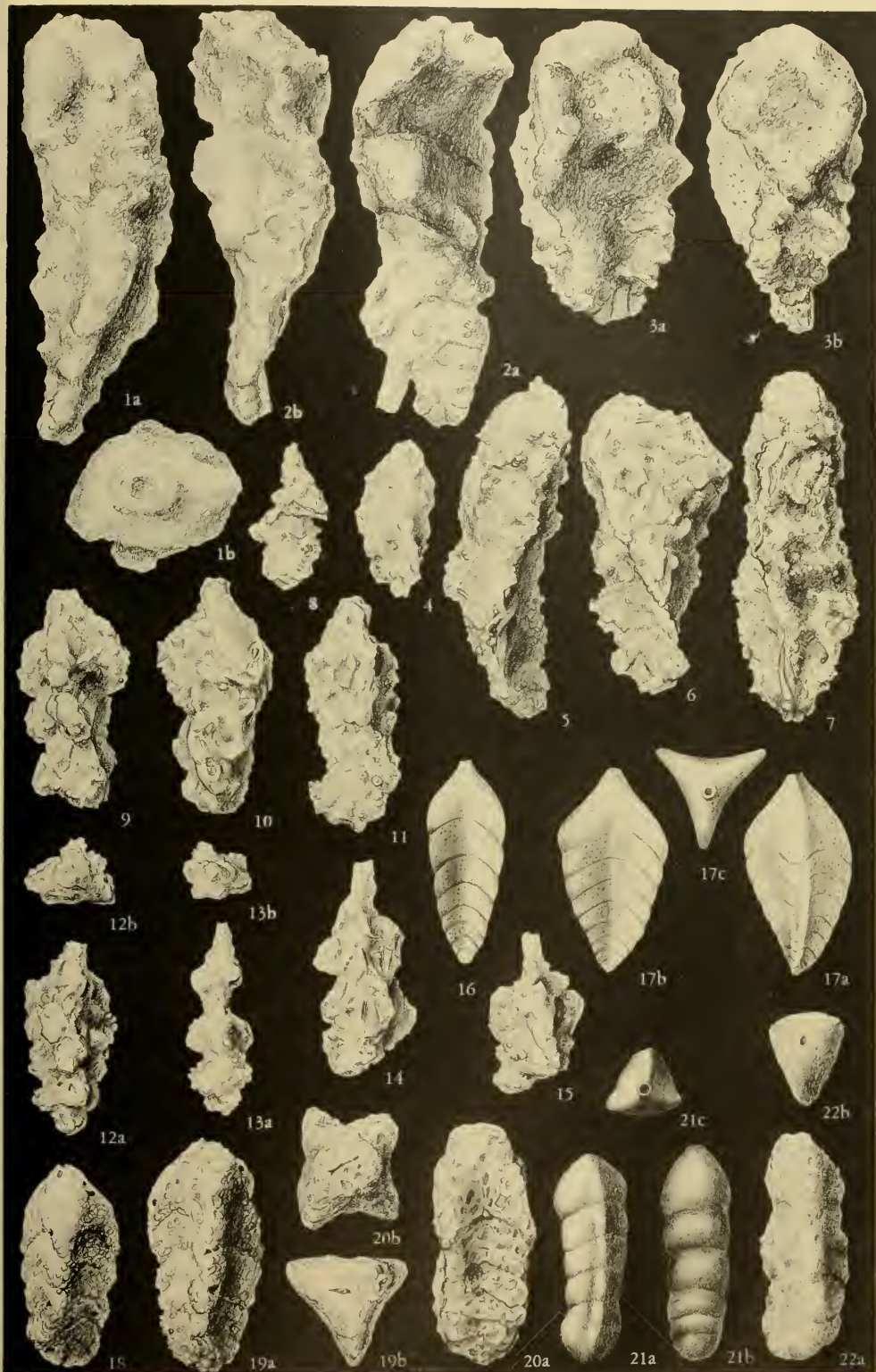
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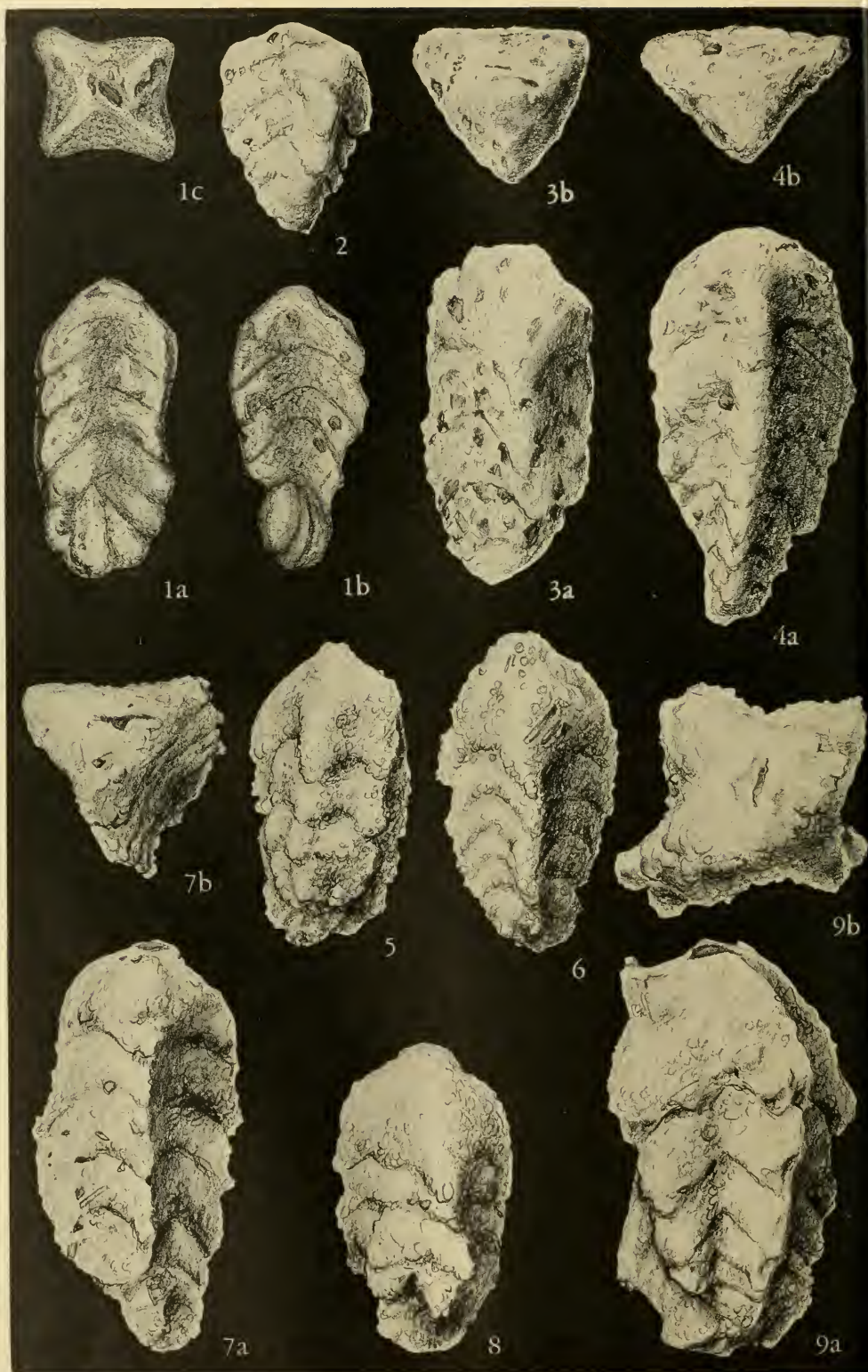
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