Late Paleozoic Foraminifera From Southern Chile

GEOLOGICAL SURVEY PROFESSIONAL PAPER 858

Prepared in cooperation with the Instituto de Investigaciones Geologicas of Chile and the Agency for International Development, U.S. Department of State

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By RAYMOND C. DOUGLASS *and* MERLYND K. NESTELL

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The southernmost fusulinid fauna known in the world shows affinities to Andean faunas

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1976

UNITED STATES DEPARTMENT OF THE INTERIOR

THOMAS S. KLEPPE, *Secretary*

GEOLOGICAL SURVEY

V. E. McKelvey, *Director*

Library of Congress Cataloging in Publication Data

Douglass, Raymond Charles.

Late Paleozoic Foraminifera from southern Chile.

(Geological Survey professional paper ; 858)

Prepared in cooperation with the Instituto de Investigaciones Geológicas of Chile and the U.S. Agency for International Development.

Bibliography: p.

Includes index.

Supt. of Docs. no. : I 19.16:858

1. Foraminifera, Fossil. 2. Palentology—Paleozoic. 3. Paleontology—Chile. I. Nestell, Merlynd K., joint author. II. Chile. Instituto de Investigaciones Geológicas. III. United States. Agency for International Development. IV. Title. V. Series: United States. Geological Survey. Professional paper ; 858.

QE772.D614 563'.1 74–20682

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402
Stock Number 024-001-2653-8

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LATE PALEOZOIC FORAMINIFERA FROM SOUTHERN CHILE

By Raymond C. Douglass and Merlynd K. Nestell [1]

ABSTRACT

Fusulinids are unusual in the Southern Hemisphere. They are present in northern Brazil, Ecuador, Peru, and Bolivia to about lat 18° S. but are unknown in any of the marine deposits of late Paleozoic age between Bolivia and southern Chile. Fusulinids were recognized in 1952 in southern Chile in limestones quarried on Isla Guarello. In 1955, Cecioni reported the discovery of the fusulinids *Millerella* and *Profusulinella* from Isla Doñas (lat 50°43'S.) and a sequence from *Fusulinella* to *Schwagerina* from the archipelago Madre de Dios. The present study is based on additional samples from the islands of Guarello and Tarlton of this archipelago. The forms described are of Late Pennsylvanian and Early Permian age. A rather large fauna of fusulinids and other Foraminifera includes 11 genera and 24 species. Ten species are new, four are referred to forms previously described from the Bolivia and Peru areas, and the remainder are unassigned.

INTRODUCTION

PREVIOUS WORK

Although the presence of limestones in the Patagonian archipelago of southern Chile was reported in 1883 by Coppinger (see Gerth, 1957), it was not until 1952 that fusulinids were recognized in these rocks. Samples collected from the limestone quarry of the Compania de Acero del Pacifico on the island of Guarello were sent to the Instituto de Geologia in Santiago, Chile. J. Tavera of the Instituto recognized the fusulinids, including a *Triticites* bearing some resemblance to *Triticites boliviensis* Dunbar and Newell 1946, but differing from it in several respects. Thin sections were sent to L. G. Henbest of the U.S. Geological Survey, who recognized a *Triticites* or early *Schwagerina* of Late Pennsylvanian or very Early Permian age. Several smaller Foraminifera were also noted but not identified.

At about the same time, a sample was also sent to the Empressa Nacional del Petroleo, and C. Mordojovich recognized the presence of fusulinids in the sample.

In 1953, G. Cecioni began a study to determine the nature and extent of the upper Paleozoic sediments in the Patagonian archipelago (Cecioni, 1955a, b; 1956). He found fusulinids as far south as Isla Doñas (lat 50° 43′ S.) (fig. 1), which were identified by R. V. Hollingsworth as *Millerella* sp. and *Profusulinella* sp., and as far north as Isla Tarlton (lat 50° 20′ S.), where *Schwagerina* sp. was identified. Intervening localities yielded *Eoschubertella* sp., *Fusulinella-Fusulina* sp., and *Triticites* sp.

CURRENT STUDY

Under the auspices of the Chilean Instituto de Investigaciones Geologicas, Douglass was able to make collections of the limestones exposed on the islands of Guarello and Tarlton in the southern part of the archipelago Madre de Dios in the province of Magallanes in southwesternmost Chile (fig. 2). Five days in late July 1959 were spent along the north edge of Tarlton, the northwest and north edges of Guarello, and the southeast tip of Guarello. The degree of deformation and recrystallization of the limestone varies locally; the best preserved samples were obtained from the northern areas of Tarlton and Guarello. Isla Doñas and the southwestern area of Madre de Dios were not visited because of lack of time and suitable transportation.

The poor preservation of most of the material caused many delays in the preparation of specimens adequate for study. Several people prepared thin sections from the samples, but most of the usable sections were prepared by Richard Margerum, U.S. Geological Survey, and M. K. Nestell. The specimens were measured by Nestell, and the paper was prepared by Douglass.

A summary of the fauna was presented by Douglass and Nestell at the International Symposium on the Carboniferous and Permian Systems in South America (Douglass and Nestell, 1972).

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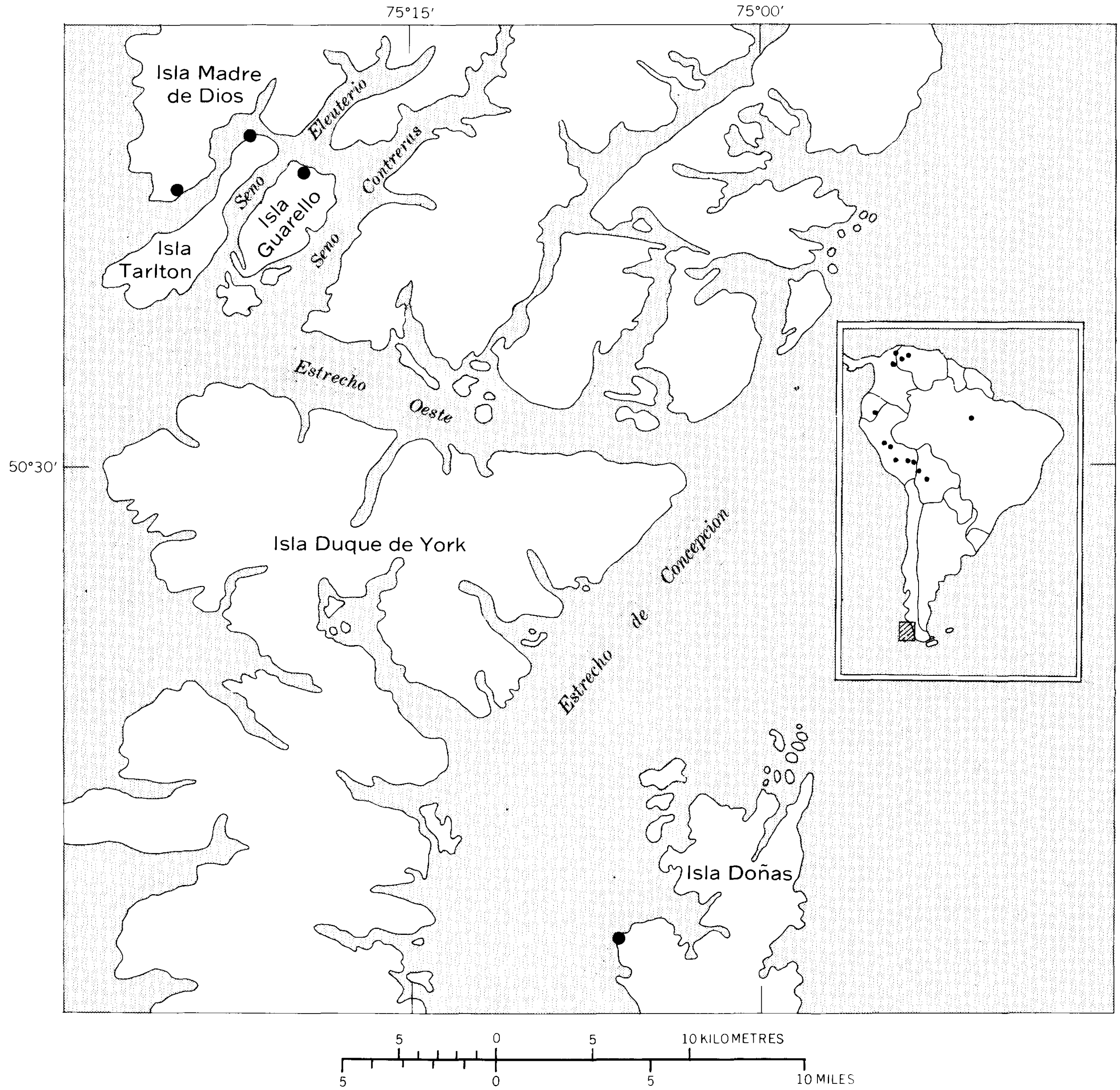


FIGURE 1.—Index map of the Madre de Dios area showing localities from which fusulinids have been reported. Insert shows general location of study area and the other areas in South America from which fusulinids have been reported.

METHODS OF STUDY

The methods used in the study of the material for this report are the same as those described by Douglass (1971, p. 4). The essence of the method is the measurement of attributes at each half volution and the conversion of the data to equivalent values at standard radii by linear interpolation. Specimens are then compared at similar diameters rather than at the same volution number. Summary curves showing the changes of several attributes in relation to the radius are plotted, so that growth patterns, instead of single dimensions, can be compared. Illustrations of several specimens from each taxon are used to show many of the attributes that cannot be reduced to meaningful numerical data at this time.

LOCALITIES

The samples are from two islands in the archipelago Madre de Dios (figs. 1, 2).

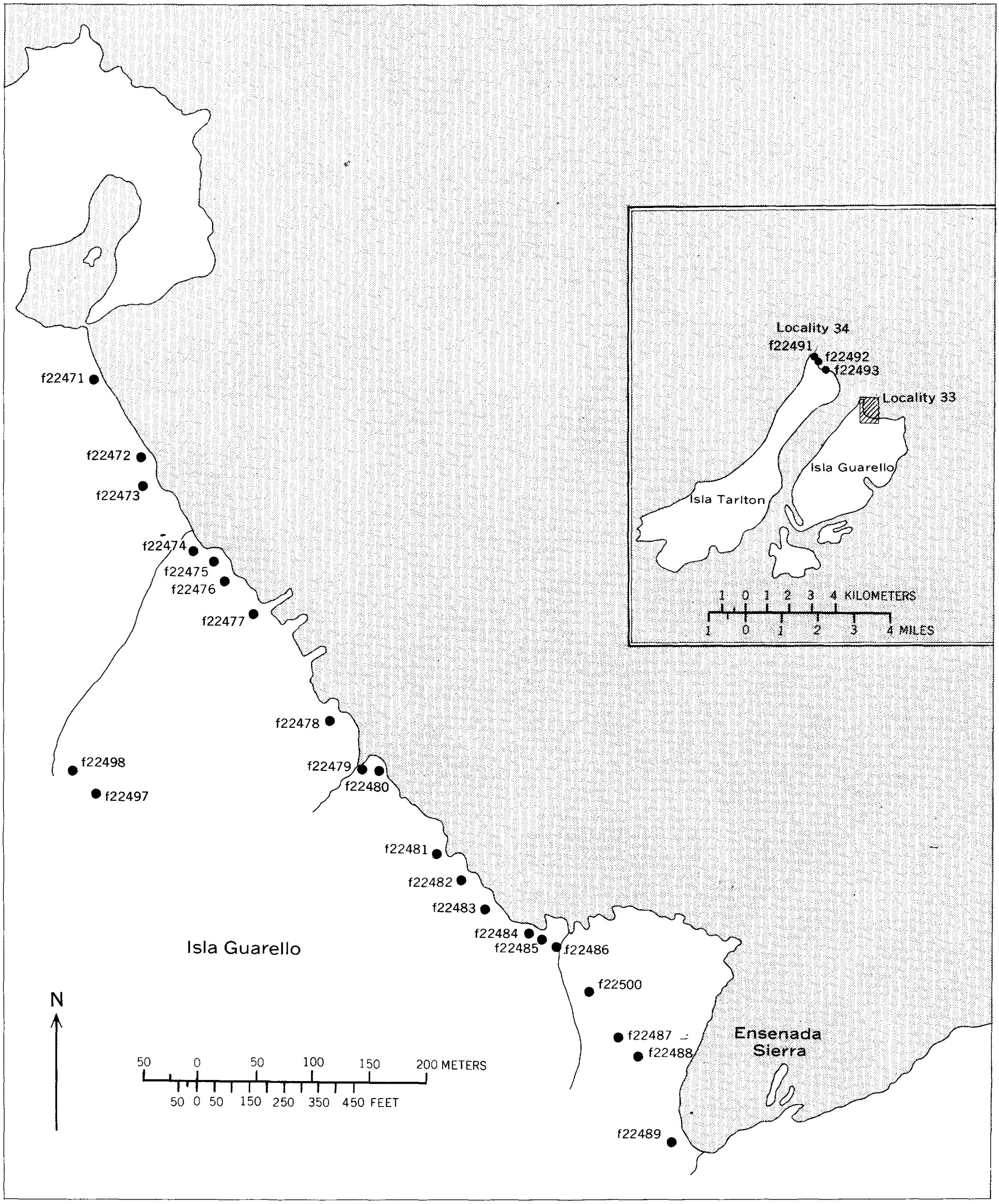


FIGURE 2.—Sampling sites on Isla Tarlton and Isla Guarello. The sites are shown in detail for Isla Guarello, and all sites are described in the section on localities.

Locality 33.—Isla Guarello: Collections were made along the northern edge of the island in the vicinity of the quarry operations. The individual sampling sites are shown in figure 2.

f22471 Near the northwest end of the nearly straight stretch of developed shore at the first lightpost northwest of the boat construction runway that occupies a small inlet. Deformed and fractured *Triticites* sp. (not described) and *Tetrataxis* sp., *Bradyina* sp., and *Climacammina* sp.

f22472 At the northwest corner of the new boat construction runway. *Triticites prima* n. sp., *Bradyina* sp., and *Climacammina* sp.

f22473 At the southwest corner of the new boat construction runway. *Triticites eleuteriensis* n. sp., *Bradyina* sp., and *Climacammina* sp.

f22474 At lightpost on path 30 ft (9 m) from northwest corner of saw shed. *Triticites* sp. (not described).

f22475 South of the saw shed at small promontory southeast of small drainage. *Triticites* sp. aff. *T. titicacaensis* Dunbar and Newell, *Tetrataxis* sp., *Bradyina* sp., and *Climacammina* sp.

f22476 About halfway between the saw shed and the northwestern pier. Deformed and fractured *Triticites* sp. (not described), *Bradyina* sp., and *Climacammina* sp.

f22477 Behind power shed at northwestern pier. Deformed and fractured *Triticites* sp. (not described), *Bradyina* sp., and *Climacammina* sp.

f22478 Just southeast of main entrance to the mine and south of the load docks. Deformed and fractured *Triticites* sp. (not described).

f22479 Below the water tank south of the loading docks and on the south side of the old waterway just east of a small drainage. *Triticites* sp. A, *Tetrataxis* sp., and *Climacammina* sp.

f22480 At small concrete pier southeast of the water tank. *Triticites chilensis* n. sp., *Schubertella* sp., *Bradyina* sp., and *Climacammina* sp.

f22481 Along the trail southeast of the concrete pier at a small reentrant in the coast. Deformed and recrystallized *Triticites*? sp. (not described).

f22482 Along the trail about 20 m past the reentrant to the southeast. *Triticites berryi* (Willard Berry), *Bradyina* sp., and *Climacammina* sp.

f22483 Along the trail about 60 m southeast of the reentrant and 50 m northwest of the beginning of a small peninsula. *Schwagerina patagoniensis* n. sp., *Millerella* sp., *Schubertella* sp., *Bradyina* sp., and *Climacammina* sp.

f22484 Small reentrant at north side of a small wooden pier. *Schwagerina* sp. A, *Tetrataxis* sp., *Bradyina* sp., and *Climacammina* sp.

f22485 Directly across small inlet from small wooden pier. Large deformed and recrystallized fusulinids (not described).

f22486 Along trail just southeast of f22485 and before small drainage. Fragments of *Triticites* sp. and *Schwagerina* sp. (not described).

f22487 Along trail at the top of the grade at a small radio shack and railroad branch. *Triticites* sp. (not described).

f22488 About 10 m southeast of the trail crest and railroad along the trail toward the recreation hall. *Triticites magallanensis* n. sp., *Schubertella* sp., *Bradyina* sp., *Climacammina* sp., and a small solitary coral.

f22489 Just south of the greenhouse at the southwest end of Ensenada Sierra, the only large cove along the northern shore of the island. Recrystallized *Triticites*? sp. (not described).

f22490 This sample is a composite of several pieces from the quarry taken from processed material ready for shipment. The stratigraphic-geographic source is mixed. The fauna is similar to that found in f22497 and f22498.

f22497 Northwest edge of the crest of the glory hole of the quarry. *Triticites guarellensis* n. sp., *Pseudofusulina chilensis* n. sp., *Tetrataxis* sp., *Bradyina* sp., and *Climacammina* sp.

f22498 West edge of the crest of the glory hole of the quarry. *Triticites guarellensis* n. sp., *Pseudofusulina chilensis* n. sp., *Millerella* sp., *Schubertella* sp., *Eoschubertella*? sp., *Bradyina* sp., and *Climacammina* sp.

f22500 At yellow navigation sign post along the trail between sites for f22486 and f22487. *Triticites australis* n. sp., and *Climacammina* sp.

Locality 34.—Isla Tarlton: Collections were made along the northern edge of the northwest end of the island at places where a small boat could approach the shore.

f22491 Northwesternmost tip of the island. *Chalaroschwagerina tarltonensis* n. sp., and an undetermined textularid.

f22492 Southeast of the tip at a salient southeast of the tree cover. *Triticites tarltonensis* n. sp., *Schwagerina* sp. aff. *S. muñaniensis* Dunbar and Newell, and *Pseudofusulina* sp. A.

f22493 Southeast along the coast at the next clear shore at a point where the shoreline bends to the east. *Schwagerina*? aff. *S.*? *patens* Dunbar and Newell.

DISPOSITION OF MATERIAL

The specimens used in this study have been deposited in the collections of the U.S. National Museum (USNM); the specimen numbers are indicated on the plate explanations. The bulk material is filed in the U.S. Geological Survey collections at the U.S. National Museum under the sample numbers listed for localities described above.

ACKNOWLEDGMENTS

Dr. Carlos Ruis F. of the Instituto de Investigaciones Geologicas (Chile) was instrumental in making arrangements for the trip to collect the samples, and the Instituto financed the trip. The staff of the Compania de Acero del Pacifico stationed at Guarello were kind enough to meet the commercial ship in the Concepcion strait and to provide transportation to Guarello; they also provided for all needs during the stay and for return transportation to the ship on its next passage. Richard Margerum did an outstanding job in the preparation of oriented thin sections for

the study and supervised the computer processing of the mensural data, using previously established programs (Douglass and Cotner, 1972). We thank Garner L. Wilde for his careful review of the manuscript.

GEOLOGIC SETTING

REGIONAL SETTING

The paleogeographic development of South America was summarized by Harrington (1962). His maps show an Andean geosyncline paralleling the west coast of South America throughout most of post-Precambrian geologic time. During Middle Pennsylvanian time, marine deposits accumulated in both northern and southern sections of the geosyncline, and an arm of the sea apparently extended inland along the area of the present Amazon River. By Late Pennsylvanian time, the seas had regressed from part of the continent, marine deposition being restricted to Colombia and Venezuela in the north and to the area south and east of Peru. The deposition in the south was predominantly continental, including glacial conglomerates and extensive tillites. Geologists who have studied the area of the western precordillera of Argentina report interbedded glacial and marine deposits of Late Pennsylvania age; however, no glacial deposits were reported for the Patagonian area.

Permian marine deposits extend from Colombia to central Chile and also occur in southern Chile. Harrington (1962, p. 1790) reported that a general amelioration of the climate in the southern part of South America in Early Permian time ended the continental glaciation in that area.

The general similarity of the fusulinid faunas from southern Chile to those from Bolivia and areas north along the Andean geosyncline suggests a shallow seaway connection during Middle Pennsylvanian to Early Permian time. Failure to find sediments (Harrington, 1962) that represent part of this time might be attributed either to subsequent erosion or to original deposition farther west, possibly followed by destruction in a subduction zone.

The absence of fusulinids in the few upper Paleozoic deposits that are found between Bolivia and southern Chile might be explained in terms of temperature tolerance; that is, the sea was warm enough to support some kinds of life, including brachiopods in central Chile (Fuenzalida, 1937, 1940), cephalopods, gastropods, and bivalves (Rocha-Campos, 1971), but not fusulinids. Gerth (1957) suggested that many of the marine deposits in this area represent interglacial transgressions. The environmental requirements of fusulinids are not known, although most authorities believe they preferred warm shallow waters. The known distribution of fusulinids extends over a large range of present latitudes—from 51° S. in Chile to north of 80° N. in Greenland (Ross and Dunbar, 1962). The relationship of the environments of deposition to the poles of the time is still a matter of conjecture. In South America the fusulinid-bearing rocks are peripheral to reported glacial deposits and lie north of them from Bolivia northward, and southwest of them in southern Chile.

LOCAL SETTING

The upper Paleozoic of southern Chile includes large masses of deformed and slightly metamorphosed limestone exposed on some islands of the Patagonian archipelago south of the 50th parallel. Cecioni (1956) reported quartzite and schist interbedded with some of the limestone. He also described several formations composed primarily of coarse to fine clastic rocks showing evidence of lower grade metamorphism and igneous intrusion. Some of the sedimentary rocks were considered by him to show evidence of glacial activity. He suggested that there was evidence of a general deepening of marine environment from east to west—from a Gondwana continental margin to areas of carbonate deposition. The only units for which ages were determined were the limestones that bear fusulinids. These are exposed in the archipelago Madre de Dios and, to a lesser extent, on the east side of Isla Duque de York and Isla Doñas (fig. 1). The available age determinations suggest that the older deposits are to the south and that the strata are progressively younger to the north.

The limestone here studied were all assigned to the Seno Eleuterio Formation by Cecioni (1956, p. 188). This formation spans an age from Middle Pennsylvanian to Early Permian. The parts sampled on the north end of Isla Tarlton are of Early Permian age. The parts sampled on the north end of Isla Guarello include rocks of both Late Pennsylvanian and Early Permian age.

The massiveness of the limestone and its high degree of deformation make determination of the attitude of the bedding difficult. In the areas visited, the strike of beds appears to be east of north, and dips are steeply northwest. Cecioni (1956, p. 200) reported a strike of N. 65° W., but the reading was apparently taken west of Tarlton. The bedding symbol on Guarello, shown on his figure 6 indicates a north-northeast strike and a dip of 80° E., but these measurements were apparently read east of the fusulinid-bearing limestones.

The lithologies present within the limestone sequence are rather restricted. The most common type consists of a fine-grained groundmass containing scattered larger inclusions, generally fusulinids. The fine-grained material in some types is silt, possibly derived from the volcanic rocks nearby; in others, it is fine particles of calcareous material, in part derived from erosion of the faunal elements. Plate 1 illustrates some of the lithologies found including some of the coarser groundmass examples such as calcarenite and pseudo-oolite.

The presence of bryozoans and of corals in some of the samples may be useful in the interpretation of the environment of deposition of the limestone. Unfortunately, only rare single specimens of coral or bryozoan were found. Plate 14, figures 3–6, shows some typical examples.

The original character of much of the limestone is obscured by metamorphism. Plastic distortion of many of the fusulinids is evidence of deformation. A significant amount of recrystallization has also taken place. Some of this is on a fine scale, simply obliterating fine original detail such as the microstructure of the wall of the fusulinids. Other recrystallization has left only the shapes of the fossils, and no fossils can be seen in the more coarsely crystalline limestone.

REVIEW OF THE FAUNAS

MIDDLE PENNSYLVANIAN

The only record available of fusulinids of this age in southern Chile is in the reports of Cecioni (1955a, b; 1956), indicating *Millerella* and *Profusulinella* from Isla Doñas and *Eoschubertella* and *Fusulinella-Fusulina* from Madre de Dios. *Millerella* is known from other deposits of Middle Pennsylvanian age in Brazil (Petri, 1956) and from the Lower Permian of Guarello (this report). *Profusulinella* was reported from Peru (Roberts, 1949) but has not been reported from elsewhere in South America. *Fusulinella* was reported from Peru by Meyer (1914), Dunbar and Newell (1946), and Roberts (1949) and from Brazil, where it was first recognized by Derby (1894) and described by Petri (1952, 1956). *Fusulina* has not been positively identified in South America. Hollingsworth's identification (in Cecioni, 1955a, b; 1956) suggests a question whether *Fusulinella* or *Fusulina* or an intermediate form was represented. No other *Fusulina* has been recognized, although the name does appear in early records indicating fusulinids in general (Derby 1894; Gerth and Kraeusel, 1931; Berry 1933). *Eoschubertella* has not been recognized with certainty elsewhere, although some small forms found on Guarello might represent this genus.

LATE PENNSYLVANIAN AND EARLY PERMIAN

A rather varied fauna is recognized in the younger rocks of Guarello and Tarlton. The forms recognized by Tavera, Henbest, and Hollingsworth (Cecioni, 1955a) include *Triticites, Schwagerina,* and a form considered intermediate between the two. Small Foraminifera were noted but not named. We have found *Tetrataxis* sp.; *Bradyina* sp.; *Climacammina* sp. and other textularids; *Millerella* sp.; small forms possibly related to *Eoschubertella; Schubertella* sp.; *Triticites* spp.; *Pseudofusulina* sp.; *Schwagerina* spp.; and *Chalaroschwagerina* sp.

The stage of development of the species of *Triticites* represented in collections f22471 through f22474 suggests a Late Pennsylvanian (Virgilian) age for the rocks in the northwestern outcrops on Isla Guarello. The *Triticites* from collections f22475 through f22479 are either Virgilian or early Wolfcampian. All collections bearing numbers above f22479 contain faunas suggesting an Early Permian (Wolfcampian) age, including species of *Triticites, Schwagerina, Pseudofusulina,* and *Chalaroschwagerina.*

The smaller Foraminifera have not been studied in detail, nor have they been reported by most authors who have described the fusulinids from South America. Petri (1956) described and illustrated some of the small forms from Brazil, and it would be surprising if similar forms were not present in Bolivia, Peru, Colombia, and Venezuela in the beds with the fusulinids. Each of the fusulinid genera recognized in southern Chile was recorded from the northern Andean areas (not always under the same name), and though there are differences at the species level, there is also considerable similarity.

Several fusulinid genera reported from the northern Andean area have not been recognized in southern Chile. These include *Staffella,* reported by Thompson and Miller (1949) from Venezuela; *Dunbarinella,* reported by Roberts (1949) from Peru; *Pseudoschwagerina,* reported from Peru by Dunbar and Newell (1946) and by Roberts (1949), from Colombia by Thompson and Miller (1949), and from Bolivia by Dunbar and Newell (1946) and Chamot (1965); *Monodiexodina,* reported from Bolivia by Chamot (1965); and *Parafusulina,* reported from Colombia and Venezuela by Thompson and Miller (1949), from Peru by Roberts (1949), and from Bolivia by Chamot (1965). These forms might be found by additional collecting northwest of Guarello.

SYSTEMATIC DESCRIPTIONS

Genus TETRATAXIS Ehrenberg, 1854

Tetrataxis spp.

Plate 2, figures 33–35

Tetrataxis was recognized in seven collections from Isla Guarello. The specimens are variable in size and in the height of the cone relative to its diameter. These attributes have been used to distinguish species. The number of specimens available in each of the samples is insufficient to determine the range of variation, but examples from three samples are illustrated to show one high- and two low-coned specimens. *Tetrataxis* is represented in collections f22471, f22475, f22479, f22484, f22490, f22497, and f22498.

Genus BRADYINA von Möller, 1879

Bradyina sp.

Plate 2, figure 32

Specimens of *Bradyina* sp. are present in most samples from Isla Guarello. Most of the specimens are crushed, and only their inner volutions preserved; although they are recognizable to genus, the species cannot be determined. One example of a well-preserved specimen is illustrated.

Genus CLIMACAMMINA Brady, 1873

Climacammina spp.

Plate 2, figures 36–38

Specimens of *Climacammina* are found in almost every sample from Isla Guarello. Most specimens are fractured or crushed but are recognizable to genus. Specimens from three of the samples are illustrated; although the orientation is not uniform, considerable variation in morphology can be seen.

Another textularid is illustrated on plate 2, figure 39. Although this might possibly represent an unusually extensive development of the apex of *Climacammina* sp., it seems unlikely. A more reasonable assumption is that this specimen represents some other textularid genus. This form was found only in collection f22471 on Isla Guarello.

Genus MILLERELLA Thompson, 1942

Millerella sp.

Plate 2, figures 24–31

Millerella sp. was recognized in three collections, but it is uncommon, and few oriented sections were obtained. The specimens are fairly large for the genus, attaining diameters of about 0.6 mm in four volutions. The proloculus is variable in size from about 30 μm to nearly 70 μm in outer diameter. The septa are closely spaced throughout growth. The number of specimens available for study precludes an adequate description or comparison of these forms, but several specimens are illustrated from collections f22490 and f22498 on Isla Guarello. *Millerella* was not recognized in the collections from Isla Tarlton.

Genns SCHUBERTELLA Staff and Wedekind, 1910

Schubertella sp.

Plate 2, figures 1–19

Specimens assignable to *Schubertella* were found in six collections. The quality of preservation and the paucity of oriented sections precludes adequate description of the specific attributes of the forms from any of the collections. The specimens are, therefore, included in the report for the sake of completeness but are not described. Examples from three of the collections are illustrated; prolocular diameter varies from about 25 to 45 μm within a sample, and one possible distorted specimen shows a maximum prolocular diameter of nearly 60 μm.

Material studied—*Schubertella* sp. is represented sparingly in collections f22480, f22483, f22488, and f22500. It is more common in collections f22490 and f22498. All these collections are from Isla Guarello. *Schubertella* sp. was not recognized on Isla Tarlton. It is associated with species of *Triticites, Schwagerina,* and *Pseudofusulina* as well as *Eoschubertella?, Millerella, Bradyina,* and *Climacammina.*

Genus EOSCHUBERTELLA Thompson, 1937

Eoschubertella? sp.

Plate 2, figures 20–23

Description.—Several specimens of a small form resembling *Eoschubertella* were found in collection f22498. They could not easily be considered juvenaria of *Triticites guarellensis* n. sp. or *Pseudofusulina chilensis* n. sp. described from that sample, nor could they be considered closely related to *Schubertella* sp. from that sample. The large proloculus (70 to 90 μm), irregular coiling, and rapid expansion, coupled with the small terminal size are characteristic of the forms previously assigned to *Eoschubertella.* The wall of *Eoschubertella* is reported as consisting of a tectum and diaphanotheca (Thompson, 1948, p. 33). The specimens studied, though not distinct, have a tectum and an inner structureless layer which probably represents diaphanotheca.

Eoschubertella was described from rocks of Middle Pennsylvanian age and is commonly considered to be restricted to rocks of that age. Whether a form as unspecialized as this stems from a single developmental event or could have evolved at several different times is unknown. It is reasonable to expect that these forms are only early stages of a larger form, but, in this instance, the larger form is not obvious.

Genus TRITICITES Girty, 1904

Triticites prima Douglass and Nestell, n. sp.

Plate 3, figures 1–7

Diagnosis.—Shell small, attaining lengths of as much as 3.2 mm and widths of 1.4 mm in five volutions. The shape is ovoid, with a straight axis of coiling. The inner volutions are more elongate and have rather pointed poles. The coiling is tight in the inner volutions, expanding regularly and rapidly. Chomata are weakly developed but persist to the last volution. The spirotheca is thin and is composed of tectum and fine keriotheca. The septa are nearly straight and are closely spaced throughout the shell.

Description.—Summaries of the numerical data are given in table 1 and figure 3. The volution height increases regularly through most of the shell growth but increases less rapidly in the outermost volutions. The length increases rapidly in relation to width in the innermost volutions, but the width increases more rapidly in the outer volutions, resulting in a nearly constant form ratio throughout much of the shell. The axis of coiling is straight.

The proloculus ranges in diameter from 120 to 190 μm in the few measurable specimens (fig. 3) and is spherical.

The wall thickness increases regularly throughout the test (fig. 3) attaining thicknesses of nearly 70 μm in the outer volutions. The wall is composed of a thin tectum and fine keriotheca. The keriotheca is so fine that it is difficult to recognize, except in some of the better preserved specimens (pl. 3, fig. 4b).

The septa are closely and regularly spaced (pl. 3, figs. 4–7) and are nearly straight throughout most of the test. They are weakly fluted in the polar regions.

The tunnel is wide and bordered by weakly developed chomata that generally extend to less than half the chamber height. No axial filling or other epithecal deposits were recognized.

Comparison and remarks.—The small size, the shape, and the thinness of the wall make this species resemble forms of *Profusulinella* more than it does most species of *Triticites*. There is a superficial resemblance to *T. burgessae* Burma, 1952, but *T. prima* has a lower form ratio, a greater volution height at comparable size, and the prolocular size ranges do not overlap.

Material studied.—*Triticites prima* was recognized only in sample f22472 in the oldest beds sampled. Thirty-seven thin sections were studied, and seven oriented specimens sufficiently undeformed for significant measurements were found. The specimens occur in a plastically deformed and partly recrystallized fine-grained silty limestone that contains some crinoidal debris, abundant fusulinids, and scattered specimens of *Bradyina* sp. and *Climacammina* sp.

Designation of types.—The specimen illustrated on plate 3, figures 1a, b, is designated the holotype (USNM 188195). The other specimens studied are paratypes (USNM 188196–201).

Triticites eleuteriensis Douglass and Nestell, n. sp.

Plate 4, figures 1–10

Diagnosis.—Shell small, attaining lengths of as much as 5 mm and widths of 1.4 mm in seven volutions. The shape is elongate fusiform to subcylindrical with relatively pointed poles and a slightly irregular axis of coiling. The coiling is tight in the inner volutions, expanding regularly in the outer volutions. Chomata are weakly developed and irregular, developed principally at the septa. They persist to the last volution. The spirotheca is thin, composed of a tectum and fine keriotheca. The septa are nearly straight and rather widely spaced.

Description.—Summaries of the numerical data are given in table 2 and figure 4. The volution height increases regularly through most of the shell but increases less rapidly in the outermost volutions. The shell length increases rapidly throughout most of the shell, so the form ratio increases through most of the shell (fig. 4). The axis of coiling is slightly irregular.

The proloculus ranges in diameter from 80 to 130 μm (fig. 4) and is spherical to subspherical.

The wall thickness increases regularly to the last volutions. The average thickness in the outer volutions tends to diminish (fig. 4), but on individual specimens this is generally not true. The wall is composed of a tectum and fine keriotheca (pl. 4, figs. 1b, 2b).

The septa are nearly straight throughout the shell but are slightly fluted near the poles. They are spaced regularly and rather widely.

The tunnel is wide and indistinct, bordered by weakly developed chomata or pseudochomata that are principally developed in the vicinity of the septa. The chomata appear almost massive and overhanging at the septa (pl. 4, fig. 10) but may appear to be absent (pl. 4, fig. 4, upper part). No axial filling or other epithecal deposits were recognized.

Comparison and remarks.—*Triticites eleuteriensis* n. sp. resembles *T. boliviensis* Dunbar and Newell, 1946, in general size and shape. The specimen selected by Dunbar and Newell as the holotype, and

TABLE 1.—*Summary numerical data for* Triticites prima *n. sp.*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	4	1.000E-01				
VOLUTION HEIGHT	4	3.225E-02	2.825E-05	5.315E-03	1.648E+01	2.658E-03
WALL THICKNESS	3	1.567E-02	1.033E-05	3.215E-03	2.052E+01	1.856E-03
SEPTAL SPACING	2	3.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
HL/RV	4	3.225E-01	2.825E-03	5.315E-02	1.648E+01	2.658E-02
RADIUS VECTOR	7	1.300E-01				
HALF-LENGTH	3	2.300E-01	7.000E-04	2.646E-02	1.150E+01	1.528E-02
VOLUTION HEIGHT	7	4.157E-02	3.762E-05	6.133E-03	1.475E+01	2.318E-03
WALL THICKNESS	6	1.783E-02	6.567E-06	2.563E-03	1.437E+01	1.046E-03
SEPTAL SPACING	3	4.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
HL/RV	3	1.769E+00	4.142E-02	2.035E-01	1.150E+01	1.175E-01
RADIUS VECTOR	7	1.600E-01				
HALF-LENGTH	3	3.300E-01	1.300E-03	3.606E-02	1.093E+01	2.082E-02
VOLUTION HEIGHT	7	5.400E-02	1.047E-04	1.023E-02	1.895E+01	3.867E-03
WALL THICKNESS	7	1.857E-02	3.619E-06	1.902E-03	1.024E+01	7.190E-04
SEPTAL SPACING	3	4.667E+00	1.333E+00	1.155E+00	2.474E+01	6.667E-01
HL/RV	3	2.062E+00	5.078E-02	2.253E-01	1.093E+01	1.301E-01
RADIUS VECTOR	7	2.000E-01				
HALF-LENGTH	3	4.467E-01	1.733E-03	4.163E-02	9.321E+00	2.404E-02
VOLUTION HEIGHT	7	6.714E-02	5.448E-05	7.381E-03	1.099E+01	2.790E-03
WALL THICKNESS	7	2.329E-02	9.905E-06	3.147E-03	1.352E+01	1.190E-03
SEPTAL SPACING	4	6.000E+00	4.000E+00	2.000E+00	3.333E+01	1.000E+00
HL/RV	3	2.233E+00	4.333E-02	2.082E-01	9.321E+00	1.202E-01
RADIUS VECTOR	7	2.500E-01				
HALF-LENGTH	3	5.667E-01	4.133E-03	6.429E-02	1.135E+01	3.712E-02
VOLUTION HEIGHT	7	8.086E-02	1.948E-05	4.413E-03	5.458E+00	1.668E-03
WALL THICKNESS	7	2.614E-02	8.810E-06	2.968E-03	1.135E+01	1.122E-03
TUNNEL WIDTH	2	2.150E+02	2.048E+03	4.525E+01	2.105E+01	3.200E+01
SEPTAL SPACING	4	7.000E+00	7.333E+00	2.708E+00	3.869E+01	1.354E+00
HL/RV	3	2.267E+00	6.613E-02	2.572E-01	1.135E+01	1.485E-01
RADIUS VECTOR	7	3.200E-01				
HALF-LENGTH	3	6.867E-01	3.233E-03	5.686E-02	8.281E+00	3.283E-02
VOLUTION HEIGHT	7	1.084E-01	1.493E-04	1.222E-02	1.127E+01	4.618E-03
WALL THICKNESS	7	3.157E-02	4.952E-06	2.225E-03	7.049E+00	8.411E-04
TUNNEL WIDTH	2	2.960E+02	2.888E+03	5.374E+01	1.816E+01	3.800E+01
SEPTAL SPACING	4	9.000E+00	3.333E+00	1.826E+00	2.029E+01	9.129E-01
HL/RV	3	2.146E+00	3.158E-02	1.777E-01	8.281E+00	1.026E-01
RADIUS VECTOR	7	4.000E-01				
HALF-LENGTH	3	8.600E-01	3.100E-03	5.568E-02	6.474E+00	3.215E-02
VOLUTION HEIGHT	7	1.330E-01	9.933E-04	3.152E-02	2.370E+01	1.191E-02
WALL THICKNESS	7	3.629E-02	1.057E-05	3.251E-03	8.960E+00	1.229E-03
SEPTAL SPACING	4	1.175E+01	1.583E+00	1.258E+00	1.071E+01	6.292E-01
HL/RV	3	2.150E+00	1.937E-02	1.392E-01	6.474E+00	8.036E-02
RADIUS VECTOR	7	5.000E-01				
HALF-LENGTH	3	1.107E+00	8.233E-03	9.074E-02	8.199E+00	5.239E-02
VOLUTION HEIGHT	7	1.724E-01	4.826E-04	2.197E-02	1.274E+01	8.303E-03
WALL THICKNESS	7	4.200E-02	2.133E-05	4.619E-03	1.100E+01	1.746E-03
SEPTAL SPACING	4	1.275E+01	7.583E+00	2.754E+00	2.160E+01	1.377E+00
HL/RV	3	2.213E+00	3.293E-02	1.815E-01	8.199E+00	1.048E-01
RADIUS VECTOR	6	6.300E-01				
HALF-LENGTH	2	1.420E+00	1.800E-03	4.243E-02	2.988E+00	3.000E-02
VOLUTION HEIGHT	6	1.953E-01	9.327E-04	3.054E-02	1.563E+01	1.247E-02
WALL THICKNESS	5	5.240E-02	1.313E-04	1.146E-02	2.187E+01	5.124E-03
SEPTAL SPACING	4	1.625E+01	4.917E+00	2.217E+00	1.365E+01	1.109E+00
HL/RV	2	2.254E+00	4.535E-03	6.734E-02	2.988E+00	4.762E-02

several of their other specimens, suggest a form with more tightly fluted septa and more closely spaced septa than those found in *T. eleuteriensis* n. sp. The wall seems to thicken more slowly in *T. boliviensis* also.

T. eleuteriensis n. sp. bears some resemblance to *T. prima* n. sp., but the two can be distinguished easily by the greater form ratio and wider septal spacing of *T. eleuteriensis* n. sp.

Material studied.—Triticites eleuteriensis n. sp. was recognized only in sample f22473 in some of the oldest beds sampled. Thirty-five thin sections were studied in which 18 oriented specimens were found to be sufficiently undeformed for significant measurements. The specimens occur in plastically deformed silty limestone that contains abundant fusulinids and scattered specimens of *Bradyina* sp. and *Climacammina* sp.

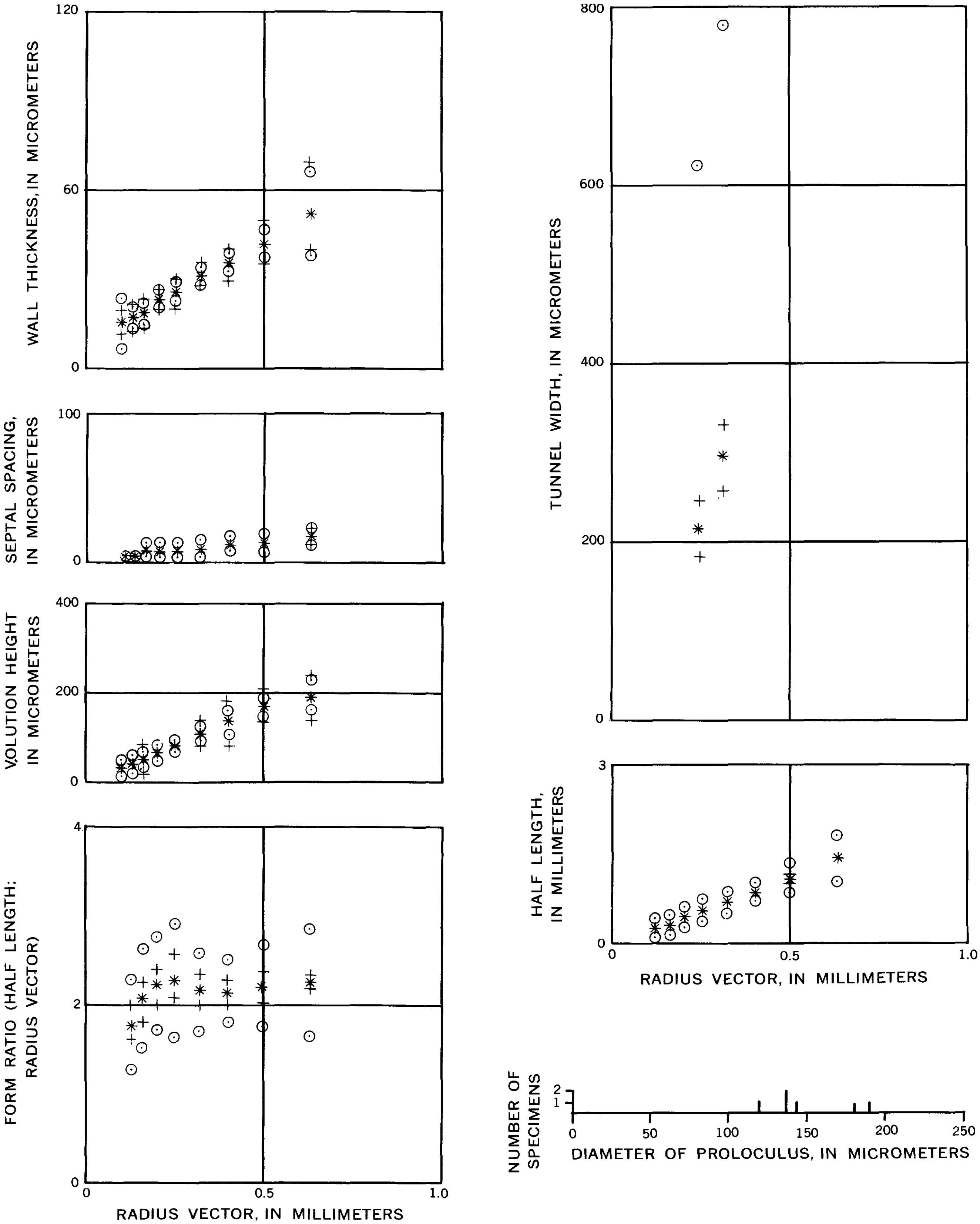
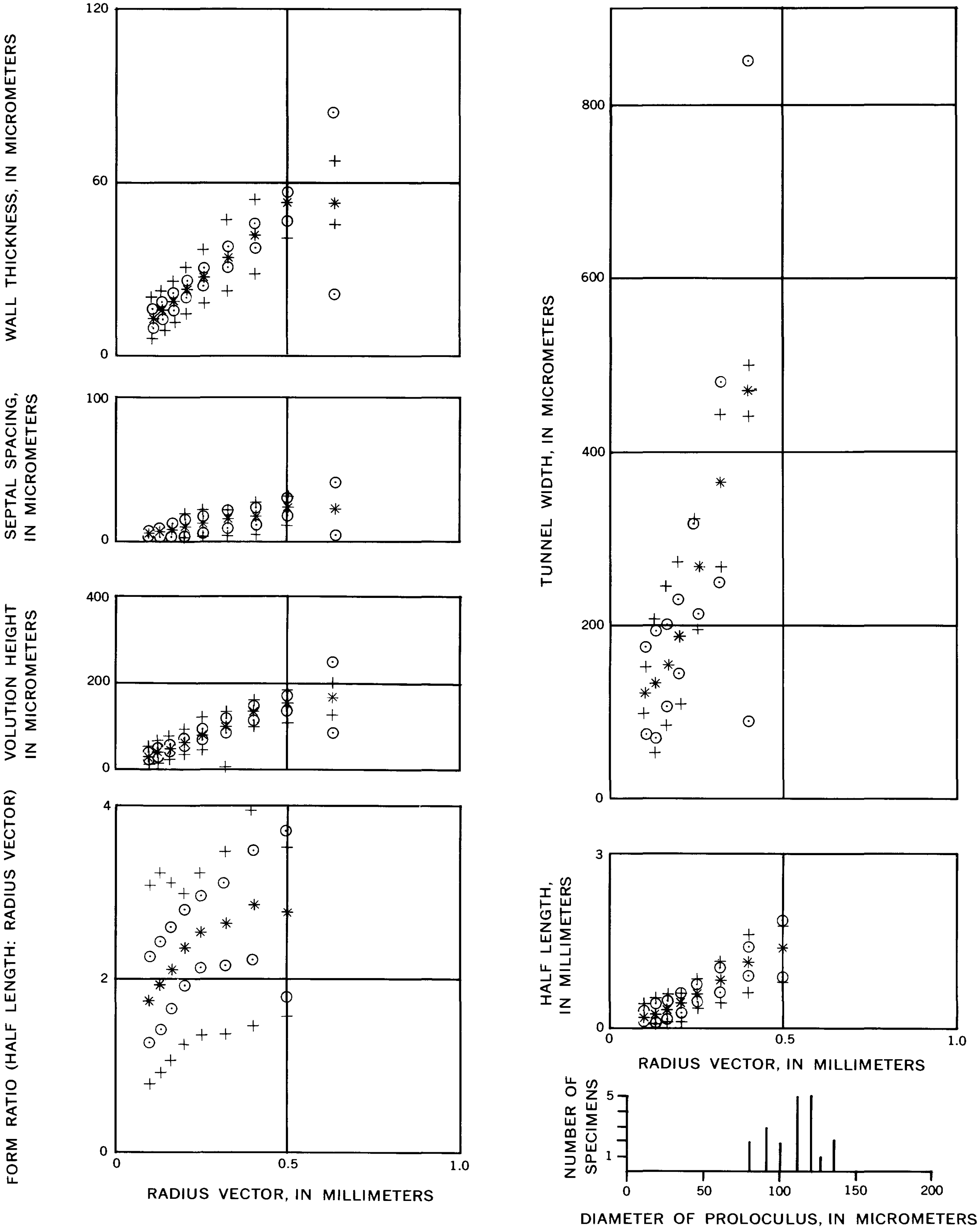

WALL THICKNESS, IN MICROMETERS
120
60
0
SEPTAL SPACING, IN MICROMETERS
100
0
VOLUTION HEIGHT IN MICROMETERS
400
200
0
FORM RATIO (HALF LENGTH: RADIUS VECTOR)
4
2
0
0
0.5
1.0
RADIUS VECTOR, IN MILLIMETERS
TUNNEL WIDTH, IN MICROMETERS
800
600
400
200
0
HALF LENGTH, IN MILLIMETERS
3
0
0
0.5
1.0
RADIUS VECTOR, IN MILLIMETERS
NUMBER OF SPECIMENS
2
1
0
50
100
150
200
250
DIAMETER OF PROLOCULUS, IN MICROMETERS

TABLE 2.—*Summary numerical data for* Triticites eleuteriensis *n. sp.*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	18	1.000E-01				
HALF-LENGTH	10	1.750E-01	4.872E-03	6.980E-02	3.989E+01	2.207E-02
VOLUTION HEIGHT	18	3.306E-02	4.570E-05	6.760E-03	2.045E+01	1.593E-03
WALL THICKNESS	17	1.241E-02	1.026E-05	3.203E-03	2.580E+01	7.768E-04
TUNNEL WIDTH	4	1.238E+02	9.563E+02	3.092E+01	2.499E+01	1.546E+01
SEPTAL SPACING	6	5.833E+00	5.767E+00	2.401E+00	4.117E+01	9.804E-01
HL/RV	10	1.750E+00	4.872E-01	6.980E-01	3.989E+01	2.207E-01
RADIUS VECTOR	18	1.300E-01				
HALF-LENGTH	10	2.530E-01	8.668E-03	9.310E-02	3.680E+01	2.944E-02
VOLUTION HEIGHT	18	4.078E-02	5.630E-05	7.503E-03	1.840E+01	1.769E-03
WALL THICKNESS	18	1.594E-02	8.644E-06	2.940E-03	1.844E+01	6.930E-04
TUNNEL WIDTH	6	1.315E+02	3.580E+03	5.984E+01	4.550E+01	2.443E+01
SEPTAL SPACING	6	7.667E+00	6.667E+00	2.582E+00	3.368E+01	1.054E+00
HL/RV	10	1.946E+00	5.129E-01	7.162E-01	3.680E+01	2.265E-01
RADIUS VECTOR	18	1.600E-01				
HALF-LENGTH	10	3.400E-01	1.109E-02	1.053E-01	3.097E+01	3.330E-02
VOLUTION HEIGHT	18	5.294E-02	1.359E-04	1.166E-02	2.202E+01	2.748E-03
WALL THICKNESS	18	1.889E-02	6.340E-06	2.518E-03	1.333E+01	5.935E-04
TUNNEL WIDTH	8	1.534E+02	3.346E+03	5.785E+01	3.772E+01	2.045E+01
SEPTAL SPACING	7	9.143E+00	1.048E+01	3.237E+00	3.540E+01	1.223E+00
HL/RV	10	2.125E+00	4.332E-01	6.581E-01	3.097E+01	2.081E-01
RADIUS VECTOR	18	2.000E-01				
HALF-LENGTH	10	4.710E-01	1.499E-02	1.224E-01	2.599E+01	3.871E-02
VOLUTION HEIGHT	18	6.422E-02	1.234E-04	1.111E-02	1.729E+01	2.618E-03
WALL THICKNESS	18	2.289E-02	1.458E-05	3.818E-03	1.668E+01	8.999E-04
TUNNEL WIDTH	8	1.869E+02	2.550E+03	5.049E+01	2.702E+01	1.785E+01
SEPTAL SPACING	8	1.025E+01	1.564E+01	3.955E+00	3.859E+01	1.398E+00
HL/RV	10	2.355E+00	3.747E-01	6.121E-01	2.599E+01	1.936E-01
RADIUS VECTOR	18	2.500E-01				
HALF-LENGTH	10	6.380E-01	2.251E-02	1.500E-01	2.351E+01	4.744E-02
VOLUTION HEIGHT	18	8.061E-02	2.877E-04	1.696E-02	2.104E+01	3.998E-03
WALL THICKNESS	18	2.783E-02	1.956E-05	4.423E-03	1.589E+01	1.042E-03
TUNNEL WIDTH	6	2.645E+02	2.438E+03	4.938E+01	1.867E+01	2.016E+01
SEPTAL SPACING	8	1.288E+01	1.955E+01	4.422E+00	3.435E+01	1.563E+00
HL/RV	10	2.552E+00	3.601E-01	6.001E-01	2.351E+01	1.898E-01
RADIUS VECTOR	18	3.200E-01				
HALF-LENGTH	10	8.450E-01	4.645E-02	2.155E-01	2.551E+01	6.815E-02
VOLUTION HEIGHT	18	1.006E-01	7.192E-04	2.682E-02	2.665E+01	6.321E-03
WALL THICKNESS	18	3.411E-02	3.340E-05	5.779E-03	1.694E+01	1.362E-03
TUNNEL WIDTH	4	3.653E+02	5.232E+03	7.233E+01	1.980E+01	3.616E+01
SEPTAL SPACING	8	1.538E+01	2.484E+01	4.984E+00	3.242E+01	1.762E+00
HL/RV	10	2.641E+00	4.536E-01	6.735E-01	2.551E+01	2.130E-01
RADIUS VECTOR	17	4.000E-01				
HALF-LENGTH	8	1.145E+00	9.263E-02	3.043E-01	2.658E+01	1.076E-01
VOLUTION HEIGHT	17	1.317E-01	2.811E-04	1.677E-02	1.273E+01	4.066E-03
WALL THICKNESS	15	4.140E-02	5.097E-05	7.139E-03	1.724E+01	1.843E-03
TUNNEL WIDTH	2	4.700E+02	1.800E+03	4.243E+01	9.027E+00	3.000E+01
SEPTAL SPACING	8	1.813E+01	2.355E+01	4.853E+00	2.678E+01	1.716E+00
HL/RV	8	2.862E+00	5.789E-01	7.609E-01	2.658E+01	2.690E-01
RADIUS VECTOR	16	5.000E-01				
HALF-LENGTH	5	1.378E+00	1.525E-01	3.905E-01	2.834E+01	1.746E-01
VOLUTION HEIGHT	16	1.537E-01	2.617E-04	1.618E-02	1.052E+01	4.044E-03
WALL THICKNESS	12	5.158E-02	5.372E-05	7.329E-03	1.421E+01	2.116E-03
SEPTAL SPACING	8	2.113E+01	2.241E+01	4.734E+00	2.241E+01	1.674E+00
HL/RV	5	2.756E+00	6.099E-01	7.809E-01	2.834E+01	3.493E-01
RADIUS VECTOR	3	6.300E-01				
VOLUTION HEIGHT	3	1.640E-01	1.156E-03	3.400E-02	2.073E+01	1.963E-02
WALL THICKNESS	3	5.233E-02	1.613E-04	1.270E-02	2.427E+01	7.333E-03
SEPTAL SPACING	2	2.050E+01	4.500E+00	2.121E+00	1.035E+01	1.500E+00

←FIGURE 3.—Summary graphs for *Triticites prima* n. sp. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 1. The diameters of proloculi are plotted against the number of specimens.


WALL THICKNESS, IN MICROMETERS
SEPTAL SPACING, IN MICROMETERS
VOLUTION HEIGHT IN MICROMETERS
FORM RATIO (HALF LENGTH: RADIUS VECTOR)
RADIUS VECTOR, IN MILLIMETERS
TUNNEL WIDTH, IN MICROMETERS
HALF LENGTH, IN MILLIMETERS
RADIUS VECTOR, IN MILLIMETERS
NUMBER OF SPECIMENS
DIAMETER OF PROLOCULUS, IN MICROMETERS

Designation of types.—The specimen illustrated on plate 4, figures 1a, b, is designated the holotype (USNM 188202). The other specimens studied are paratypes (USNM 188203–211).

Triticites sp. aff. T. titicacaensis Dunbar and Newell, 1946

Plate 5, figures 1–6

Diagnosis.—Shell small, attaining lengths of 5 mm and widths of 3.5 mm in five volutions. The shape is fusiform throughout with a straight axis of coiling. The tunnel is narrow and well defined by chomata that are well developed and persist to the last volution. The spirotheca is thin and is composed of a tectum and fine keriotheca. The septa are closely spaced and are fluted throughout the length of the shell.

Description.—Summaries of the numerical data are given in table 3 and figure 5. The volution height increases slowly but regularly. The shell length also increases gradually throughout, so that the form ratio increases nearly constantly throughout the shell (fig. 5). The axis of coiling is straight.

The prolocular diameter is in the 120–160 μm range and is spherical.

The wall thickness increases regularly to nearly 80 μm in the outer volutions. The wall is composed of a tectum and fine keriotheca (pl. 5, fig. 2b).

The septa are fluted throughout the shell and are closely spaced.

The tunnel is rather narrow and is distinct. It is well defined by strongly developed chomata that extend to about half the chamber height in some volutions and persist to the last volution. No evidence of axial filling or of other epithecal deposits was observed.

Comparison and remarks.—This distinctive form is not represented by enough undeformed specimens to allow a proper description or comparison. It seems to resemble *T. titicacaensis* Dunbar and Newell (1946, p. 479), but it is more fusiform, and the septa are not as intensively fluted.

Material studied.—Thirty-nine thin sections were prepared from sample f22475 containing plastically deformed specimens of this *Triticites* sp. Only three specimens could be used for making measurements, and the reliability of the data from these is questionable. The specimens are associated with *Tetrataxis* sp., *Bradyina* sp., and *Climacammina* sp. in fine-grained silty limestone.

Triticites sp. A

Plate 6, figures 1–6

Diagnosis.—Shell small, attaining lengths of 4.5 mm and widths of 1.6 mm in six volutions. The shape is fusiform to subcylindrical with a straight axis of coiling. The coiling is tight in the inner volutions, expanding regularly in the outer whorls. Chomata are well developed and persist to the outer volution. The spirotheca is very thin, generally less than 50 μm, even in the outer volutions. It is composed of a tectum and very fine keriotheca. The septa are closely and regularly spaced and are slightly fluted in the inner whorls. They are more fluted in the outer whorls and near the poles.

Description.—Summaries of the numerical data are given in table 4 and figure 6. The volution height increases regularly throughout the shell, and the length increases rapidly. The form ratio increases to as much as four in some specimens, though it averages only a little more than two. The axis of coiling is straight.

The proloculus ranges in diameter from about 90 to 140 μm and is spherical.

The wall is composed of a tectum and very fine keriotheca (pl. 6, figs. 1b, 3b). The wall thickness increases regularly but seldom attains 50 μm.

The septa are regularly and closely spaced. They are weakly fluted in the inner volutions but more intensely fluted in the poles and in the outer volutions.

The tunnel is narrow and bordered by well-developed chomata that appear overhanging in the vicinity of the septa. The chomata generally extend less than half the chamber height and are almost symmetrical midway between septa. No axial filling or other epithecal deposits were recognized.

Comparison and remarks.—The small size, shape, and thin spirotheca of this form distinguish it from previously described species. The species can be distinguished from *T. prima* n. sp. by its more elongate cylindrical shape, by the development of the chomata, and by the narrower tunnel. The more elongate shape and larger prolocular diameter serve to distinguish it from *T. burgessae* Burma, 1942.

Material studied.—*Triticites* sp. A was recognized only in sample f22479 in one of the older beds sampled. Nineteen thin sections were prepared, and 10 specimens were sufficiently oriented for obtaining

FIGURE 4.—Summary graphs for *Triticites eleuteriensis* n. sp. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 2. The diameters of proloculi are plotted against the number of specimens.

TABLE 3.—*Summary numerical data for* Triticites *sp. aff.* T. titicacaensis *Dunbar and Newell, 1946*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	3	1.000E-01				
HALF-LENGTH	3	1.567E-01	2.333E-04	1.528E-02	9.750E+00	8.819E-03
VOLUTION HEIGHT	3	3.233E-02	6.333E-06	2.517E-03	7.783E+00	1.453E-03
WALL THICKNESS	3	1.467E-02	4.133E-05	6.429E-03	4.383E+01	3.712E-03
HL/RV	3	1.567E+00	2.333E-02	1.528E-01	9.750E+00	8.819E-02
RADIUS VECTOR	3	1.300E-01				
HALF-LENGTH	3	2.200E-01	7.000E-04	2.646E-02	1.203E+01	1.528E-02
VOLUTION HEIGHT	3	4.733E-02	9.333E-06	3.055E-03	6.454E+00	1.764E-03
WALL THICKNESS	3	1.833E-02	5.733E-05	7.572E-03	4.130E+01	4.372E-03
HL/RV	3	1.692E+00	4.142E-02	2.035E-01	1.203E+01	1.175E-01
RADIUS VECTOR	3	1.600E-01				
HALF-LENGTH	3	2.667E-01	1.633E-03	4.041E-02	1.516E+01	2.333E-02
VOLUTION HEIGHT	3	6.400E-02	6.300E-05	7.937E-03	1.240E+01	4.583E-03
WALL THICKNESS	3	2.333E-02	1.203E-04	1.097E-02	4.701E+01	6.333E-03
HL/RV	3	1.667E+00	6.380E-02	2.526E-01	1.516E+01	1.458E-01
RADIUS VECTOR	3	2.000E-01				
HALF-LENGTH	3	3.500E-01	2.800E-03	5.292E-02	1.512E+01	3.055E-02
VOLUTION HEIGHT	3	7.900E-02	1.920E-04	1.386E-02	1.754E+01	8.000E-03
WALL THICKNESS	3	2.500E-02	3.700E-05	6.083E-03	2.433E+01	3.512E-03
TUNNEL WIDTH	2	9.050E+01	2.450E+01	4.950E+00	5.469E+00	3.500E+00
HL/RV	3	1.750E+00	7.000E-02	2.646E-01	1.512E+01	1.528E-01
RADIUS VECTOR	3	2.500E-01				
HALF-LENGTH	3	4.467E-01	8.233E-03	9.074E-02	2.031E+01	5.239E-02
VOLUTION HEIGHT	3	9.733E-02	2.293E-04	1.514E-02	1.556E+01	8.743E-03
WALL THICKNESS	3	3.033E-02	1.043E-04	1.021E-02	3.367E+01	5.897E-03
TUNNEL WIDTH	2	1.200E+02	5.120E+02	2.263E+01	1.886E+01	1.600E+01
HL/RV	3	1.787E+00	1.317E-01	3.630E-01	2.031E+01	2.095E-01
RADIUS VECTOR	3	3.200E-01				
HALF-LENGTH	3	5.900E-01	1.710E-02	1.308E-01	2.216E+01	7.550E-02
VOLUTION HEIGHT	3	1.200E-01	1.750E-04	1.323E-02	1.102E+01	7.638E-03
WALL THICKNESS	3	3.867E-02	2.293E-04	1.514E-02	3.916E+01	8.743E-03
TUNNEL WIDTH	2	1.685E+02	1.013E+03	3.182E+01	1.888E+01	2.250E+01
HL/RV	3	1.844E+00	1.670E-01	4.086E-01	2.216E+01	2.359E-01
RADIUS VECTOR	3	4.000E-01				
HALF-LENGTH	3	8.167E-01	2.343E-02	1.531E-01	1.874E+01	8.838E-02
VOLUTION HEIGHT	3	1.373E-01	1.923E-04	1.387E-02	1.010E+01	8.007E-03
WALL THICKNESS	3	4.467E-02	1.203E-04	1.097E-02	2.456E+01	6.333E-03
TUNNEL WIDTH	2	2.440E+02	3.200E+01	5.657E+00	2.318E+00	4.000E+00
HL/RV	3	2.042E+00	1.465E-01	3.827E-01	1.874E+01	2.210E-01
RADIUS VECTOR	2	5.000E-01				
HALF-LENGTH	2	1.055E+00	4.500E-04	2.121E-02	2.011E+00	1.500E-02
VOLUTION HEIGHT	2	1.710E-01	2.420E-04	1.556E-02	9.097E+00	1.100E-02
WALL THICKNESS	2	5.350E-02	4.500E-06	2.121E-03	3.965E+00	1.500E-03
TUNNEL WIDTH	2	3.510E+02	7.220E+02	2.687E+01	7.655E+00	1.900E+01
HL/PV	2	2.110E+00	1.800E-03	4.243E-02	2.011E+00	3.000E-02
RADIUS VECTOR	2	6.300E-01				
HALF-LENGTH	2	1.330E+00	2.880E-02	1.697E-01	1.276E+01	1.200E-01
VOLUTION HEIGHT	2	2.200E-01	2.000E-04	1.414E-02	6.428E+00	1.000E-02
WALL THICKNESS	2	6.600E-02	3.200E-05	5.657E-03	8.571E+00	4.000E-03
TUNNEL WIDTH	2	4.800E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
HL/RV	2	2.111E+00	7.256E-02	2.694E-01	1.276E+01	1.905E-01
RADIUS VECTOR	2	7.900E-01				
HALF-LENGTH	2	2.090E+00	5.120E-02	2.263E-01	1.083E+01	1.600E-01
VOLUTION HEIGHT	2	2.430E-01	1.458E-03	3.818E-02	1.571E+01	2.700E-02
WALL THICKNESS	2	7.150E-02	1.250E-05	3.536E-03	4.945E+00	2.500E-03
HL/RV	2	2.646E+00	8.204E-02	2.864E-01	1.083E+01	2.025E-01

measurements. The specimens occur in a fine calcarenite with abundant sparry cement. Many of the grains are parts of echinoderms. One fragment of a bryozoan was recognized, and some fragments of fusulinids other than *T.* sp. A were found. Smaller foraminifers include *Tetrataxis* sp. and *Climacammina* sp.

Triticites magallanensis Douglass and Nestell, n. sp.

Plate 6, figures 7–14

Diagnosis.—Shell small, attaining lengths of as much as 5.5 mm and widths of 1.5 mm in six volutions. The shape is elongate fusiform to subcylindrical with rounded poles and a straight axis of coiling. The coiling expands regularly and rapidly. Chomata are weak and are discontinuous in the outer volutions. The spirotheca is thin, composed of a tectum and fine keriotheca. The septa are nearly straight, except at the poles.

Description.—Summaries of the numerical data are given in table 5 and figure 7. The volution height increases regularly and rather rapidly throughout the shell. The length increases regularly, producing a form ratio that increases rapidly through the early volutions and continues to rise more gradually throughout growth (fig. 7). The axis of coiling is straight in most specimens.

The proloculus ranges in diameter from about 100 to 280 μm and is commonly subspherical to oblate.

The wall thickness increases regularly, to as much as 80 μm in some specimens (fig. 7). The wall is composed of a tectum and fine keriotheca (pl. 6, figs. 7b, 13b).

The septa are essentially straight across the middle of the test and only slightly fluted at the poles. The spacing is less regular than on many of the forms studied, showing greater variability among specimens and less regularity of increase throughout individual specimens.

The tunnel is wide and indistinct with weakly developed chomata or parachomata throughout most of the shell. No axial filling or other epithecal deposits were recognized.

Comparison and remarks.—Triticites magallanensis resembles *T. boliviensis* Dunbar and Newell, 1946, to some extent, but *T. boliviensis* has a greater form ratio, a thinner wall, a smaller proloculus, and a narrower tunnel. *T. magallanensis* resembles *T. eleuteriensis* in some respects but is more cylindrical, starts with a larger proloculus, attains a greater size in fewer volutions, and has a more coarsely keriothecal wall. It may be a lineal descendant of *T. eleuteriensis* n. sp.

Material studied.—T. magallanensis n. sp. was recognized only in sample f22488 among the younger beds sampled on Isla Guarello. Twenty-nine thin sections were prepared on which 16 oriented specimens were sufficiently undeformed for measurement. The specimens occur in plastically deformed and fractured calcisiltite with abundant shell debris. A varied fauna includes crinoidal fragments, echinoderm spines, fragments of Bryozoa, and a small solitary coral, in addition to abundant *Triticites* and a few specimens of *Schubertella* sp., *Bradyina* sp., and *Climacammina* sp.

Designation of types.—The specimen illustrated on plate 6, figures 13a, b, is designated the holotype (USNM 188230). The other specimens studied are paratypes (USNM 188224–229 and 188231).

Triticites chilensis Douglass and Nestell, n. sp.

Plate 7, figures 1–9

Diagnosis.—Shell small, attaining lengths of as much as 4.7 mm and widths to 2.2 mm in six volutions. The shape is fusiform with slightly convex to slightly concave lateral slopes and rounded to pointed poles. The axis of coiling is nearly straight. The coiling is fairly regular and rapid. The chomata are well developed and persist to the last volution. The spirotheca is composed of a tectum and fine keriotheca and attains thicknesses of nearly 100 μm in the outer volutions. The septa are fluted throughout the shell.

Description.—Summaries of the numerical data are given in table 6 and figure 8. The volution height increases regularly and rapidly throughout the shell, as does the half length. The form ratio increases rather rapidly in the early volutions and then more slowly to the end of growth (fig. 8). The axis of coiling is nearly straight.

The proloculus ranges in diameter from 100 to 220 μm (fig. 8) and is spherical to subspherical.

The wall thickness increases rapidly to a maximum of about 95 μm in the outer volutions of some specimens. The wall is composed of a thin tectum and keriotheca. Keriotheca can be seen on the proloculus of some specimens (pl. 7, fig. 1b).

The septa are fluted throughout the shell. The fluting is weak across the equatorial area and becomes more intense toward the poles.

The tunnel winds irregularly but widens rapidly and regularly. It is bordered by well-developed chomata that persist to the last volution. The chomata appear to overhang the tunnel in the vicinity of the septa but are symmetrical between septa. No axial filling or other epithecal deposits were recognized.

Comparison and remarks.—This form bears some resemblance to *T. patulus* Dunbar and Newell, 1946, and to additional specimens assigned to *T. patulus* by Roberts, 1949. *T. patulus* differs by having a thicker wall in the early volutions and by having a larger size and greater expansion of the outer volutions. *T. chilensis* differs even more from the forms assigned to *T. patulus* by Ross, 1963. His form has a thicker wall in the early volutions and a thinner wall in the outer volutions. It has a greater form ratio in the early volutions and a smaller form ratio in the outer volutions. The expansion of the outer whorls is greater than in the typical specimens of Dunbar and Newell.

Material studied.—Triticites chilensis n. sp. was recognized only in sample f22480. Twenty-nine thin sections were prepared, and 22 oriented specimens were measured. The specimens occur in a pseudo-

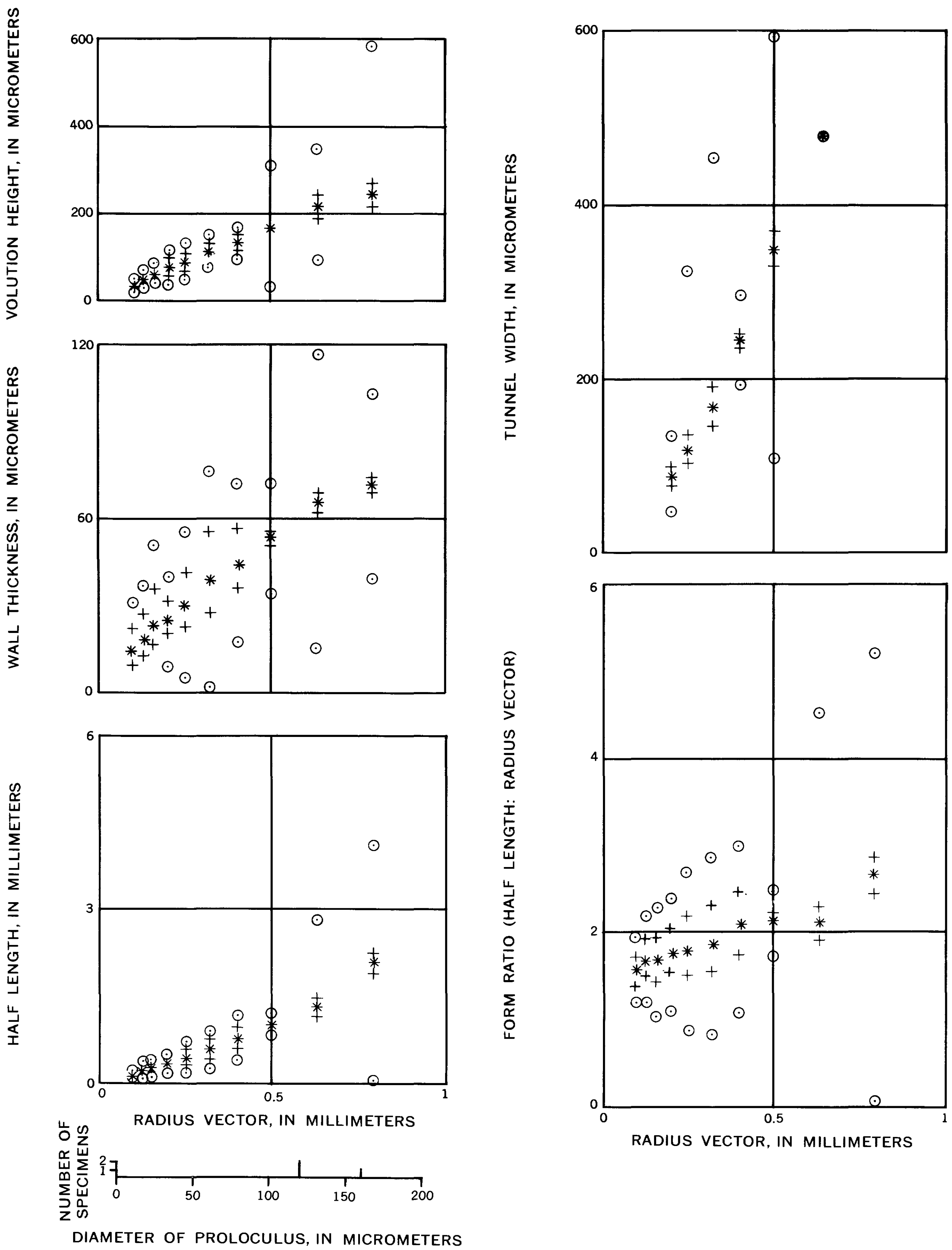

VOLUTION HEIGHT, IN MICROMETERS
WALL THICKNESS, IN MICROMETERS
HALF LENGTH, IN MILLIMETERS
TUNNEL WIDTH, IN MICROMETERS
FORM RATIO (HALF LENGTH: RADIUS VECTOR)
RADIUS VECTOR, IN MILLIMETERS
RADIUS VECTOR, IN MILLIMETERS
NUMBER OF SPECIMENS
DIAMETER OF PROLOCULUS, IN MICROMETERS

TABLE 4.—*Summary numerical data for* Triticites *sp. A*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	9	1.000E-01				
HALF-LENGTH	5	1.720E-01	4.420E-03	6.648E-02	3.865E+01	2.973E-02
VOLUTION HEIGHT	9	3.711E-02	8.861E-05	9.413E-03	2.537E+01	3.138E-03
WALL THICKNESS	9	1.033E-02	3.000E-06	1.732E-03	1.676E+01	5.774E-04
TUNNEL WIDTH	4	7.175E+01	3.656E+02	1.912E+01	2.665E+01	9.560E+00
SEPTAL SPACING	3	3.333E+00	3.333E-01	5.774E-01	1.732E+01	3.333E-01
HL/RV	5	1.720E+00	4.420E-01	6.648E-01	3.865E+01	2.973E-01
RADIUS VECTOR	10	1.300E-01				
HALF-LENGTH	6	2.300E-01	1.296E-02	1.138E-01	4.950E+01	4.648E-02
VOLUTION HEIGHT	10	4.810E-02	3.721E-05	6.100E-03	1.268E+01	1.929E-03
WALL THICKNESS	10	1.210E-02	3.656E-06	1.912E-03	1.580E+01	6.046E-04
TUNNEL WIDTH	5	8.640E+01	5.028E+02	2.242E+01	2.595E+01	1.003E+01
SEPTAL SPACING	3	4.333E+00	3.333E-01	5.774E-01	1.332E+01	3.333E-01
HL/RV	6	1.769E+00	7.669E-01	8.757E-01	4.950E+01	3.575E-01
RADIUS VECTOR	10	1.600E-01				
HALF-LENGTH	6	3.183E-01	2.114E-02	1.454E-01	4.567E+01	5.935E-02
VOLUTION HEIGHT	10	5.860E-02	1.382E-05	3.718E-03	6.344E+00	1.176E-03
WALL THICKNESS	10	1.500E-02	3.556E-06	1.886E-03	1.257E+01	5.963E-04
TUNNEL WIDTH	6	1.018E+02	8.414E+02	2.901E+01	2.848E+01	1.184E+01
SEPTAL SPACING	3	5.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
HL/RV	6	1.990E+00	8.257E-01	9.087E-01	4.567E+01	3.710E-01
RADIUS VECTOR	10	2.000E-01				
HALF-LENGTH	6	4.317E-01	3.386E-02	1.840E-01	4.263E+01	7.512E-02
VOLUTION HEIGHT	10	7.130E-02	6.357E-05	7.973E-03	1.118E+01	2.521E-03
WALL THICKNESS	10	1.890E-02	5.878E-06	2.424E-03	1.283E+01	7.667E-04
TUNNEL WIDTH	6	1.370E+02	8.672E+02	2.945E+01	2.150E+01	1.202E+01
SEPTAL SPACING	3	6.000E+00	1.000E+00	1.000E+00	1.667E+01	5.774E-01
HL/RV	6	2.158E+00	8.464E-01	9.200E-01	4.263E+01	3.756E-01
RADIUS VECTOR	10	2.500E-01				
HALF-LENGTH	5	5.680E-01	5.647E-02	2.376E-01	4.184E+01	1.063E-01
VOLUTION HEIGHT	10	8.890E-02	1.594E-04	1.263E-02	1.420E+01	3.993E-03
WALL THICKNESS	10	2.330E-02	1.668E-05	4.084E-03	1.753E+01	1.291E-03
TUNNEL WIDTH	3	1.503E+02	7.233E+01	8.505E+00	5.657E+00	4.910E+00
SEPTAL SPACING	3	6.667E+00	1.333E+00	1.155E+00	1.732E+01	6.667E-01
HL/RV	5	2.272E+00	9.035E-01	9.505E-01	4.184E+01	4.251E-01
RADIUS VECTOR	9	3.200E-01				
HALF-LENGTH	4	7.300E-01	9.780E-02	3.127E-01	4.284E+01	1.564E-01
VOLUTION HEIGHT	9	1.083E-01	1.802E-04	1.343E-02	1.239E+01	4.475E-03
WALL THICKNESS	9	2.956E-02	1.728E-05	4.157E-03	1.406E+01	1.386E-03
TUNNEL WIDTH	2	2.050E+02	3.380E+02	1.838E+01	8.968E+00	1.300E+01
SEPTAL SPACING	3	8.333E+00	2.333E+00	1.528E+00	1.833E+01	8.819E-01
HL/RV	4	2.281E+00	9.551E-01	9.773E-01	4.284E+01	4.886E-01
RADIUS VECTOR	7	4.000E-01				
HALF-LENGTH	2	6.300E-01	3.200E-03	5.657E-02	8.979E+00	4.000E-02
VOLUTION HEIGHT	7	1.356E-01	1.670E-04	1.292E-02	9.531E+00	4.884E-03
WALL THICKNESS	7	3.400E-02	1.200E-05	3.464E-03	1.019E+01	1.309E-03
SEPTAL SPACING	3	1.067E+01	1.333E+00	1.155E+00	1.083E+01	6.667E-01
HL/RV	2	1.575E+00	2.000E-02	1.414E-01	8.979E+00	1.000E-01
RADIUS VECTOR	2	5.000E-01				
VOLUTION HEIGHT	2	1.735E-01	8.450E-05	9.192E-03	5.298E+00	6.500E-03
WALL THICKNESS	2	4.350E-02	6.050E-05	7.778E-03	1.788E+01	5.500E-03

oolite. The small grains are of various origins, and many are coated with a thin covering of possible algal origin. Fusulinids are common in the sample, including the *Triticites* and a small form tentatively identified as a *Schubertella* sp. Echinodermal and bryozoan fragments are detectable, and there are scattered specimens of *Bradyina* sp. and *Climacammina* sp.

Designation of types.—The specimen illustrated on plate 7, figures 2a, b, is designated the holotype (USNM 188233). The other specimens studied are paratypes (USNM 188232 and 188234–240).

FIGURE 5.—Summary graphs for *Triticites* sp. aff. *T. titicacaensis* Dunbar and Newell, 1946. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 3. The diameters of proloculi are plotted against the number of specimens.

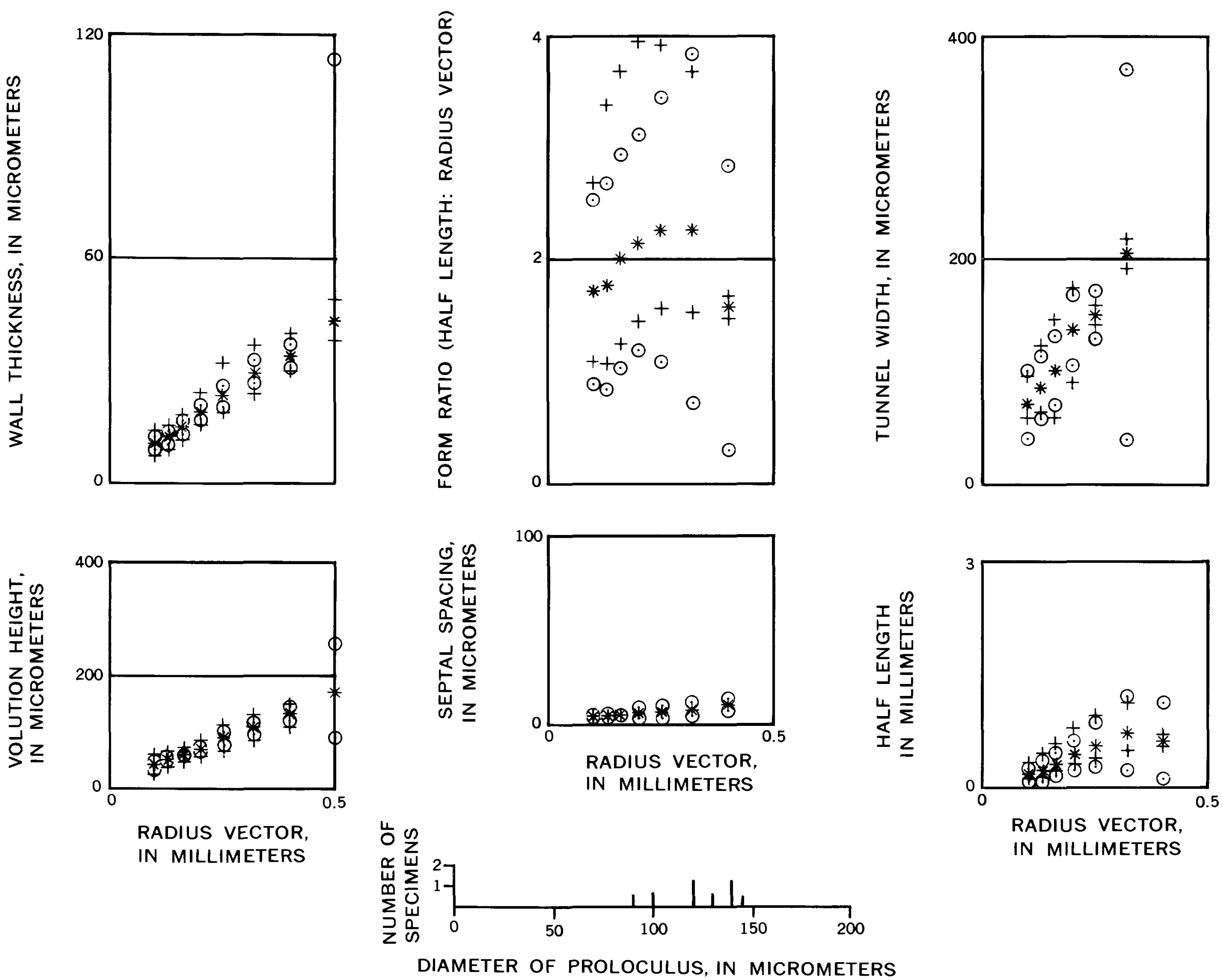


FIGURE 6.—Summary graphs for *Triticites* sp. A. Each characteristic is plotted against the radius vector. This shows the changes in each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 4. The diameters of proloculi are plotted against the number of specimens.

TABLE 5.—*Summary numerical data for* Triticites magallanensis *n. sp.*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	5	1.000E-01				
VOLUTION HEIGHT	5	2.900E-02	6.750E-05	8.216E-03	2.833E+01	3.674E-03
WALL THICKNESS	5	9.000E-03	1.000E-06	1.000E-03	1.111E+01	4.472E-04
SEPTAL SPACING	3	6.333E+00	4.333E+00	2.082E+00	3.287E+01	1.202E+00
RADIUS VECTOR	10	1.300E-01				
HALF-LENGTH	2	2.050E-01	4.500E-04	2.121E-02	1.035E+01	1.500E-02
VOLUTION HEIGHT	9	3.822E-02	1.734E-04	1.317E-02	3.446E+01	4.390E-03
WALL THICKNESS	10	1.200E-02	5.333E-06	2.309E-03	1.925E+01	7.303E-04
SEPTAL SPACING	8	8.375E+00	7.125E+00	2.669E+00	3.187E+01	9.437E-01
HL/RV	2	1.577E+00	2.663E-02	1.632E-01	1.035E+01	1.154E-01
RADIUS VECTOR	13	1.600E-01				
HALF-LENGTH	3	2.900E-01	1.900E-03	4.359E-02	1.503E+01	2.517E-02
VOLUTION HEIGHT	12	5.183E-02	9.142E-05	9.562E-03	1.845E+01	2.760E-03
WALL THICKNESS	13	1.492E-02	9.577E-06	3.095E-03	2.074E+01	8.583E-04
SEPTAL SPACING	10	1.050E+01	1.406E+01	3.749E+00	3.571E+01	1.186E+00
HL/RV	3	1.812E+00	7.422E-02	2.724E-01	1.503E+01	1.573E-01
RADIUS VECTOR	15	2.000E-01				
HALF-LENGTH	3	4.700E-01	9.100E-03	9.539E-02	2.030E+01	5.508E-02
VOLUTION HEIGHT	15	6.980E-02	1.355E-04	1.164E-02	1.667E+01	3.005E-03
WALL THICKNESS	15	1.973E-02	8.210E-06	2.865E-03	1.452E+01	7.398E-04
SEPTAL SPACING	12	1.225E+01	3.311E+01	5.754E+00	4.698E+01	1.661E+00
HL/RV	3	2.350E+00	2.275E-01	4.770E-01	2.030E+01	2.754E-01
RADIUS VECTOR	15	2.500E-01				
HALF-LENGTH	3	6.133E-01	2.743E-02	1.656E-01	2.700E+01	9.563E-02
VOLUTION HEIGHT	15	8.513E-02	9.798E-05	9.899E-03	1.163E+01	2.556E-03
WALL THICKNESS	15	2.407E-02	2.835E-05	5.325E-03	2.212E+01	1.375E-03
SEPTAL SPACING	11	1.473E+01	5.802E+01	7.617E+00	5.172E+01	2.297E+00
HL/RV	3	2.453E+00	4.389E-01	6.625E-01	2.700E+01	3.825E-01
RADIUS VECTOR	15	3.200E-01				
HALF-LENGTH	3	8.333E-01	3.293E-02	1.815E-01	2.178E+01	1.048E-01
VOLUTION HEIGHT	15	1.091E-01	1.523E-04	1.234E-02	1.131E+01	3.186E-03
WALL THICKNESS	15	3.120E-02	3.289E-05	5.735E-03	1.838E+01	1.481E-03
SEPTAL SPACING	9	1.867E+01	1.090E+02	1.044E+01	5.593E+01	3.480E+00
HL/RV	3	2.604E+00	3.216E-01	5.671E-01	2.178E+01	3.274E-01
RADIUS VECTOR	15	4.000E-01				
HALF-LENGTH	3	1.053E+00	6.443E-02	2.538E-01	2.410E+01	1.466E-01
VOLUTION HEIGHT	15	1.321E-01	3.391E-04	1.842E-02	1.394E+01	4.755E-03
WALL THICKNESS	14	4.057E-02	3.642E-05	6.035E-03	1.487E+01	1.613E-03
SEPTAL SPACING	9	2.300E+01	1.960E+02	1.400E+01	6.087E+01	4.667E+00
HL/RV	3	2.633E+00	4.027E-01	6.346E-01	2.410E+01	3.664E-01
RADIUS VECTOR	13	5.000E-01				
HALF-LENGTH	3	1.423E+00	9.373E-02	3.062E-01	2.151E+01	1.768E-01
VOLUTION HEIGHT	13	1.598E-01	5.339E-04	2.311E-02	1.446E+01	6.408E-03
WALL THICKNESS	11	5.091E-02	5.009E-05	7.077E-03	1.390E+01	2.134E-03
SEPTAL SPACING	6	1.950E+01	1.550E+01	3.937E+00	2.019E+01	1.607E+00
HL/RV	3	2.847E+00	3.749E-01	6.123E-01	2.151E+01	3.535E-01
RADIUS VECTOR	8	6.300E-01				
HALF-LENGTH	2	1.745E+00	1.985E-01	4.455E-01	2.553E+01	3.150E-01
VOLUTION HEIGHT	8	2.096E-01	6.014E-04	2.452E-02	1.170E+01	8.670E-03
WALL THICKNESS	7	6.286E-02	1.255E-04	1.120E-02	1.782E+01	4.234E-03
SEPTAL SPACING	4	2.550E+01	2.233E+01	4.726E+00	1.853E+01	2.363E+00
HL/RV	2	2.770E+00	5.000E-01	7.071E-01	2.553E+01	5.000E-01
RADIUS VECTOR	4	7.900E-01				
HALF-LENGTH	2	2.330E+00	4.608E-01	6.788E-01	2.913E+01	4.800E-01
VOLUTION HEIGHT	4	2.245E-01	2.807E-03	5.298E-02	2.360E+01	2.649E-02
WALL THICKNESS	3	6.400E-02	2.080E-04	1.442E-02	2.253E+01	8.327E-03
HL/RV	2	2.949E+00	7.383E-01	8.593E-01	2.913E+01	6.076E-01

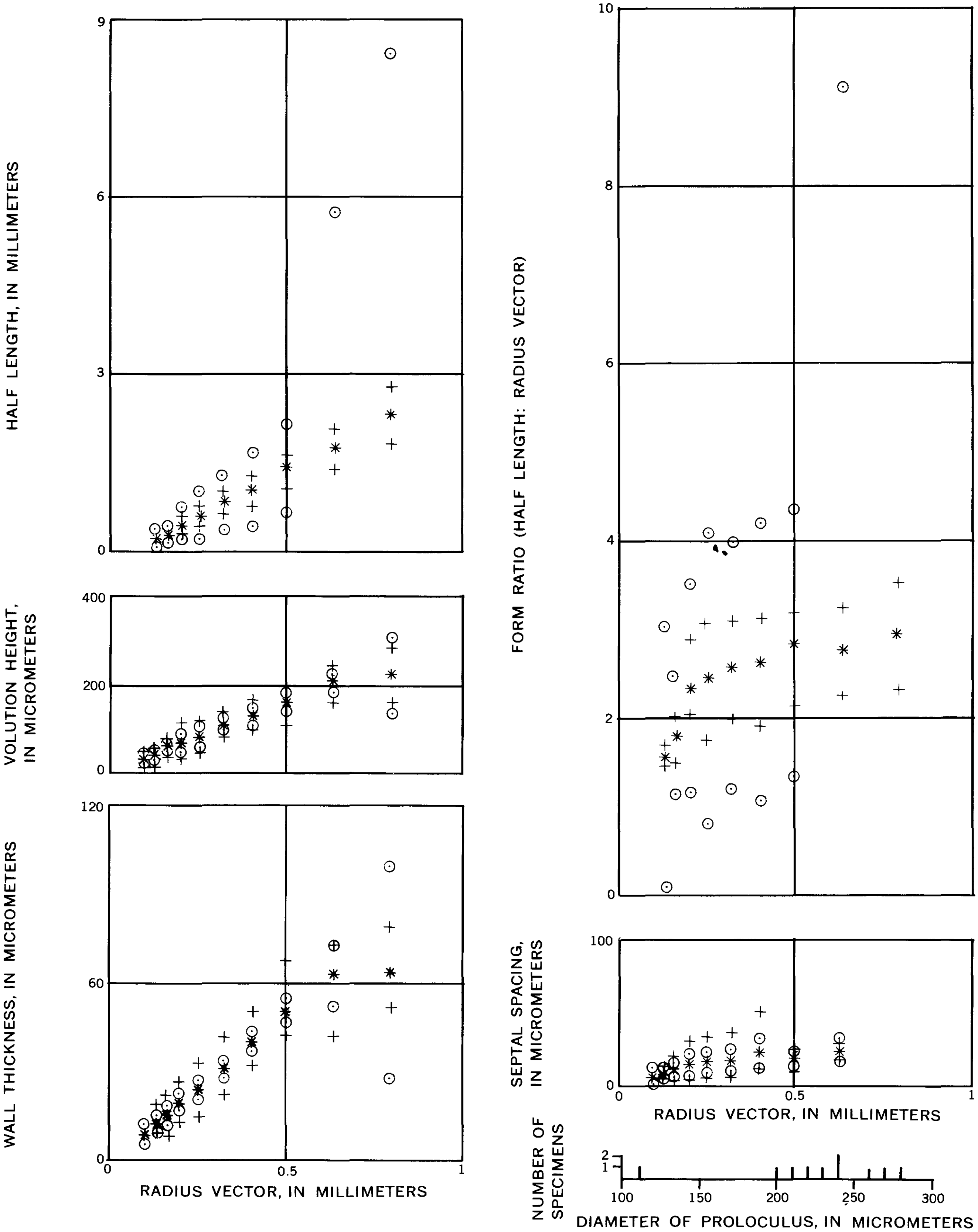
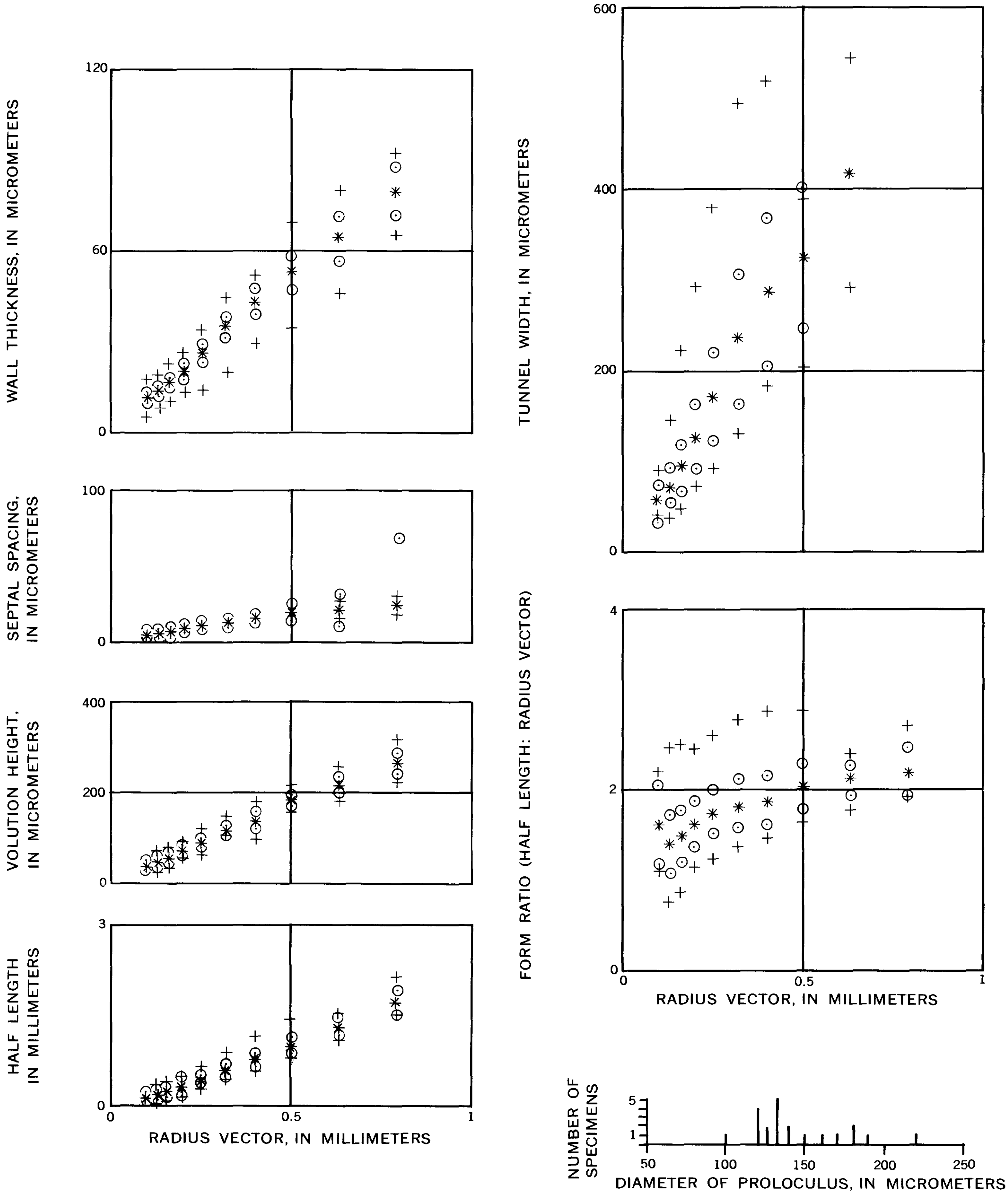


FIGURE 7.—Summary graphs for *Triticites magallanensis* n. sp. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 5. The diameters of proloculi are plotted against the number of specimens.

TABLE 6.—*Summary numerical data for* Triticites chilensis *n. sp.*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	13	1.000E-01				
HALF-LENGTH	6	1.617E-01	1.657E-03	4.070E-02	2.518E+01	1.662E-02
VOLUTION HEIGHT	13	3.662E-02	9.090E-06	3.015E-03	8.234E+00	8.362E-04
WALL THICKNESS	13	1.131E-02	7.564E-06	2.750E-03	2.432E+01	7.628E-04
TUNNEL WIDTH	6	5.550E+01	3.867E+02	1.966E+01	3.543E+01	8.028E+00
SEPTAL SPACING	7	5.000E+00	1.333E+00	1.155E+00	2.309E+01	4.364E-01
HL/RV	6	1.617E+00	1.657E-01	4.070E-01	2.518E+01	1.662E-01
RADIUS VECTOR	20	1.300E-01				
HALF-LENGTH	12	1.833E-01	4.370E-03	6.610E-02	3.606E+01	1.908E-02
VOLUTION HEIGHT	20	4.465E-02	4.119E-05	6.418E-03	1.437E+01	1.435E-03
WALL THICKNESS	20	1.365E-02	1.077E-05	3.281E-03	2.404E+01	7.337E-04
TUNNEL WIDTH	12	7.333E+01	9.719E+02	3.117E+01	4.251E+01	8.999E+00
SEPTAL SPACING	8	6.125E+00	6.964E-01	8.345E-01	1.362E+01	2.950E-01
HL/RV	12	1.410E+00	2.586E-01	5.085E-01	3.606E+01	1.468E-01
RADIUS VECTOR	22	1.600E-01				
HALF-LENGTH	14	2.386E-01	6.505E-03	8.066E-02	3.381E+01	2.156E-02
VOLUTION HEIGHT	22	5.795E-02	5.328E-05	7.300E-03	1.260E+01	1.556E-03
WALL THICKNESS	22	1.655E-02	1.369E-05	3.700E-03	2.236E+01	7.888E-04
TUNNEL WIDTH	14	9.364E+01	2.043E+03	4.520E+01	4.827E+01	1.208E+01
SEPTAL SPACING	8	7.375E+00	1.125E+00	1.061E+00	1.438E+01	3.750E-01
HL/RV	14	1.491E+00	2.541E-01	5.041E-01	3.381E+01	1.347E-01
RADIUS VECTOR	22	2.000E-01				
HALF-LENGTH	14	3.250E-01	7.673E-03	8.760E-02	2.695E+01	2.341E-02
VOLUTION HEIGHT	22	7.145E-02	8.902E-05	9.435E-03	1.320E+01	2.012E-03
WALL THICKNESS	22	2.009E-02	1.218E-05	3.490E-03	1.737E+01	7.441E-04
TUNNEL WIDTH	13	1.277E+02	3.562E+03	5.968E+01	4.674E+01	1.655E+01
SEPTAL SPACING	8	8.750E+00	1.929E+00	1.389E+00	1.587E+01	4.910E-01
HL/RV	14	1.625E+00	1.918E-01	4.380E-01	2.695E+01	1.171E-01
RADIUS VECTOR	22	2.500E-01				
HALF-LENGTH	14	4.407E-01	1.150E-02	1.072E-01	2.433E+01	2.866E-02
VOLUTION HEIGHT	22	9.050E-02	1.265E-04	1.125E-02	1.243E+01	2.398E-03
WALL THICKNESS	22	2.623E-02	1.618E-05	4.023E-03	1.534E+01	8.577E-04
TUNNEL WIDTH	13	1.721E+02	6.537E+03	8.085E+01	4.699E+01	2.242E+01
SEPTAL SPACING	8	1.075E+01	1.643E+00	1.282E+00	1.192E+01	4.532E-01
	14	1.763E+00	1.840E-01	4.289E-01	2.433E+01	1.146E-01
RADIUS VECTOR	20	3.200E-01				
HALF-LENGTH	13	5.915E-01	1.928E-02	1.389E-01	2.347E+01	3.851E-02
VOLUTION HEIGHT	20	1.146E-01	1.031E-04	1.015E-02	8.856E+00	2.270E-03
WALL THICKNESS	20	3.460E-02	4.309E-05	6.565E-03	1.897E+01	1.468E-03
TUNNEL WIDTH	11	2.358E+02	1.148E+04	1.071E+02	4.543E+01	3.230E+01
SEPTAL SPACING	6	1.300E+01	3.200E+00	1.789E+00	1.376E+01	7.303E-01
HL/RV	13	1.849E+00	1.883E-01	4.339E-01	2.347E+01	1.203E-01
RADIUS VECTOR	19	4.000E-01				
HALF-LENGTH	13	7.577E-01	3.144E-02	1.773E-01	2.340E+01	4.917E-02
VOLUTION HEIGHT	19	1.405E-01	2.259E-04	1.503E-02	1.070E+01	3.448E-03
WALL THICKNESS	19	4.295E-02	5.416E-05	7.360E-03	1.714E+01	1.688E-03
TUNNEL WIDTH	9	2.860E+02	1.161E+04	1.078E+02	3.768E+01	3.592E+01
SEPTAL SPACING	5	1.640E+01	3.800E+00	1.949E+00	1.189E+01	8.718E-01
HL/RV	13	1.894E+00	1.965E-01	4.433E-01	2.340E+01	1.229E-01
RADIUS VECTOR	16	5.000E-01				
HALF-LENGTH	12	1.022E+00	3.567E-02	1.889E-01	1.849E+01	5.452E-02
VOLUTION HEIGHT	16	1.800E-01	2.767E-04	1.663E-02	9.241E+00	4.158E-03
WALL THICKNESS	16	5.306E-02	8.500E-05	9.219E-03	1.737E+01	2.305E-03
TUNNEL WIDTH	6	3.247E+02	5.323E+03	7.296E+01	2.247E+01	2.978E+01
SEPTAL SPACING	4	1.900E+01	6.667E+00	2.582E+00	1.359E+01	1.291E+00
HL/RV	12	2.043E+00	1.427E-01	3.777E-01	1.849E+01	1.090E-01
RADIUS VECTOR	12	6.300E-01				
HALF-LENGTH	8	1.329E+00	1.733E-02	1.316E-01	9.906E+00	4.654E-02
VOLUTION HEIGHT	12	2.172E-01	4.889E-04	2.211E-02	1.018E+01	6.383E-03
WALL THICKNESS	11	6.455E-02	1.211E-04	1.100E-02	1.705E+01	3.318E-03
TUNNEL WIDTH	2	4.185E+02	3.200E+04	1.789E+02	4.275E+01	1.265E+02
SEPTAL SPACING	3	2.100E+01	1.900E+01	4.359E+00	2.076E+01	2.517E+00
HL/RV	8	2.109E+00	4.366E-02	2.089E-01	9.906E+00	7.387E-02
RADIUS VECTOR	9	7.900E-01				
HALF-LENGTH	7	1.731E+00	5.505E-02	2.346E-01	1.355E+01	8.868E-02
VOLUTION HEIGHT	9	2.647E-01	8.298E-04	2.881E-02	1.088E+01	9.602E-03
WALL THICKNESS	8	7.975E-02	1.005E-04	1.002E-02	1.257E+01	3.544E-03
SEPTAL SPACING	2	2.350E+01	2.450E+01	4.950E+00	2.106E+01	3.500E+00
HL/RV	7	2.192E+00	8.820E-02	2.970E-01	1.355E+01	1.123E-01


WALL THICKNESS, IN MICROMETERS
SEPTAL SPACING, IN MICROMETERS
VOLUTION HEIGHT, IN MICROMETERS
HALF LENGTH IN MILLIMETERS
RADIUS VECTOR, IN MILLIMETERS
TUNNEL WIDTH, IN MICROMETERS
FORM RATIO (HALF LENGTH: RADIUS VECTOR)
RADIUS VECTOR, IN MILLIMETERS
NUMBER OF SPECIMENS
DIAMETER OF PROLOCULUS, IN MICROMETERS

Triticites berryi (Willard Berry) 1933

Plate 8, figures 1–13

Fusulina berryi Berry, 1933, p. 270, pl. 22, figs. 6 and 7 [not 10].

Tritcites berryi (Willard Berry). Dunbar and Newell, 1946, p. 476–477, pl. 8, figs. 1–10.

Diagnosis.—Shell attains lengths of as much as 8 mm and widths of as much as 2.5 mm in seven to eight volutions. Shape fusiform to elongate fusiform with a straight axis of coiling. Chomata persist to last volution. Spirotheca thickens gradually to nearly 90 μm in the outer volutions, composed of tectum and fine keriotheca. Septa regularly spaced and fluted throughout the shell.

Description.—Summaries of the numerical data for the specimens from Chile are given in table 7 and figure 9. The volution height increases regularly, and the half length increases rapidly, so the form ratio increases throughout the shell (fig. 9). The specimens from Bolivia attain a slightly higher form ratio, approaching four in some specimens. The axis of coiling is straight.

The prolocular diameter ranges from 120 to 150 μm in the specimens reported from the type area. The diameters are a little greater in the specimens from Chile (fig. 9).

The wall thickness increases rapidly throughout the shell to a maximum of 80 μm in specimens from the type area and 90 μm in specimens from Chile (fig. 9). The wall is composed of a tectum and fine but well-developed keriotheca (pl. 8, figs. 1b, 3b, 5b, 13).

The septa are regularly spaced and fluted throughout the shell. The fluting through the equatorial area is weak and becomes more intense toward the poles.

The tunnel widens regularly but commonly has an irregular path. It is bordered by well-developed but not massive chomata that appear to overhang in the vicinity of septa but are more symmetrical between septa. No axial filling or other epithecal deposits were recognized.

Comparison and remarks.—The specimens from Chile are similar in all essentials to the specimens described by Dunbar and Newell from Bolivia. There are some differences. The Bolivian specimens are a little more regular in symmetry, but this may be a function of partial deformation of the Chilean specimens. Some of the Bolivian specimens have more intensely fluted septa, but no more than shown on plate 8, figure 8, from Chile. The chomata on some of the Bolivian specimens appear more massive, but, as noted, the proximity to a septum makes as much difference. *T. berryi* also bears some resemblance to *T. chilensis*, but *T. berryi* has a larger form ratio and a narrower tunnel.

Material studied.—*Triticites berryi* was recognized only in sample f22482. Thirty-one thin sections were studied, and 24 oriented specimens were sufficiently undeformed to be measured. The specimens occur in a plastically deformed silty limestone containing some echinodermal debris, including fragments of ossicles and rare echinoid spines. Rare specimens of *Bradyina* sp. and *Climacammina* sp. are also present.

Triticites australis Douglass and Nestell, n. sp.

Plate 9, figures 1–12

Diagnosis.—Shell fusiform, attaining lengths of as much as 6 mm and widths of as much as 2.5 mm in six volutions with a straight axis of coiling. Shell expands regularly and fairly rapidly. Chomata weakly developed but persisting through most of the shell. Spirotheca thickens gradually to about 80 μm in the outer volutions, composed of tectum and fine keriotheca. Septa closely and regularly spaced, gently fluted.

Description.—Summaries of the numerical data are given in table 8 and figure 10. The volution height and length increase regularly, and the form ratio increases gradually throughout the shell (fig. 10). The axis of coiling is essentially straight.

The proloculus ranges in diameter from 120 to 320 μm (fig. 10) and is spherical to subspherical.

The wall thickness increases regularly to about 80 μm in the outer volutions (fig. 10). The wall is composed of a tectum and fine keriotheca. The keriotheca are difficult to distinguish in most of the specimens in spite of the apparently good preservation (pl. 9, figs. 1b–3b).

The septa are closely and evenly spaced (fig. 10), are gently but irregularly fluted across the middle of the shell, and are more intensely fluted at the poles.

The tunnel is irregular in its path. It widens gradually and is bordered by weakly developed chomata that persist throughout most of the shell. No axial filling or other epithecal deposits were recognized.

FIGURE 8.—Summary graphs for *Triticites chilensis* n. sp. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 6. The diameters of proloculi are plotted against the number of specimens.

TABLE 7.—*Summary numerical data for* Triticites berryi (*Willard Berry*) *1933*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	12	1.000E-01				
HALF-LENGTH	7	1.557E-01	2.895E-03	5.381E-02	3.456E+01	2.034E-02
VOLUTION HEIGHT	12	2.633E-02	4.042E-05	6.358E-03	2.414E+01	1.835E-03
WALL THICKNESS	12	1.108E-02	4.447E-06	2.109E-03	1.903E+01	6.088E-04
TUNNEL WIDTH	4	7.025E+01	6.149E+02	2.480E+01	3.530E+01	1.240E+01
SEPTAL SPACING	4	5.250E+00	9.167E-01	9.574E-01	1.824E+01	4.787E-01
HL/RV	7	1.557E+00	2.895E-01	5.381E-01	3.456E+01	2.034E-01
RADIUS VECTOR	22	1.300E-01				
HALF-LENGTH	12	2.117E-01	6.306E-03	7.941E-02	3.752E+01	2.292E-02
VOLUTION HEIGHT	22	3.868E-02	2.975E-05	5.454E-03	1.410E+01	1.163E-03
WALL THICKNESS	22	1.459E-02	9.682E-06	3.112E-03	2.133E+01	6.634E-04
TUNNEL WIDTH	9	8.167E+01	6.878E+02	2.622E+01	3.211E+01	8.742E+00
SEPTAL SPACING	10	6.000E+00	2.667E+00	1.633E+00	2.722E+01	5.164E-01
HL/RV	12	1.628E+00	3.731E-01	6.109E-01	3.752E+01	1.763E-01
RADIUS VECTOR	24	1.600E-01				
HALF-LENGTH	13	2.877E-01	9.003E-03	9.488E-02	3.298E+01	2.632E-02
VOLUTION HEIGHT	24	5.296E-02	2.465E-05	4.965E-03	9.375E+00	1.013E-03
WALL THICKNESS	24	1.758E-02	1.243E-05	3.525E-03	2.005E+01	7.196E-04
TUNNEL WIDTH	11	1.027E+02	1.365E+03	3.694E+01	3.596E+01	1.114E+01
SEPTAL SPACING	11	7.545E+00	3.673E+00	1.916E+00	2.540E+01	5.778E-01
HL/RV	13	1.798E+00	3.517E-01	5.930E-01	3.298E+01	1.645E-01
RADIUS VECTOR	24	2.000E-01				
HALF-LENGTH	13	3.938E-01	1.633E-02	1.278E-01	3.244E+01	3.544E-02
VOLUTION HEIGHT	24	6.942E-02	1.690E-04	1.300E-02	1.873E+01	2.654E-03
WALL THICKNESS	24	2.146E-02	1.843E-05	4.293E-03	2.001E+01	8.764E-04
TUNNEL WIDTH	11	1.416E+02	3.183E+03	5.642E+01	3.983E+01	1.701E+01
SEPTAL SPACING	11	9.182E+00	5.964E+00	2.442E+00	2.660E+01	7.363E-01
HL/RV	13	1.969E+00	4.081E-01	6.389E-01	3.244E+01	1.772E-01
RADIUS VECTOR	24	2.500E-01				
HALF-LENGTH	13	5.108E-01	2.659E-02	1.631E-01	3.193E+01	4.523E-02
VOLUTION HEIGHT	24	8.796E-02	3.809E-04	1.952E-02	2.219E+01	3.984E-03
WALL THICKNESS	24	2.762E-02	2.842E-05	5.331E-03	1.930E+01	1.088E-03
TUNNEL WIDTH	11	1.849E+02	4.018E+03	6.339E+01	3.428E+01	1.911E+01
SEPTAL SPACING	11	1.109E+01	7.691E+00	2.773E+00	2.500E+01	8.362E-01
HL/RV	13	2.043E+00	4.255E-01	6.523E-01	3.193E+01	1.809E-01
RADIUS VECTOR	24	3.200E-01				
HALF-LENGTH	13	6.831E-01	4.447E-02	2.109E-01	3.087E+01	5.849E-02
VOLUTION HEIGHT	24	1.116E-01	4.111E-04	2.028E-02	1.816E+01	4.139E-03
WALL THICKNESS	24	3.512E-02	4.359E-05	6.602E-03	1.880E+01	1.348E-03
TUNNEL WIDTH	10	2.166E+02	5.530E+03	7.436E+01	3.433E+01	2.352E+01
SEPTAL SPACING	11	1.355E+01	1.087E+01	3.297E+00	2.434E+01	9.942E-01
HL/RV	13	2.135E+00	4.343E-01	6.590E-01	3.087E+01	1.828E-01
RADIUS VECTOR	23	4.000E-01				
HALF-LENGTH	13	9.477E-01	7.084E-02	2.661E-01	2.808E+01	7.382E-02
VOLUTION HEIGHT	23	1.398E-01	2.687E-04	1.639E-02	1.172E+01	3.418E-03
WALL THICKNESS	23	4.435E-02	5.396E-05	7.346E-03	1.656E+01	1.532E-03
TUNNEL WIDTH	7	3.286E+02	1.001E+04	1.000E+02	3.044E+01	3.781E+01
SEPTAL SPACING	10	1.550E+01	3.389E+00	1.841E+00	1.188E+01	5.821E-01
HL/RV	13	2.369E+00	4.427E-01	6.654E-01	2.808E+01	1.845E-01
RADIUS VECTOR	21	5.000E-01				
HALF-LENGTH	10	1.213E+00	1.049E-01	3.239E-01	2.670E+01	1.024E-01
VOLUTION HEIGHT	21	1.728E-01	3.127E-04	1.768E-02	1.023E+01	3.859E-03
WALL THICKNESS	21	5.633E-02	7.153E-05	8.458E-03	1.501E+01	1.846E-03
TUNNEL WIDTH	3	3.990E+02	1.789E+04	1.337E+02	3.352E+01	7.722E+01
SEPTAL SPACING	10	1.830E+01	6.011E+00	2.452E+00	1.340E+01	7.753E-01
HL/RV	10	2.426E+00	4.196E-01	6.478E-01	2.670E+01	2.049E-01
RADIUS VECTOR	14	6.300E-01				
HALF-LENGTH	4	1.632E+00	1.043E-01	3.229E-01	1.978E+01	1.615E-01
VOLUTION HEIGHT	14	2.108E-01	5.491E-04	2.343E-02	1.112E+01	6.263E-03
WALL THICKNESS	13	6.823E-02	8.036E-05	8.964E-03	1.314E+01	2.486E-03
TUNNEL WIDTH	2	5.015E+02	3.150E+04	1.775E+02	3.539E+01	1.255E+02
SEPTAL SPACING	8	2.300E+01	1.457E+01	3.817E+00	1.660E+01	1.350E+00
HL/RV	4	2.591E+00	2.628E-01	5.126E-01	1.978E+01	2.563E-01
RADIUS VECTOR	3	7.900E-01				
VOLUTION HEIGHT	3	2.657E-01	1.543E-04	1.242E-02	4.676E+00	7.172E-03
WALL THICKNESS	3	7.333E-02	6.533E-05	8.083E-03	1.102E+01	4.667E-03

Comparison and remarks.—*T. australis* n. sp. shows a superficial resemblance to *T. asperoides* Ross (1965, p. 1170), but the average proloculus is smaller in *T. asperoides,* its septal spacing is wider, and its wall is thicker at comparable sizes. *T. australis* n. sp. bears a resemblance to *T. chilensis* n. sp., but the lower form ratio and more rapid thickening of the wall in that form serve to distinguish it.

Material studied.—Thirty-two thin sections from sample f22500, in which 29 oriented specimens could be measured, were studied. The specimens occur in a silty limestone and a pseudo-oolite. Crinoidal debris and some coral and brachiopod fragments are present along with *Schubertella*? sp., *Bradyina* sp., and *Climacammina* sp.

Designation of types.—The specimen illustrated on plate 9, figures 1a, b, is designated the holotype (USNM 188256). The other specimens studied are paratypes (USNM 188257–267).

Triticites guarellensis Douglass and Nestell, n. sp.

Plate 10, figures 1–10

Diagnosis.—Shell elongate fusiform, generally about 8 mm long and 2 mm wide in five volutions, but some specimens attain lengths of as much as 12 mm and one, 13 mm with a width of 3 mm in six volutions. The inner volutions are fusiform and the outer volutions elongate. Starting from a fairly large proloculus, the shell expands regularly and fairly rapidly. The spirotheca is composed of a tectum and keriotheca. The septa are fluted gently across the middle of the shell and intensely at the poles.

Description.—Summaries of the numerical data are given in table 9 and figure 11. The volution increases in height at a regular and fairly rapid rate, producing an open look in the larger specimens. The length increases more rapidly, so the form ratio increases rapidly through the growth of the shell, attaining values of more than four in some specimens. The axis of coiling is straight to slightly irregular.

The proloculus ranges in outer diameter from 160 to 360 μm, but most of the proloculi are within the range of 200 and 260 μm. The proloculi tend to be spherical.

The wall thickens gradually, attaining thicknesses of nearly 100 μm in the outer volutions. It is composed of a tectum and keriotheca that are fairly coarse in the outer volutions. The preservation in most of the material is not very good (pl. 10, fig. 1b, 3b, 8b).

The septa are closely but irregularly spaced. They are fluted throughout the shell and produce sporadic chamberlets in the equatorial area. They are tightly but irregularly fluted in the polar areas.

The tunnel wanders irregularly and widens rapidly. It is bounded by small but persistent chomata that are present throughout most of the shell. They become pseudochomata in the outer volutions of some specimens. No other epithecal deposits were recognized.

Comparison and remarks.—*Triticites guarellensis* n. sp. bears some resemblance to *T. boliviensis* Dunbar and Newell (1946, p. 481) but has a larger proloculus, a thicker wall, and, in general, more tightly fluted septa, although the holotype illustrated by Dunbar and Newell (1946 pl. 9, fig. 4) suggests intense fluting throughout the shell. The stratigraphic position of the two forms is similar in that both are found in association with other fusulinids of Early Permian age. Further study of the variability of *T. boliviensis* might show overlap of these species.

Material studied.—*Triticites guarellensis* n. sp. is found in samples f22497 and f22498. Many of the specimens in 64 thin sections were deformed. The numerical data are based on 21 oriented sections. This species is found associated with *Pseudofusulina chilensis* n. sp. The lithology and associated fauna are described under that species.

Designation of types.—The specimen illustrated in plate 10, figures 8a, b, is designated the holotype (USNM 188329). The other specimens studied are paratypes (USNM 1883282–328, 188330, and 188331).

Triticites tarltonensis Douglass and Nestell, n. sp.

Plate 11, figures 1–6

Diagnosis.—Shell elongate fusiform to subcylindrical, attaining lengths of as much as 10 mm and widths of as much as 2.5 mm in six volutions. The shell expands regularly and lengthens rapidly, attaining a form ratio of more than four in some specimens. The septa are closely spaced and irregularly but tightly fluted in parts of some specimens. The tunnel widens rapidly and is well defined by chomata in the inner volutions. The wall thickens gradually and is composed of a tectum and fine keriotheca.

Description.—Summaries of the numerical data are given in table 10 and figure 12. The volution height increases regularly throughout the shell, and the length increases rapidly (fig. 12) forming an elongate fusiform to subcylindrical shell with mean form ratios of about three in the outer volutions and form ratios as high as 4.5 in some specimens. The axis of coiling is essentially straight.

The proloculus is small, from 120 to 250 μm in outer diameter (fig. 12), and is generally spherical.

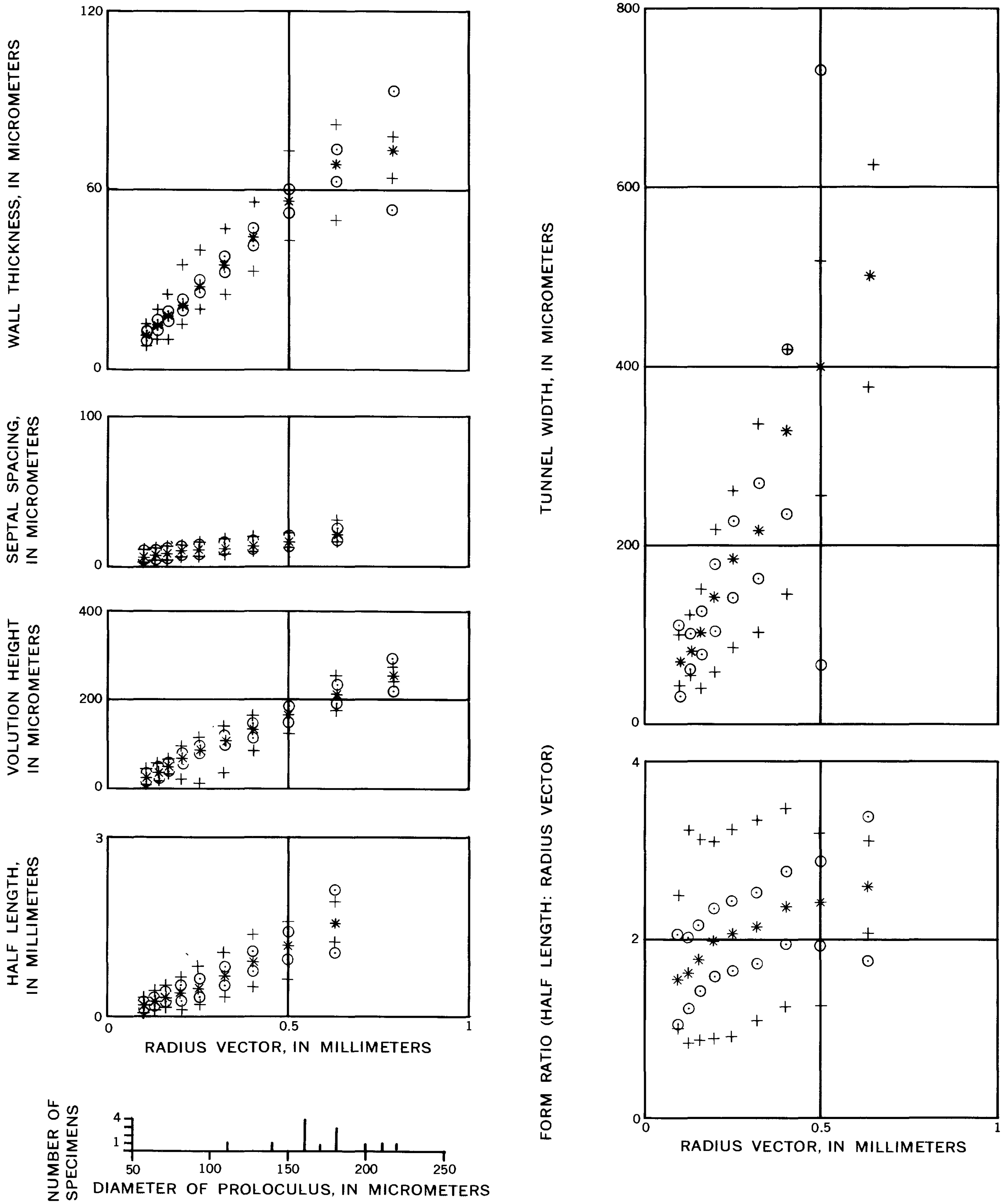

WALL THICKNESS, IN MICROMETERS
SEPTAL SPACING, IN MICROMETERS
VOLUTION HEIGHT IN MICROMETERS
HALF LENGTH, IN MILLIMETERS
RADIUS VECTOR, IN MILLIMETERS
NUMBER OF SPECIMENS
DIAMETER OF PROLOCULUS, IN MICROMETERS
TUNNEL WIDTH, IN MICROMETERS
FORM RATIO (HALF LENGTH: RADIUS VECTOR)
RADIUS VECTOR, IN MILLIMETERS

TABLE 8.—*Summary numerical data for* Triticites australis *n. sp.*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	2	1.000E-01				
VOLUTION HEIGHT	2	3.350E-02	1.445E-04	1.202E-02	3.588E+01	8.500E-03
WALL THICKNESS	2	1.050E-02	5.000E-07	7.071E-04	6.734E+00	5.000E-04
RADIUS VECTOR	8	1.300E-01				
HALF-LENGTH	2	1.300E-01	2.000E-04	1.414E-02	1.088E+01	1.000E-02
VOLUTION HEIGHT	8	3.850E-02	5.971E-05	7.728E-03	2.007E+01	2.732E-03
WALL THICKNESS	8	1.200E-02	1.486E-05	3.854E-03	3.212E+01	1.363E-03
TUNNEL WIDTH	2	2.600E+01	8.820E+02	2.970E+01	1.142E+02	2.100E+01
SEPTAL SPACING	3	7.000E+00	7.000E+00	2.646E+00	3.780E+01	1.528E+00
HL/RV	2	1.000E+00	1.183E-02	1.088E-01	1.088E+01	7.692E-02
RADIUS VECTOR	21	1.600E-01				
HALF-LENGTH	9	1.911E-01	3.361E-03	5.798E-02	3.034E+01	1.933E-02
VOLUTION HEIGHT	21	4.995E-02	6.235E-05	7.896E-03	1.581E+01	1.723E-03
WALL THICKNESS	21	1.324E-02	1.219E-05	3.491E-03	2.637E+01	7.619E-04
TUNNEL WIDTH	10	6.460E+01	6.412E+02	2.532E+01	3.920E+01	8.007E+00
SEPTAL SPACING	9	7.111E+00	2.361E+00	1.537E+00	2.161E+01	5.122E-01
HL/RV	9	1.194E+00	1.313E-01	3.623E-01	3.034E+01	1.208E-01
RADIUS VECTOR	29	2.000E-01				
HALF-LENGTH	12	2.600E-01	5.800E-03	7.616E-02	2.929E+01	2.198E-02
VOLUTION HEIGHT	29	6.817E-02	8.386E-05	9.158E-03	1.343E+01	1.701E-03
WALL THICKNESS	29	2.052E-02	3.417E-04	1.848E-02	9.009E+01	3.433E-03
TUNNEL WIDTH	13	9.431E+01	1.014E+03	3.184E+01	3.376E+01	8.830E+00
SEPTAL SPACING	14	7.929E+00	1.148E+00	1.072E+00	1.352E+01	2.864E-01
HL/RV	12	1.300E+00	1.450E-01	3.808E-01	2.929E+01	1.099E-01
RADIUS VECTOR	29	2.500E-01				
HALF-LENGTH	12	3.983E-01	1.107E-02	1.052E-01	2.709E+01	3.037E-02
VOLUTION HEIGHT	29	8.697E-02	1.548E-04	1.244E-02	1.431E+01	2.311E-03
WALL THICKNESS	29	2.114E-02	1.219E-05	3.492E-03	1.652E+01	6.485E-04
TUNNEL WIDTH	13	1.292E+02	3.676E+03	6.063E+01	4.692E+01	1.682E+01
SEPTAL SPACING	14	8.714E+00	6.813E-01	8.254E-01	9.472E+00	2.206E-01
HL/RV	12	1.553E+00	1.771E-01	4.209E-01	2.709E+01	1.215E-01
RADIUS VECTOR	29	3.200E-01				
HALF-LENGTH	12	5.417E-01	1.658E-02	1.288E-01	2.377E+01	3.717E-02
VOLUTION HEIGHT	29	1.076E-01	1.681E-04	1.297E-02	1.205E+01	2.408E-03
WALL THICKNESS	29	2.734E-02	2.366E-05	4.864E-03	1.779E+01	9.033E-04
TUNNEL WIDTH	13	1.749E+02	5.059E+03	7.113E+01	4.066E+01	1.973E+01
SEPTAL SPACING	15	9.933E+00	1.067E+00	1.033E+00	1.040E+01	2.667E-01
HL/RV	12	1.693E+00	1.619E-01	4.024E-01	2.377E+01	1.162E-01
RADIUS VECTOR	29	4.000E-01				
HALF-LENGTH	12	7.683E-01	2.647E-02	1.627E-01	2.118E+01	4.697E-02
VOLUTION HEIGHT	29	1.335E-01	3.723E-04	1.929E-02	1.445E+01	3.583E-03
WALL THICKNESS	29	3.476E-02	6.126E-05	7.827E-03	2.252E+01	1.453E-03
TUNNEL WIDTH	11	2.501E+02	1.445E+04	1.202E+02	4.807E+01	3.625E+01
SEPTAL SPACING	16	1.219E+01	2.563E+00	1.601E+00	1.313E+01	4.002E-01
HL/RV	12	1.921E+00	1.654E-01	4.067E-01	2.118E+01	1.174E-01
RADIUS VECTOR	29	5.000E-01				
HALF-LENGTH	12	1.052E+00	5.235E-02	2.288E-01	2.174E+01	6.605E-02
VOLUTION HEIGHT	29	1.671E-01	4.018E-04	2.005E-02	1.200E+01	3.722E-03
WALL THICKNESS	29	4.607E-02	6.564E-05	8.102E-03	1.759E+01	1.504E-03
TUNNEL WIDTH	9	3.527E+02	3.047E+04	1.745E+02	4.949E+01	5.818E+01
SEPTAL SPACING	16	1.538E+01	5.183E+00	2.277E+00	1.481E+01	5.692E-01
HL/RV	12	2.105E+00	2.094E-01	4.576E-01	2.174E+01	1.321E-01
RADIUS VECTOR	26	6.300E-01				
HALF-LENGTH	9	1.462E+00	1.311E-01	3.621E-01	2.476E+01	1.207E-01
VOLUTION HEIGHT	26	2.072E-01	5.681E-04	2.384E-02	1.151E+01	4.675E-03
WALL THICKNESS	26	5.931E-02	7.214E-05	8.494E-03	1.432E+01	1.666E-03
TUNNEL WIDTH	3	3.907E+02	1.025E+05	3.201E+02	8.195E+01	1.848E+02
SEPTAL SPACING	15	1.940E+01	4.686E+00	2.165E+00	1.116E+01	5.589E-01
HL/RV	9	2.321E+00	3.303E-01	5.747E-01	2.476E+01	1.916E-01
RADIUS VECTOR	24	7.900E-01				
HALF-LENGTH	7	1.944E+00	1.651E-01	4.075E-01	2.096E+01	1.540E-01
VOLUTION HEIGHT	24	2.499E-01	8.281E-04	2.878E-02	1.152E+01	5.874E-03
WALL THICKNESS	24	6.762E-02	8.964E-05	9.468E-03	1.400E+01	1.933E-03
SEPTAL SPACING	14	2.629E+01	1.453E+01	3.811E+00	1.450E+01	1.019E+00
HL/RV	7	2.461E+00	2.661E-01	5.158E-01	2.096E+01	1.950E-01
RADIUS VECTOR	11	1.000E+00				
HALF-LENGTH	2	2.305E+00	4.140E-01	6.435E-01	2.792E+01	4.550E-01
VOLUTION HEIGHT	11	2.725E-01	2.166E-03	4.654E-02	1.707E+01	1.403E-02
WALL THICKNESS	11	7.173E-02	1.014E-04	1.007E-02	1.404E+01	3.036E-03
SEPTAL SPACING	5	3.260E+01	2.680E+01	5.177E+00	1.588E+01	2.315E+00
HL/RV	2	2.305E+00	4.141E-01	6.435E-01	2.792E+01	4.550E-01

←FIGURE 9.—Summary graphs for *Triticites berryi* (Willard Berry, 1933). Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 7. The diameters of proloculi are plotted against the number of specimens.

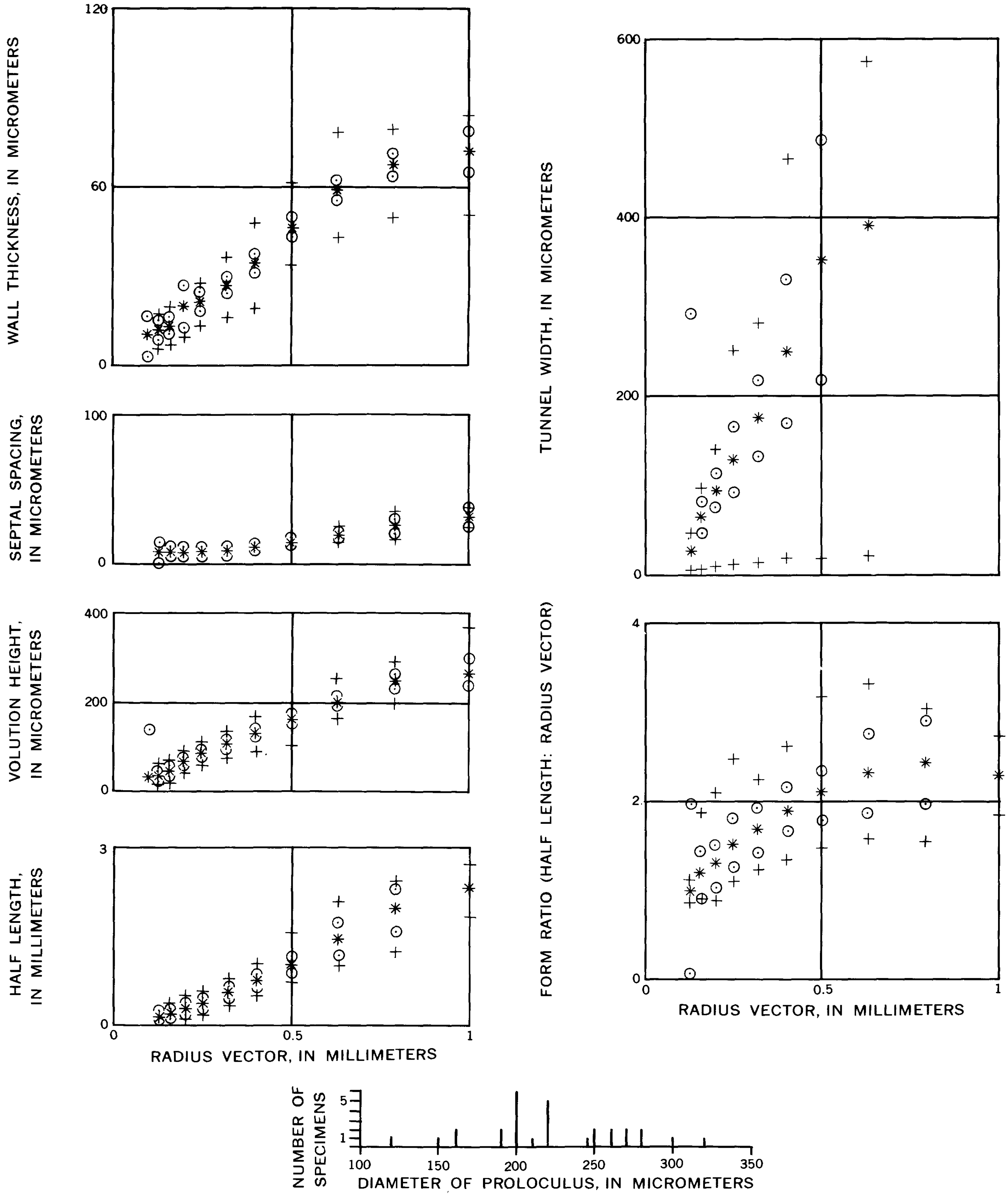

WALL THICKNESS, IN MICROMETERS
SEPTAL SPACING, IN MICROMETERS
VOLUTION HEIGHT, IN MICROMETERS
HALF LENGTH, IN MILLIMETERS
RADIUS VECTOR, IN MILLIMETERS
TUNNEL WIDTH, IN MICROMETERS
FORM RATIO (HALF LENGTH: RADIUS VECTOR)
RADIUS VECTOR, IN MILLIMETERS
NUMBER OF SPECIMENS
DIAMETER OF PROLOCULUS, IN MICROMETERS

TABLE 9.—*Summary numerical data for* Triticites guarellensis *n. sp.*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	10	1.300E-01				
HALF-LENGTH	6	1.800E-01	2.080E-03	4.561E-02	2.534E+01	1.862E-02
VOLUTION HEIGHT	10	3.600E-02	1.540E-04	1.241E-02	3.447E+01	3.924E-03
WALL THICKNESS	10	1.170E-02	1.001E-05	3.164E-03	2.704E+01	1.001E-03
TUNNEL WIDTH	6	7.417E+01	1.502E+02	1.225E+01	1.652E+01	5.003E+00
SEPTAL SPACING	4	7.500E+00	3.000E+00	1.732E+00	2.309E+01	8.660E-01
HL/RV	6	1.385E+00	1.231E-01	3.508E-01	2.534E+01	1.432E-01
RADIUS VECTOR	18	1.600E-01				
HALF-LENGTH	12	2.367E-01	4.497E-03	6.706E-02	2.833E+01	1.936E-02
VOLUTION HEIGHT	18	5.128E-02	9.104E-05	9.541E-03	1.861E+01	2.249E-03
WALL THICKNESS	18	1.283E-02	1.215E-05	3.485E-03	2.716E+01	8.215E-04
TUNNEL WIDTH	10	9.160E+01	6.400E+02	2.530E+01	2.762E+01	8.000E+00
SEPTAL SPACING	6	6.833E+00	5.667E-01	7.528E-01	1.102E+01	3.073E-01
HL/RV	12	1.479E+00	1.757E-01	4.191E-01	2.833E+01	1.210E-01
RADIUS VECTOR	19	2.000E-01				
HALF-LENGTH	13	3.654E-01	8.144E-03	9.024E-02	2.470E+01	2.503E-02
VOLUTION HEIGHT	19	6.821E-02	1.183E-04	1.088E-02	1.594E+01	2.495E-03
WALL THICKNESS	19	1.674E-02	1.476E-05	3.842E-03	2.295E+01	8.814E-04
TUNNEL WIDTH	12	1.249E+02	1.056E+03	3.249E+01	2.601E+01	9.379E+00
SEPTAL SPACING	6	7.500E+00	4.300E+00	2.074E+00	2.765E+01	8.466E-01
HL/RV	13	1.827E+00	2.036E-01	4.512E-01	2.470E+01	1.251E-01
RADIUS VECTOR	21	2.500E-01				
HALF-LENGTH	13	5.208E-01	1.032E-02	1.016E-01	1.951E+01	2.818E-02
VOLUTION HEIGHT	21	8.567E-02	8.733E-05	9.345E-03	1.091E+01	2.039E-03
WALL THICKNESS	21	2.148E-02	2.936E-05	5.419E-03	2.523E+01	1.182E-03
TUNNEL WIDTH	13	1.858E+02	3.180E+03	5.639E+01	3.034E+01	1.564E+01
SEPTAL SPACING	7	8.571E+00	5.286E+00	2.299E+00	2.682E+01	8.690E-01
HL/RV	13	2.083E+00	1.652E-01	4.064E-01	1.951E+01	1.127E-01
RADIUS VECTOR	21	3.200E-01				
HALF-LENGTH	13	7.138E-01	2.984E-02	1.727E-01	2.420E+01	4.791E-02
VOLUTION HEIGHT	21	1.058E-01	1.953E-04	1.397E-02	1.321E+01	3.049E-03
WALL THICKNESS	21	2.690E-02	4.019E-05	6.340E-03	2.356E+01	1.383E-03
TUNNEL WIDTH	13	2.818E+02	6.894E+03	8.303E+01	2.947E+01	2.303E+01
SEPTAL SPACING	8	9.875E+00	1.268E+00	1.126E+00	1.140E+01	3.981E-01
HL/RV	13	2.231E+00	2.914E-01	5.398E-01	2.420E+01	1.497E-01
RADIUS VECTOR	21	4.000E-01				
HALF-LENGTH	13	9.715E-01	4.856E-02	2.204E-01	2.268E+01	6.112E-02
VOLUTION HEIGHT	21	1.371E-01	2.270E-04	1.507E-02	1.099E+01	3.288E-03
WALL THICKNESS	21	3.429E-02	6.041E-05	7.773E-03	2.267E+01	1.696E-03
TUNNEL WIDTH	10	3.895E+02	2.464E+04	1.570E+02	4.030E+01	4.964E+01
SEPTAL SPACING	8	1.275E+01	6.786E+00	2.605E+00	2.043E+01	9.210E-01
HL/RV	13	2.429E+00	3.035E-01	5.509E-01	2.268E+01	1.528E-01
RADIUS VECTOR	21	5.000E-01				
HALF-LENGTH	13	1.278E+00	7.639E-02	2.764E-01	2.163E+01	7.665E-02
VOLUTION HEIGHT	21	1.730E-01	3.638E-04	1.907E-02	1.103E+01	4.162E-03
WALL THICKNESS	21	4.357E-02	6.756E-05	8.219E-03	1.886E+01	1.794E-03
TUNNEL WIDTH	7	5.737E+02	6.980E+04	2.642E+02	4.605E+01	9.986E+01
SEPTAL SPACING	8	1.513E+01	1.670E+01	4.086E+00	2.702E+01	1.445E+00
HL/RV	13	2.555E+00	3.055E-01	5.528E-01	2.163E+01	1.533E-01
RADIUS VECTOR	19	6.300E-01				
HALF-LENGTH	12	1.762E+00	1.457E-01	3.817E-01	2.167E+01	1.102E-01
VOLUTION HEIGHT	19	2.076E-01	9.736E-04	3.120E-02	1.503E+01	7.158E-03
WALL THICKNESS	19	5.374E-02	1.153E-04	1.074E-02	1.998E+01	2.464E-03
TUNNEL WIDTH	3	7.683E+02	1.903E+05	4.362E+02	5.677E+01	2.518E+02
SEPTAL SPACING	7	1.871E+01	3.290E+01	5.736E+00	3.065E+01	2.168E+00
HL/RV	12	2.795E+00	3.670E-01	6.058E-01	2.167E+01	1.749E-01
RADIUS VECTOR	11	7.900E-01				
HALF-LENGTH	6	2.377E+00	2.504E-01	5.004E-01	2.105E+01	2.043E-01
VOLUTION HEIGHT	11	2.608E-01	2.169E-03	4.657E-02	1.785E+01	1.404E-02
WALL THICKNESS	11	6.864E-02	1.315E-04	1.147E-02	1.670E+01	3.457E-03
SEPTAL SPACING	4	2.075E+01	1.492E+01	3.862E+00	1.861E+01	1.931E+00
HL/RV	6	3.008E+00	4.012E-01	6.334E-01	2.105E+01	2.586E-01
RADIUS VECTOR	4	1.000E+00				
VOLUTION HEIGHT	4	3.427E-01	1.545E-03	3.931E-02	1.147E+01	1.965E-02
WALL THICKNESS	4	8.425E-02	6.225E-05	7.890E-03	9.365E+00	3.945E-03
SEPTAL SPACING	3	2.700E+01	6.300E+01	7.937E+00	2.940E+01	4.583E+00

←FIGURE 10.—Summary graphs for *Triticites australis* n. sp. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 8. The diameters of proloculi are plotted against the number of specimens.

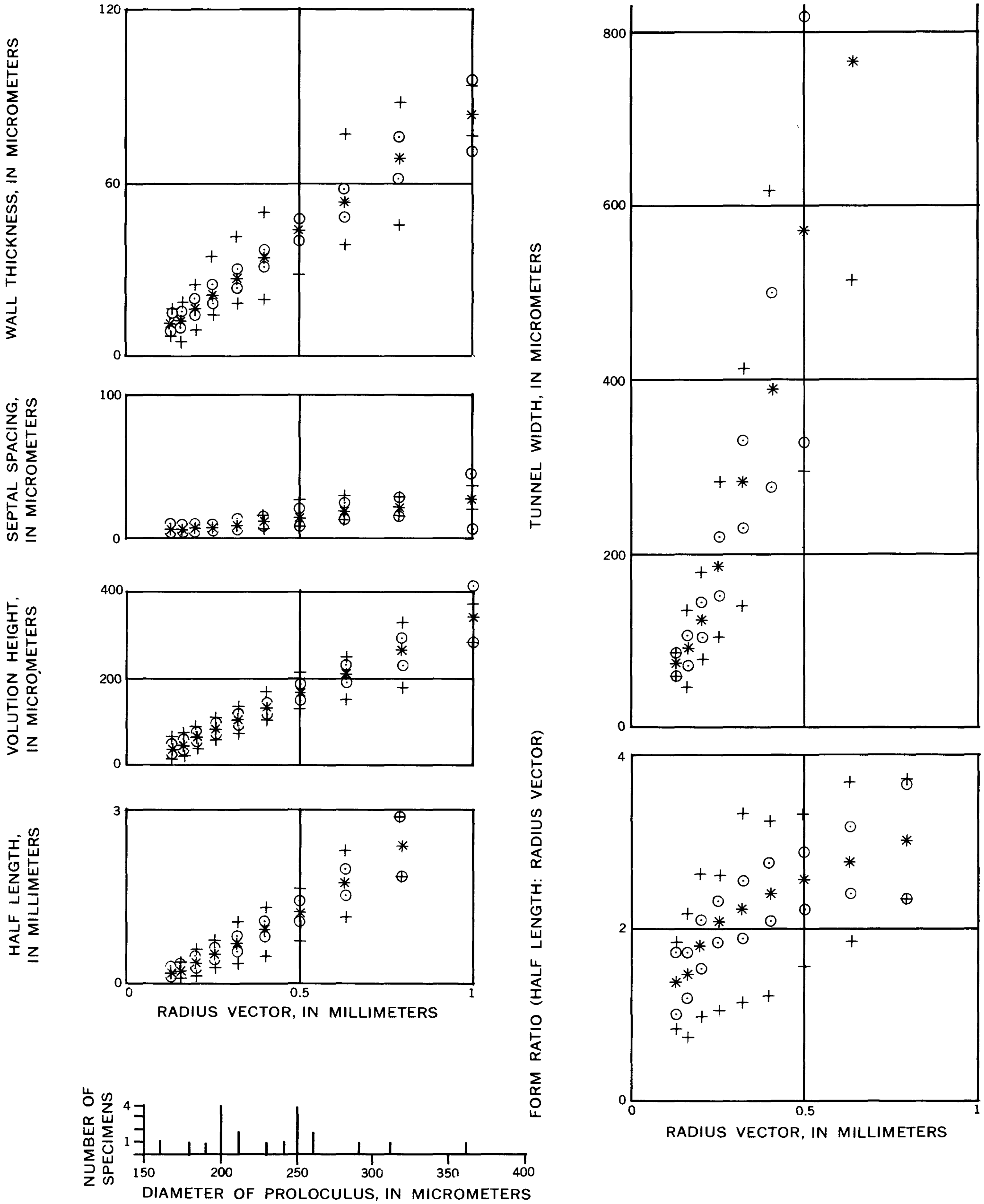
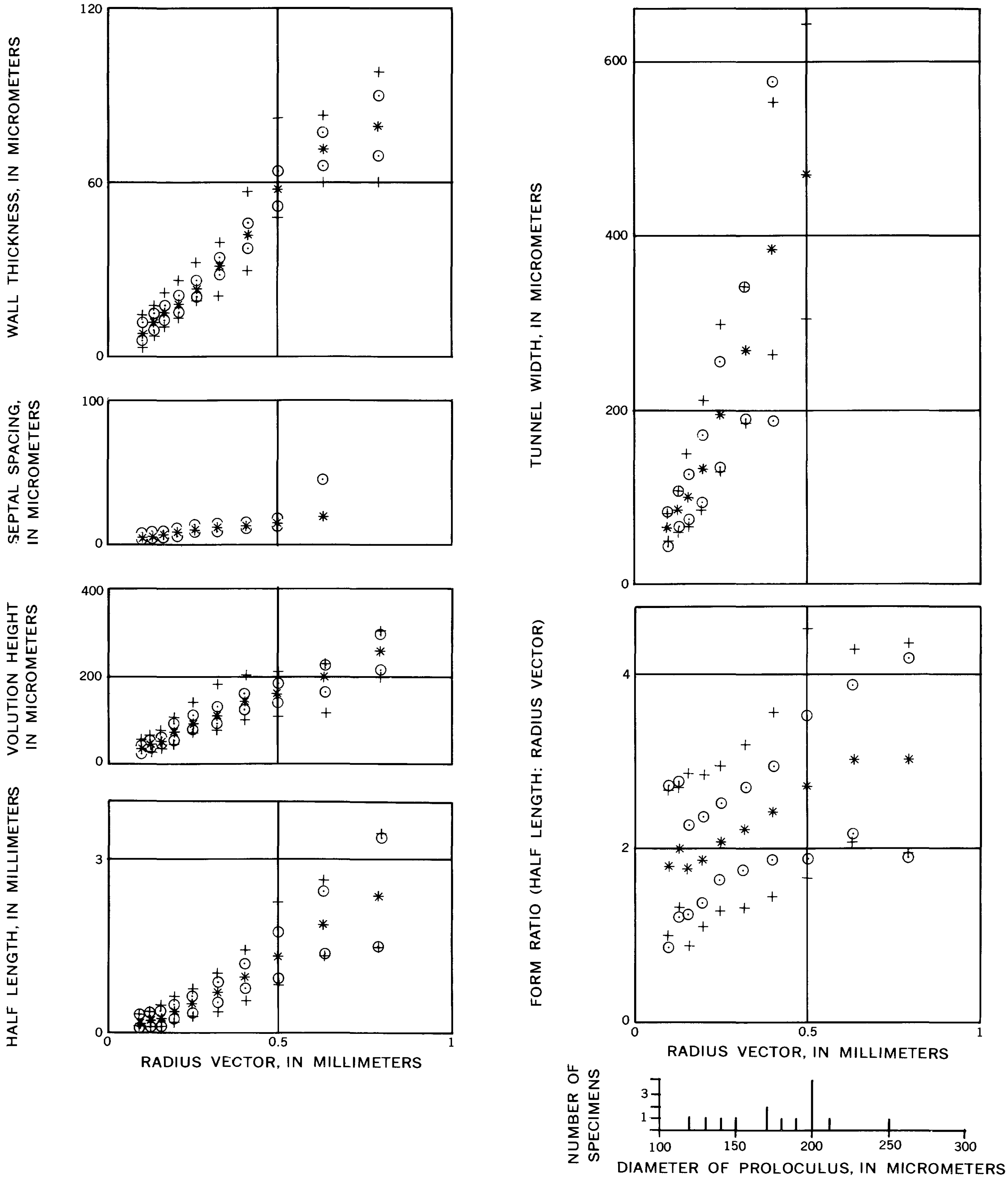

WALL THICKNESS, IN MICROMETERS
0
60
120
SEPTAL SPACING, IN MICROMETERS
0
100
VOLUTION HEIGHT, IN MICROMETERS
0
200
400
HALF LENGTH, IN MILLIMETERS
0
3
0
0.5
1
RADIUS VECTOR, IN MILLIMETERS
NUMBER OF SPECIMENS
1
4
150
200
250
300
350
400
DIAMETER OF PROLOCULUS, IN MICROMETERS
TUNNEL WIDTH, IN MICROMETERS
0
200
400
600
800
FORM RATIO (HALF LENGTH: RADIUS VECTOR)
0
2
4
0
0.5
1
RADIUS VECTOR, IN MILLIMETERS

TABLE 10.—*Summary numerical data for* Triticites tarltonensis *n. sp.*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	8	1.000E-01				
HALF-LENGTH	5	1.800E-01	5.700E-03	7.550E-02	4.194E+01	3.376E-02
VOLUTION HEIGHT	8	3.262E-02	5.512E-05	7.425E-03	2.276E+01	2.625E-03
WALL THICKNESS	8	8.750E-03	4.214E-06	2.053E-03	2.346E+01	7.258E-04
TUNNEL WIDTH	4	6.500E+01	1.667E+02	1.291E+01	1.986E+01	6.455E+00
SEPTAL SPACING	3	4.667E+00	3.333E-01	5.774E-01	1.237E+01	3.333E-01
HL/RV	5	1.800E+00	5.700E-01	7.550E-01	4.194E+01	3.376E-01
RADIUS VECTOR	11	1.300E-01				
HALF-LENGTH	5	2.600E-01	6.650E-03	8.155E-02	3.136E+01	3.647E-02
VOLUTION HEIGHT	11	4.073E-02	5.722E-05	7.564E-03	1.857E+01	2.281E-03
WALL THICKNESS	11	1.209E-02	8.091E-06	2.844E-03	2.353E+01	8.576E-04
TUNNEL WIDTH	5	8.760E+01	2.633E+02	1.623E+01	1.852E+01	7.257E+00
SEPTAL SPACING	6	5.833E+00	2.167E+00	1.472E+00	2.523E+01	6.009E-01
HL/RV	5	2.000E+00	3.935E-01	6.273E-01	3.136E+01	2.805E-01
RADIUS VECTOR	16	1.600E-01				
HALF-LENGTH	9	2.811E-01	1.166E-02	1.080E-01	3.841E+01	3.600E-02
VOLUTION HEIGHT	16	5.419E-02	6.990E-05	8.360E-03	1.543E+01	2.090E-03
WALL THICKNESS	16	1.581E-02	1.176E-05	3.430E-03	2.169E+01	8.574E-04
TUNNEL WIDTH	8	1.014E+02	8.548E+02	2.924E+01	2.884E+01	1.034E+01
SEPTAL SPACING	7	7.000E+00	1.000E+00	1.000E+00	1.429E+01	3.780E-01
HL/RV	9	1.757E+00	4.555E-01	6.749E-01	3.841E+01	2.250E-01
RADIUS VECTOR	16	2.000E-01				
HALF-LENGTH	9	3.744E-01	1.705E-02	1.306E-01	3.487E+01	4.353E-02
VOLUTION HEIGHT	16	7.319E-02	8.630E-05	9.290E-03	1.269E+01	2.322E-03
WALL THICKNESS	16	1.875E-02	1.407E-05	3.751E-03	2.000E+01	9.376E-04
TUNNEL WIDTH	8	1.343E+02	2.072E+03	4.552E+01	3.391E+01	1.609E+01
SEPTAL SPACING	7	8.429E+00	1.286E+00	1.134E+00	1.345E+01	4.286E-01
HL/RV	9	1.872E+00	4.263E-01	6.529E-01	3.487E+01	2.176E-01
RADIUS VECTOR	16	2.500E-01				
HALF-LENGTH	9	5.233E-01	2.110E-02	1.453E-01	2.776E+01	4.842E-02
VOLUTION HEIGHT	16	9.337E-02	2.114E-04	1.454E-02	1.557E+01	3.635E-03
WALL THICKNESS	16	2.419E-02	1.803E-05	4.246E-03	1.755E+01	1.062E-03
TUNNEL WIDTH	7	1.953E+02	4.240E+03	6.512E+01	3.334E+01	2.461E+01
SEPTAL SPACING	7	1.086E+01	2.810E+00	1.676E+00	1.544E+01	6.335E-01
HL/RV	9	2.093E+00	3.376E-01	5.810E-01	2.776E+01	1.937E-01
RADIUS VECTOR	16	3.200E-01				
HALF-LENGTH	9	7.156E-01	4.245E-02	2.060E-01	2.879E+01	6.868E-02
VOLUTION HEIGHT	16	1.156E-01	4.388E-04	2.095E-02	1.812E+01	5.237E-03
WALL THICKNESS	16	3.125E-02	3.887E-05	6.234E-03	1.995E+01	1.559E-03
TUNNEL WIDTH	5	2.676E+02	3.702E+03	6.084E+01	2.274E+01	2.721E+01
SEPTAL SPACING	7	1.214E+01	4.143E+00	2.035E+00	1.676E+01	7.693E-01
HL/RV	9	2.236E+00	4.146E-01	6.439E-01	2.879E+01	2.146E-01
RADIUS VECTOR	16	4.000E-01				
HALF-LENGTH	9	9.711E-01	7.779E-02	2.789E-01	2.872E+01	9.297E-02
VOLUTION HEIGHT	16	1.438E-01	5.135E-04	2.266E-02	1.576E+01	5.665E-03
WALL THICKNESS	16	4.206E-02	7.126E-05	8.442E-03	2.007E+01	2.110E-03
TUNNEL WIDTH	4	3.843E+02	1.509E+04	1.228E+02	3.197E+01	6.141E+01
SEPTAL SPACING	7	1.386E+01	5.810E+00	2.410E+00	1.739E+01	9.110E-01
HL/RV	9	2.428E+00	4.862E-01	6.973E-01	2.872E+01	2.324E-01
RADIUS VECTOR	13	5.000E-01				
HALF-LENGTH	8	1.361E+00	2.475E-01	4.975E-01	3.655E+01	1.759E-01
VOLUTION HEIGHT	13	1.699E-01	7.111E-04	2.667E-02	1.569E+01	7.396E-03
WALL THICKNESS	13	5.808E-02	1.051E-04	1.025E-02	1.765E+01	2.843E-03
TUNNEL WIDTH	2	4.745E+02	5.678E+04	2.383E+02	5.022E+01	1.685E+02
SEPTAL SPACING	5	1.640E+01	4.300E+00	2.074E+00	1.264E+01	9.274E-01
HL/RV	8	2.722E+00	9.900E-01	9.950E-01	3.655E+01	3.518E-01
RADIUS VECTOR	9	6.300E-01				
HALF-LENGTH	6	1.915E+00	2.603E-01	5.102E-01	2.664E+01	2.083E-01
VOLUTION HEIGHT	9	1.969E-01	1.412E-03	3.757E-02	1.908E+01	1.252E-02
WALL THICKNESS	9	7.156E-02	5.803E-05	7.618E-03	1.065E+01	2.539E-03
SEPTAL SPACING	2	2.000E+01	8.000E+00	2.828E+00	1.414E+01	2.000E+00
HL/RV	6	3.040E+00	6.558E-01	8.098E-01	2.664E+01	3.306E-01
RADIUS VECTOR	7	7.900E-01				
HALF-LENGTH	5	2.416E+00	5.411E-01	7.356E-01	3.045E+01	3.290E-01
VOLUTION HEIGHT	7	2.626E-01	1.858E-03	4.310E-02	1.642E+01	1.629E-02
WALL THICKNESS	7	7.943E-02	1.276E-04	1.130E-02	1.422E+01	4.270E-03
HL/RV	5	3.058E+00	8.671E-01	9.312E-01	3.045E+01	4.164E-01

←FIGURE 11.—Summary graphs for *Triticites guarellensis* n. sp. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 9. The diameters of proloculi are plotted against the number of specimens.


WALL THICKNESS, IN MICROMETERS
SEPTAL SPACING, IN MICROMETERS
VOLUTION HEIGHT IN MICROMETERS
HALF LENGTH, IN MILLIMETERS
RADIUS VECTOR, IN MILLIMETERS
TUNNEL WIDTH, IN MICROMETERS
FORM RATIO (HALF LENGTH: RADIUS VECTOR)
RADIUS VECTOR, IN MILLIMETERS
NUMBER OF SPECIMENS
DIAMETER OF PROLOCULUS, IN MICROMETERS

The wall increases regularly in thickness to a mean of about 80 μm and maximum of 98μm in the outer volutions. It is composed of a tectum and fine keriotheca. The wall shows some irregularity (pl. 11, figs. 2a,b) but is not rugose.

The septa are closely spaced and are fluted irregularly. Some specimens show fluting across the middle of the shell, and all show tight but irregular fluting on the poles.

The tunnel widens rapidly and is obvious in the inner volutions where it is bounded by well developed but small chomata. Beyond the fourth volution the tunnel is indistinct, and chomata are poorly developed or present only as pseudochomata. No axial filling was recognized.

Comparison and remarks.—*T. tarltonensis* n. sp. bears some resemblance to the specimens described by Roberts as *Schwagerina tintensis* Roberts (1949, p. 213), but his form has more uniformly ovoid shape and more regularly fluted septa. The statement that chomata are developed throughout the shell precludes assigning his forms to *Schwagerina*, but without further study it would be difficult to reassign them properly. The form described as *T. boliviensis* by Dunbar and Newell (1946, p. 481) has a similar form ratio but has a thinner wall and does not become as large.

Material studied.—Sixteen oriented thin sections of *T. tarltonensis* were measured from sample f22492. This sample of silty limestone contains abundant fusulinids, including *Triticites*, *Pseudofusulina* sp. A, and *Schwagerina patagoniensis* n. sp.

Designation of types.—The specimen illustrated on plate 11, figures 1a, b, is designated the holotype (USNM 188307). The other specimens studied are paratypes (USNM 188308–312).

Genus SCHWAGERINA Moller, 1877

Schwagerina patagoniensis Douglass and Nestell, n. sp.

Plate 12, figures 1–10

Diagnosis.—Shell elongate fusiform, attaining lengths of as much as 8.5 mm and widths of as much as 2.3 mm in five volutions. The inner volutions fusiform, the shell expanding regularly and lengthening rapidly with a straight axis of coiling. Spirotheca of a tectum and fairly coarse keriotheca thickening regularly and rapidly throughout the shell. The septa are irregularly fluted and closely spaced. Pseudochomata are present erratically in the inner three volutions.

Description.—Summaries of the numerical data are given in table 11 and figure 13. The volution height increases regularly through the shell, and the length increases rapidly. The form ratio increases almost constantly through most of the shell, but the average decreases for the last volution (fig. 13). The axis of coiling is essentially straight.

The proloculus is large and spherical to oblate, from 260 μm to 380 μm in outer diameter.

The wall thickness increases rapidly throughout the test to about 90 μm in the outer volutions (fig. 13). The wall is composed of a tectum on fairly coarse keriotheca (pl. 12, fig. 9b).

The septa are closely spaced and are irregularly fluted throughout the length of the shell. They may have some epithecal deposits in the vicinity of the tunnel (pl. 12, figs. 8, 9b).

The tunnel is poorly defined, having only pseudochomata developed erratically through the early volutions. True chomata may be present in the earliest part of the shell, but many sections in the area of the tunnel failed to reveal any. No axial filling was recognized.

Comparison and remarks.—*Schwagerina patagoniensis* n. sp. is assigned to the genus *Schwagerina*, even though it is not typical of the members of of the genus. It is probably closely related to forms such as *Schwagerina demissa* Skinner and Wilde (1965, p. 44) that do not develop quite enough rugosity to be assigned to *Pseudofusulina*. The wall is irregular (pl. 12, fig. 1 upper part), but few specimens show any rugosity, and then only in local areas. Available data are insufficient to compare the Chilean and Californian forms, but on the California specimens the wall is reported thicker and the proloculus smaller. Perhaps further study would indicate that the Chilean form is a geographic variant of *S. demissa*. The age of the samples is apparently similar.

Material studied.—*Schwagerina patagoniensis* n. sp. was recognized in sample f22483 in fine-grained silty limestone that is fractured and plastically deformed. The presence of common isolated proloculi and fusulinid juvenaria suggests that almost no winnowing has occurred. Twenty-two thin sections were studied containing 16 oriented specimens that were measured. *Millerella* sp., *Schubertella* sp., *Bradyina* sp., and *Climacammina* sp. are also present in the sample.

FIGURE 12.—Summary graphs for *Triticites tarltonensis* n. sp. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean ⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 10. The diameters of proloculi are plotted against the number of specimens.

Designation of types.—The specimen illustrated on plate 12, figure 1, is designated the holotype (USNM 188241). The other specimens studied are paratypes (USNM 188242–250).

Schwagerina sp. A

Plate 12, figures 11–15

Description.—Several specimens of a moderately large and highly inflated *Schwagerina* are recognized from sample f22484. Summaries of the numerical data are given in table 12 and figure 14. Most of the specimens are deformed, and few significant measurements could be made. The specimens are as much as 8 mm long and 3 mm wide in four volutions. The form ratio remains close to two on most specimens.

The proloculus is large, ranging from a little less than 300 μm to nearly 450 μm in outside diameter (fig. 14). It is subspherical to oblate.

The spirotheca is composed of a tectum and keriotheca. It thickens fairly rapidly to about 90 μm in the outer volutions.

The septa are closely spaced and tightly fluted throughout the shell, but the fluting is irregular both in intensity and in height.

The tunnel is indistinct, and no chomata were recognized.

Comparison and remarks.—*Schwagerina* sp. A bears some resemblance to *Schwagerina patagoniensis* n. sp., but it has a larger proloculus, is more inflated, has more intensely fluted septa, and has a less distinct tunnel.

Material studied.—Nineteen thin sections were studied from sample f22484, and measurements were made on six of the less deformed specimens. The specimens occur in a fractured and plastically deformed silty limestone associated with some echinodermal debris and with *Tetrataxis* sp., *Bradyina* sp., and *Climacammina* sp.

Schwagerina sp. aff. S. muñaniensis Dnnbar and Newell, 1946

Plate 13, figures 1–6

Diagnosis.—Shell small, thickly fusiform with pointed poles. Length as much as 6 mm and widths as much as 3 mm in seven volutions. The inner volutions are tightly coiled, and the shell expands gradually, maintaining a form ratio near two. The spirotheca is composed of a tectum and fine keriotheca. The septa are closely spaced and tightly fluted throughout.

Description.—Summaries of the numerical data are given in table 13 and figure 15. The volution height increases regularly throughout the growth of the shell (fig. 15), and the length increases slowly, so the mean form ratio stays below two, some specimens attaining a form ratio of more than three in some volutions. The axis of coiling is nearly straight.

The proloculus is small, 100–230 μm, and is sperical to subspherical.

The wall is composed of a tectum and fine keriotheca. It thickens gradually throughout the growth, attaining about 100 μm in the outer volutions.

The septa are closely spaced and are fluted throughout the shell. Fluting extends through the entire height of the chamber, even in the equatorial area.

The tunnel is rather narrow and is indistinct in some areas, as there are no chomata beyond the proloculus. A small amount of epithecal deposit tends to accumulate along the axis and as pseudochomata in parts of some specimens.

Comparison and remarks.—The specimens from Chile bear a striking resemblance to the specimens illustrated from Peru. The reported form ratio in the Peruvian forms is greater, and those forms do not attain as thick a wall. The specimens in both suites are variable, and overlap is considerable. The form described as *Schwagerina pseudoprinceps* Skinner and Wilde (1965, p. 45) is similar in many respects but is larger and is more regular in its fluting.

Material studied.—*S.* sp. aff. *S. muñaniensis* is found in sample f22492 associated with *Triticites tarltonensis* n. sp. and *Pseudofusulina* sp. A. Eight oriented sections were measured, and other specimens were studied in 30 thin sections of silty limestone.

Schwagerina? sp. aff. S.? patens Dunbar and Newell, 1946

Plate 14, figures 1, 2

Several deformed specimens of fusulinids resembling *Schwagerina? patens* Dunbar and Newell (1946, p. 464) are present in sample f22493 from Isla Tarlton. None is sufficiently well preserved for accurate comparison. The tightly coiled inner volutions, followed by rapid expansion and elongation, are apparent, and it seems likely that better preservation might show other similarities.

Genus PSEUDOFUSULINA Dunbar and Skinner, 1931

Pseudofusulina chilensis Douglass and Nestell, n. sp.

Plate 15, figures 1–17; plate 16, figures 1–4

Diagnosis.—Shell small for the genus, attaining lengths of 8 mm and widths of 2.5 to 3 mm in five volutions. The shape is elongate fusiform to ovoid with irregular lateral slopes and rounded poles. The coiling is loose and irregular. The septa are irregularly spaced and irregularly fluted throughout the shell. The spirotheca is composed of a tectum and fairly coarse keriotheca. It develops irregular rugosity. The tunnel is indistinct and wanders in the equatorial area.

Descriptions.—Summaries of the numerical data

TABLE 11.—*Summary numerical data for* Schwagerina patagoniensis *n. sp.*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	9	2.000E-01				
HALF-LENGTH	7	3.243E-01	9.062E-03	9.519E-02	2.935E+01	3.598E-02
VOLUTION HEIGHT	9	6.044E-02	1.503E-04	1.226E-02	2.028E+01	4.086E-03
WALL THICKNESS	9	1.678E-02	1.344E-05	3.667E-03	2.185E+01	1.222E-03
TUNNEL WIDTH	4	1.175E+02	3.130E+02	1.769E+01	1.506E+01	8.846E+00
SEPTAL SPACING	2	7.000E+00	2.000E+00	1.414E+00	2.020E+01	1.000E+00
HL/RV	7	1.621E+00	2.265E-01	4.760E-01	2.935E+01	1.799E-01
RADIUS VECTOR	16	2.500E-01				
HALF-LENGTH	11	4.518E-01	1.698E-02	1.303E-01	2.884E+01	3.928E-02
VOLUTION HEIGHT	16	8.237E-02	1.174E-04	1.084E-02	1.316E+01	2.709E-03
WALL THICKNESS	16	2.106E-02	1.860E-05	4.312E-03	2.047E+01	1.078E-03
TUNNEL WIDTH	7	1.517E+02	3.492E+02	1.869E+01	1.232E+01	7.063E+00
SEPTAL SPACING	5	8.600E+00	1.800E+00	1.342E+00	1.560E+01	6.000E-01
HL/RV	11	1.807E+00	2.716E-01	5.212E-01	2.884E+01	1.571E-01
RADIUS VECTOR	16	3.200E-01				
HALF-LENGTH	11	6.845E-01	2.737E-02	1.654E-01	2.417E+01	4.988E-02
VOLUTION HEIGHT	16	1.038E-01	4.082E-04	2.020E-02	1.946E+01	5.051E-03
WALL THICKNESS	16	2.756E-02	4.680E-05	6.841E-03	2.482E+01	1.710E-03
TUNNEL WIDTH	9	2.384E+02	1.737E+03	4.167E+01	1.748E+01	1.389E+01
SEPTAL SPACING	5	9.400E+00	2.300E+00	1.517E+00	1.613E+01	6.782E-01
HL/RV	11	2.139E+00	2.673E-01	5.170E-01	2.417E+01	1.559E-01
RADIUS VECTOR	16	4.000E-01				
HALF-LENGTH	11	9.291E-01	5.113E-02	2.261E-01	2.434E+01	6.818E-02
VOLUTION HEIGHT	16	1.343E-01	1.056E-03	3.249E-02	2.419E+01	8.122E-03
WALL THICKNESS	16	3.587E-02	4.092E-05	6.397E-03	1.783E+01	1.599E-03
TUNNEL WIDTH	8	3.220E+02	5.669E+03	7.529E+01	2.338E+01	2.662E+01
SEPTAL SPACING	5	1.140E+01	4.300E+00	2.074E+00	1.819E+01	9.274E-01
HL/RV	11	2.323E+00	3.196E-01	5.653E-01	2.434E+01	1.704E-01
RADIUS VECTOR	16	5.000E-01				
HALF-LENGTH	11	1.288E+00	5.468E-02	2.338E-01	1.815E+01	7.050E-02
VOLUTION HEIGHT	16	1.843E-01	2.501E-04	1.581E-02	8.580E+00	3.954E-03
WALL THICKNESS	16	4.812E-02	5.172E-05	7.191E-03	1.494E+01	1.798E-03
TUNNEL WIDTH	5	4.232E+02	1.008E+04	1.004E+02	2.372E+01	4.490E+01
SEPTAL SPACING	5	1.380E+01	3.700E+00	1.924E+00	1.394E+01	8.602E-01
HL/RV	11	2.576E+00	2.187E-01	4.677E-01	1.815E+01	1.410E-01
RADIUS VECTOR	16	6.300E-01				
HALF-LENGTH	10	1.660E+00	1.061E-01	3.258E-01	1.963E+01	1.030E-01
VOLUTION HEIGHT	16	2.364E-01	2.743E-04	1.656E-02	7.004E+00	4.140E-03
WALL THICKNESS	16	6.025E-02	8.900E-05	9.434E-03	1.566E+01	2.358E-03
SEPTAL SPACING	5	1.840E+01	6.300E+00	2.510E+00	1.364E+01	1.122E+00
HL/RV	10	2.635E+00	2.674E-01	5.171E-01	1.963E+01	1.635E-01
RADIUS VECTOR	14	7.900E-01				
HALF-LENGTH	8	2.304E+00	1.845E-01	4.295E-01	1.864E+01	1.519E-01
VOLUTION HEIGHT	14	2.826E-01	3.963E-04	1.991E-02	7.045E+00	5.320E-03
WALL THICKNESS	14	7.350E-02	3.412E-05	5.841E-03	7.947E+00	1.561E-03
SEPTAL SPACING	5	2.100E+01	5.000E+00	2.236E+00	1.065E+01	1.000E+00
HL/RV	8	2.916E+00	2.956E-01	5.437E-01	1.864E+01	1.922E-01
RADIUS VECTOR	6	1.000E+00				
HALF-LENGTH	3	2.693E+00	1.377E-01	3.711E-01	1.378E+01	2.143E-01
VOLUTION HEIGHT	6	3.138E-01	1.077E-03	3.282E-02	1.046E+01	1.340E-02
WALL THICKNESS	4	8.425E-02	1.092E-05	3.304E-03	3.922E+00	1.652E-03
SEPTAL SPACING	2	2.400E+01	1.800E+01	4.243E+00	1.768E+01	3.000E+00
HL/RV	3	2.693E+00	1.377E-01	3.711E-01	1.378E+01	2.143E-01

are given in table 14 and figure 16. The volution height increases rapidly but irregularly throughout the shell. The length increases more regularly and rapidly. The form ratio increases throughout growth but never exceeds 2.6 (fig. 16). The axis of coiling is essentially straight.

The proloculus is large, ranging from 200 to 400 μm in outer diameter (fig. 16). It is generally spherical but occasionally partly flattened.

The wall thickness increases rapidly to nearly 100 μm in the outer volutions. The wall is composed of a tectum and fairly coarse keriotheca (pl. 16, figs. 1, 2), and it tends to be irregular in its outer surface (pl. 15, fig. 15b; pl. 16, fig. 3).

The septa are irregularly spaced and irregularly fluted. Closed chamberlets are common in the lower half of the chambers. No cuniculi were seen.

The tunnel wanders in the equatorial area and is one-third to one-half the chamber height. The width is variable and poorly defined in the absence of chomata. Some thickening of the septa to develop pseudochomata is found irregularly distributed (pl. 16, fig. 1). No other epithecal deposits were recognized.

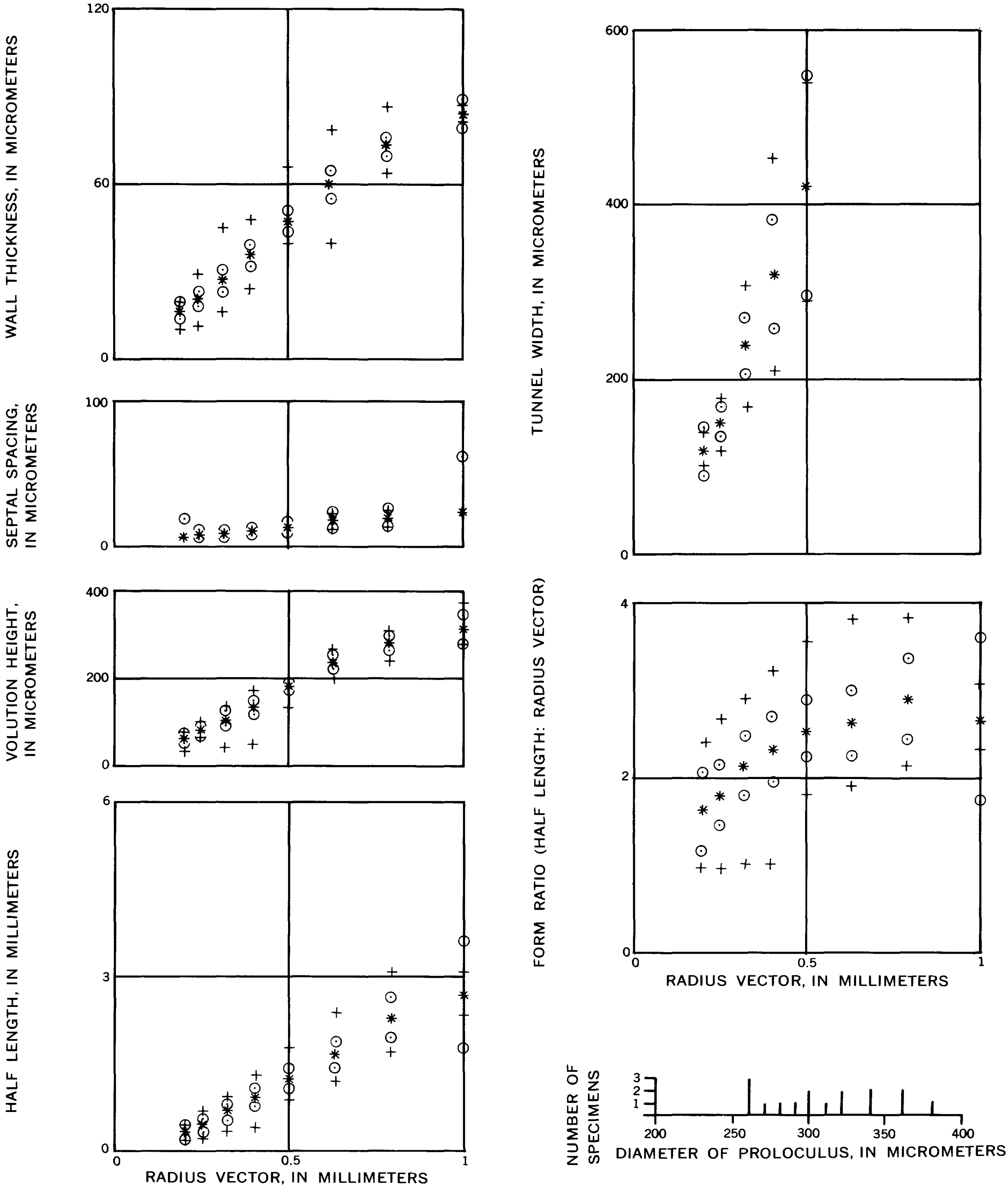

WALL THICKNESS, IN MICROMETERS
120
60
0
SEPTAL SPACING, IN MICROMETERS
100
0
VOLUTION HEIGHT, IN MICROMETERS
400
200
0
HALF LENGTH, IN MILLIMETERS
6
3
0
0
0.5
1
RADIUS VECTOR, IN MILLIMETERS
TUNNEL WIDTH, IN MICROMETERS
600
400
200
0
FORM RATIO (HALF LENGTH: RADIUS VECTOR)
4
2
0
0
0.5
1
RADIUS VECTOR, IN MILLIMETERS
NUMBER OF SPECIMENS
3
2
1
200
250
300
350
400
DIAMETER OF PROLOCULUS, IN MICROMETERS

TABLE 12.—*Summary numerical data for* Schwagerina *sp. A*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	5	2.500E-01				
HALF-LENGTH	3	3.433E-01	9.633E-03	9.815E-02	2.859E+01	5.667E-02
VOLUTION HEIGHT	5	8.820E-02	8.170E-05	9.039E-03	1.025E+01	4.042E-03
WALL THICKNESS	5	1.840E-02	2.030E-05	4.506E-03	2.449E+01	2.015E-03
TUNNEL WIDTH	3	1.353E+02	3.236E+03	5.689E+01	4.204E+01	3.284E+01
HL/RV	3	1.373E+00	1.541E-01	3.926E-01	2.859E+01	2.267E-01
RADIUS VECTOR	5	3.200E-01				
HALF-LENGTH	3	4.933E-01	2.963E-02	1.721E-01	3.489E+01	9.939E-02
VOLUTION HEIGHT	5	1.142E-01	4.370E-05	6.611E-03	5.789E+00	2.956E-03
WALL THICKNESS	5	2.320E-02	3.170E-05	5.630E-03	2.427E+01	2.518E-03
TUNNEL WIDTH	2	2.025E+02	1.531E+04	1.237E+02	6.111E+01	8.750E+01
HL/RV	3	1.542E+00	2.894E-01	5.379E-01	3.489E+01	3.106E-01
RADIUS VECTOR	6	4.000E-01				
HALF-LENGTH	3	6.900E-01	6.430E-02	2.536E-01	3.675E+01	1.464E-01
VOLUTION HEIGHT	6	1.517E-01	1.063E-04	1.031E-02	6.797E+00	4.208E-03
WALL THICKNESS	6	2.850E-02	1.990E-05	4.461E-03	1.565E+01	1.821E-03
TUNNEL WIDTH	2	2.940E+02	2.290E+04	1.513E+02	5.147E+01	1.070E+02
SEPTAL SPACING	3	1.033E+01	4.333E+00	2.082E+00	2.015E+01	1.202E+00
HL/RV	3	1.725E+00	4.019E-01	6.339E-01	3.675E+01	3.660E-01
RADIUS VECTOR	6	5.000E-01				
HALF-LENGTH	3	8.600E-01	5.770E-02	2.402E-01	2.793E+01	1.387E-01
VOLUTION HEIGHT	6	2.040E-01	3.804E-04	1.950E-02	9.561E+00	7.962E-03
WALL THICKNESS	6	3.550E-02	5.870E-05	7.662E-03	2.158E+01	3.128E-03
SEPTAL SPACING	3	1.300E+01	4.000E+00	2.000E+00	1.538E+01	1.155E+00
HL/RV	3	1.720E+00	2.308E-01	4.804E-01	2.793E+01	2.774E-01
RADIUS VECTOR	6	6.300E-01				
HALF-LENGTH	4	1.257E+00	2.118E-01	4.602E-01	3.659E+01	2.301E-01
VOLUTION HEIGHT	6	2.577E-01	8.995E-04	2.999E-02	1.164E+01	1.224E-02
WALL THICKNESS	6	5.083E-02	1.006E-04	1.003E-02	1.973E+01	4.094E-03
SEPTAL SPACING	2	1.750E+01	1.250E+01	3.536E+00	2.020E+01	2.500E+00
HL/RV	4	1.996E+00	5.335E-01	7.304E-01	3.659E+01	3.652E-01
RADIUS VECTOR	5	7.900E-01				
HALF-LENGTH	3	1.490E+00	1.596E-01	3.995E-01	2.681E+01	2.307E-01
VOLUTION HEIGHT	5	2.966E-01	5.848E-04	2.418E-02	8.153E+00	1.081E-02
WALL THICKNESS	5	6.220E-02	1.367E-04	1.169E-02	1.880E+01	5.229E-03
SEPTAL SPACING	2	2.250E+01	4.050E+01	6.364E+00	2.828E+01	4.500E+00
HL/RV	3	1.886E+00	2.557E-01	5.057E-01	2.681E+01	2.920E-01
RADIUS VECTOR	3	1.000E+00				
HALF-LENGTH	2	1.700E+00	1.620E-02	1.273E-01	7.487E+00	9.000E-02
VOLUTION HEIGHT	3	3.517E-01	5.143E-04	2.268E-02	6.449E+00	1.309E-02
WALL THICKNESS	3	7.033E-02	3.803E-04	1.950E-02	2.773E+01	1.126E-02
HL/RV	2	1.700E+00	1.620E-02	1.273E-01	7.487E+00	9.000E-02

Comparison and remarks.—*Pseudofusulina chilensis* n. sp. is similar in general appearance to *P. eximia* Skinner and Wilde (1965, p. 66) from California. It differs by having a smaller form ratio, larger proloculus, more closely spaced septa, and less rugosity than *P. eximia.* The lack of well-developed rugosity in *P. chilensis* n. sp. suggests that this is one of the more primitive species of the genus. It does not seem to be closely related to the forms assigned to *Pseudofusulina* by Roberts (1949, p. 215–219).

Material studied.—Forty-seven thin sections from sample f22497 and 109 sections from sample f22498 were prepared, and 33 oriented specimens of this species were measured for study. In sample f22497, the material is a silty limestone that was fractured and deformed plastically. Some echinodermal debris, some coral fragments, and several smaller foraminifers including *Tetrataxis* sp., *Bradyina* sp., *Climacammina* sp. occur associated with the abundant fusulinids, including this species and *Triticites guarellensis* n. sp.. In sample f22498, the material is

FIGURE 13.—Summary graphs for *Schwagerina patagoniensis* n. sp. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 11. The diameters of proloculi are plotted against the number of specimens.

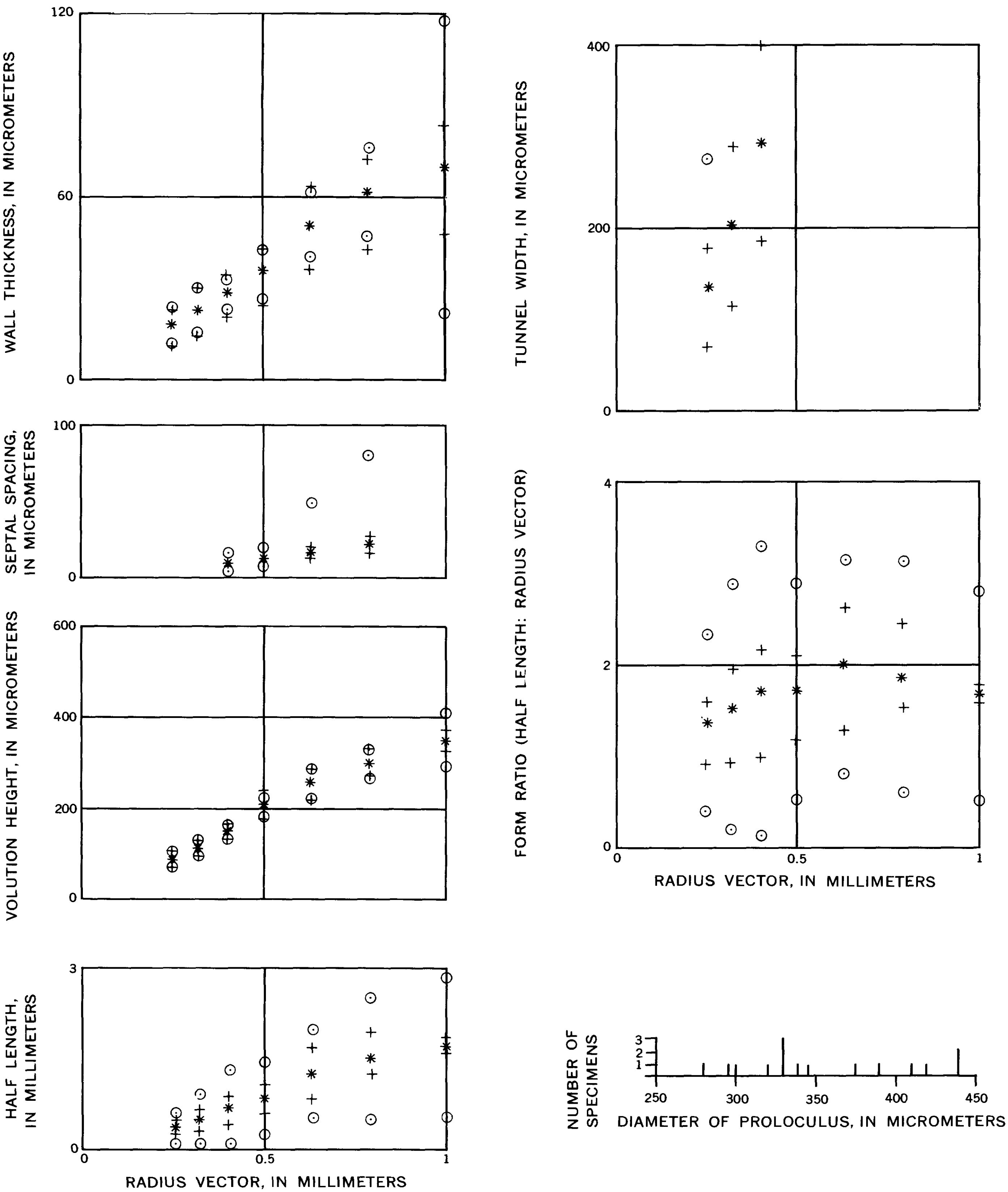


FIGURE 14.—Summary graphs for *Schwagerina* sp. A. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 12. The diameters of proloculi are plotted against the number of specimens.

TABLE 13.—*Summary numerical data for* Schwagerina *sp. aff.* S. muñaniensis *Dunbar and Newell, 1946*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	4	1.000E-01				
HALF-LENGTH	3	1.633E-01	3.033E-03	5.508E-02	3.372E+01	3.180E-02
VOLUTION HEIGHT	4	3.825E-02	9.392E-05	9.946E-03	2.600E+01	4.973E-03
WALL THICKNESS	4	9.000E-03	1.333E-06	1.155E-03	1.283E+01	5.774E-04
TUNNEL WIDTH	2	4.000E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
HL/RV	3	1.633E+00	3.033E-01	5.508E-01	3.372E+01	3.180E-01
RADIUS VECTOR	5	1.300E-01				
HALF-LENGTH	3	2.200E-01	3.900E-03	6.245E-02	2.839E+01	3.606E-02
VOLUTION HEIGHT	5	4.980E-02	5.720E-05	7.563E-03	1.519E+01	3.382E-03
WALL THICKNESS	5	1.320E-02	7.700E-06	2.775E-03	2.102E+01	1.241E-03
TUNNEL WIDTH	2	5.550E+01	4.050E+01	6.364E+00	1.147E+01	4.500E+00
SEPTAL SPACING	2	5.000E+00	2.000E+00	1.414E+00	2.828E+01	1.000E+00
HL/RV	3	1.692E+00	2.308E-01	4.804E-01	2.839E+01	2.774E-01
RADIUS VECTOR	7	1.600E-01				
HALF-LENGTH	5	2.580E-01	5.370E-03	7.328E-02	2.840E+01	3.277E-02
VOLUTION HEIGHT	7	6.229E-02	4.757E-05	6.897E-03	1.107E+01	2.607E-03
WALL THICKNESS	7	1.600E-02	1.067E-05	3.266E-03	2.041E+01	1.234E-03
TUNNEL WIDTH	3	6.500E+01	2.500E+01	5.000E+00	7.692E+00	2.887E+00
SEPTAL SPACING	2	5.000E+00	2.000E+00	1.414E+00	2.828E+01	1.000E+00
HL/RV	5	1.612E+00	2.098E-01	4.580E-01	2.840E+01	2.048E-01
RADIUS VECTOR	7	2.000E-01				
HALF-LENGTH	5	3.460E-01	9.930E-03	9.965E-02	2.880E+01	4.456E-02
VOLUTION HEIGHT	7	7.514E-02	9.748E-05	9.873E-03	1.314E+01	3.732E-03
WALL THICKNESS	7	1.914E-02	1.014E-05	3.185E-03	1.664E+01	1.204E-03
TUNNEL WIDTH	3	8.700E+01	1.030E+02	1.015E+01	1.167E+01	5.859E+00
SEPTAL SPACING	2	6.500E+00	5.000E-01	7.071E-01	1.088E+01	5.000E-01
HL/RV	5	1.730E+00	2.483E-01	4.982E-01	2.880E+01	2.228E-01
RADIUS VECTOR	8	2.500E-01				
HALF-LENGTH	5	4.480E-01	1.197E-02	1.094E-01	2.442E+01	4.893E-02
VOLUTION HEIGHT	8	9.537E-02	1.686E-04	1.298E-02	1.361E+01	4.590E-03
WALL THICKNESS	8	2.412E-02	8.411E-06	2.900E-03	1.202E+01	1.025E-03
TUNNEL WIDTH	3	1.107E+02	4.663E+02	2.159E+01	1.951E+01	1.247E+01
SEPTAL SPACING	3	6.667E+00	2.333E+00	1.528E+00	2.291E+01	8.819E-01
HL/RV	5	1.792E+00	1.915E-01	4.376E-01	2.442E+01	1.957E-01
RADIUS VECTOR	8	3.200E-01				
HALF-LENGTH	5	6.120E-01	4.237E-02	2.058E-01	3.363E+01	9.205E-02
VOLUTION HEIGHT	8	1.202E-01	5.359E-04	2.315E-02	1.925E+01	8.185E-03
WALL THICKNESS	8	2.950E-02	1.229E-05	3.505E-03	1.188E+01	1.239E-03
TUNNEL WIDTH	3	1.550E+02	7.960E+02	2.821E+01	1.820E+01	1.629E+01
SEPTAL SPACING	3	7.667E+00	5.333E+00	2.309E+00	3.012E+01	1.333E+00
HL/RV	5	1.912E+00	4.138E-01	6.432E-01	3.363E+01	2.877E-01
RADIUS VECTOR	8	4.000E-01				
HALF-LENGTH	5	7.540E-01	5.653E-02	2.378E-01	3.153E+01	1.063E-01
VOLUTION HEIGHT	8	1.525E-01	1.080E-03	3.286E-02	2.155E+01	1.162E-02
WALL THICKNESS	8	3.862E-02	1.541E-05	3.926E-03	1.016E+01	1.388E-03
TUNNEL WIDTH	3	2.287E+02	1.705E+03	4.130E+01	1.806E+01	2.384E+01
SEPTAL SPACING	3	1.000E+01	1.300E+01	3.606E+00	3.606E+01	2.082E+00
HL/RV	5	1.885E+00	3.533E-01	5.944E-01	3.153E+01	2.658E-01
RADIUS VECTOR	8	5.000E-01				
HALF-LENGTH	5	9.480E-01	1.155E-01	3.399E-01	3.585E+01	1.520E-01
VOLUTION HEIGHT	8	1.895E-01	1.058E-03	3.253E-02	1.717E+01	1.150E-02
WALL THICKNESS	8	4.775E-02	1.650E-05	4.062E-03	8.507E+00	1.436E-03
TUNNEL WIDTH	3	2.970E+02	6.069E+03	7.790E+01	2.623E+01	4.498E+01
SEPTAL SPACING	3	1.233E+01	2.033E+01	4.509E+00	3.656E+01	2.603E+00
HL/RV	5	1.896E+00	4.621E-01	6.798E-01	3.585E+01	3.040E-01
RADIUS VECTOR	8	6.300E-01				
HALF-LENGTH	5	1.132E+00	1.201E-01	3.465E-01	3.061E+01	1.550E-01
VOLUTION HEIGHT	8	2.324E-01	7.051E-04	2.655E-02	1.143E+01	9.388E-03
WALL THICKNESS	8	6.075E-02	3.107E-05	5.574E-03	9.176E+00	1.971E-03
SEPTAL SPACING	3	1.700E+01	5.200E+01	7.211E+00	4.242E+01	4.163E+00
HL/RV	5	1.797E+00	3.025E-01	5.500E-01	3.061E+01	2.460E-01
RADIUS VECTOR	7	7.900E-01				
HALF-LENGTH	5	1.458E+00	1.910E-01	4.370E-01	2.997E+01	1.954E-01
VOLUTION HEIGHT	7	2.780E-01	8.693E-04	2.948E-02	1.061E+01	1.114E-02
WALL THICKNESS	7	7.114E-02	1.981E-05	4.451E-03	6.256E+00	1.682E-03
SEPTAL SPACING	2	1.700E+01	1.280E+02	1.131E+01	6.655E+01	8.000E+00
HL/RV	5	1.846E+00	3.060E-01	5.532E-01	2.997E+01	2.474E-01
RADIUS VECTOR	5	1.000E+00				
HALF-LENGTH	3	1.533E+00	1.002E-01	3.166E-01	2.065E+01	1.828E-01
VOLUTION HEIGHT	5	3.432E-01	1.309E-03	3.618E-02	1.054E+01	1.618E-02
WALL THICKNESS	5	7.700E-02	4.950E-05	7.036E-03	9.137E+00	3.146E-03
SEPTAL SPACING	2	1.950E+01	1.125E+02	1.061E+01	5.439E+01	7.500E+00
HL/RV	3	1.533E+00	1.002E-01	3.166E-01	2.065E+01	1.828E-01
RADIUS VECTOR	2	1.260E+00				
VOLUTION HEIGHT	2	4.015E-01	1.250E-05	3.536E-03	8.806E-01	2.500E-03
WALL THICKNESS	2	9.550E-02	5.000E-07	7.071E-04	7.404E-01	5.000E-04
RADIUS VECTOR	2	1.580E+00				
VOLUTION HEIGHT	2	4.475E-01	3.445E-03	5.869E-02	1.312E+01	4.150E-02
WALL THICKNESS	2	1.005E-01	1.125E-04	1.061E-02	1.055E+01	7.500E-03

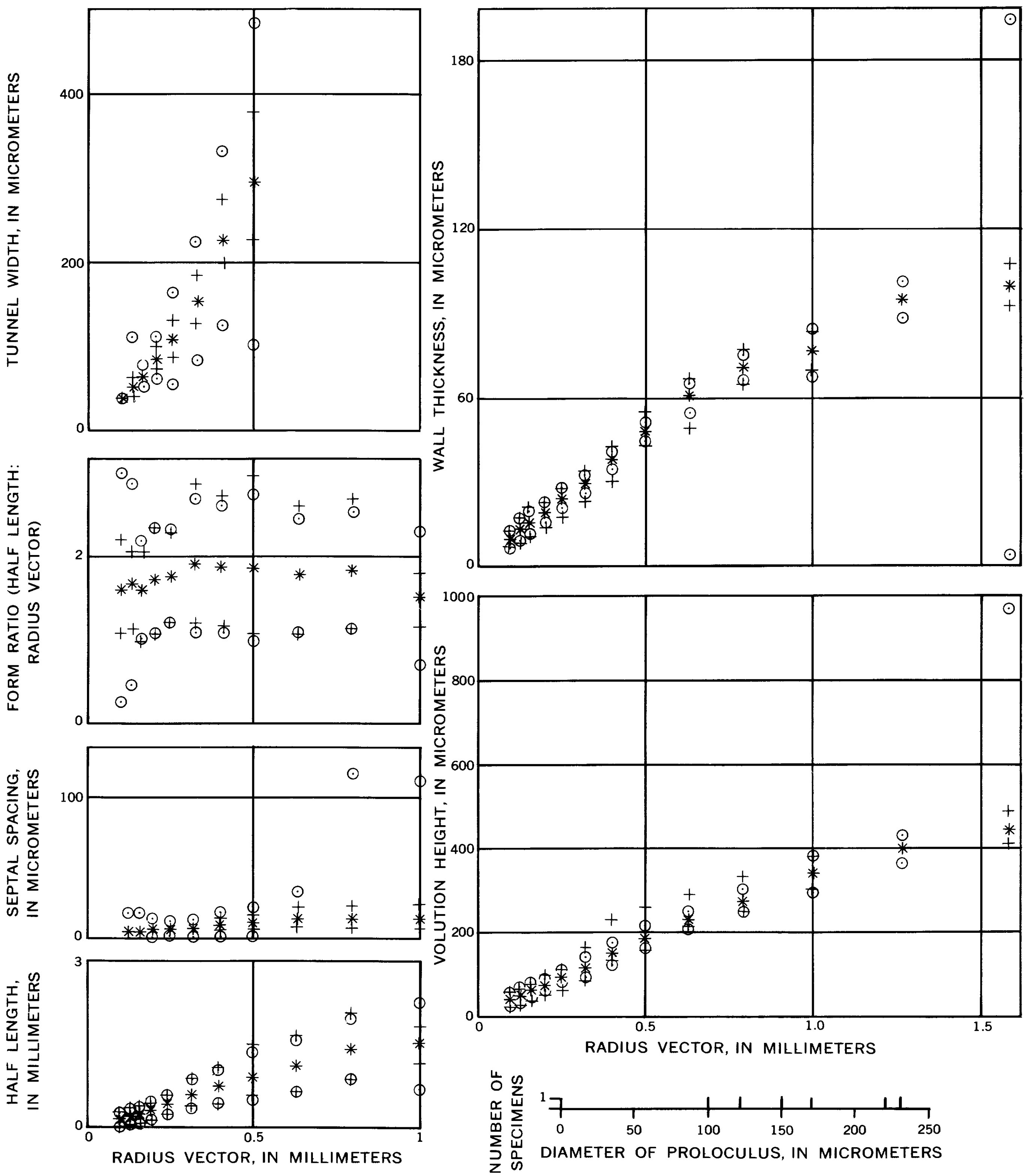


FIGURE 15.—Summary graphs for *Schwagerina* sp. aff. *S. muñaniensis* Dunbar and Newell, 1946. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 13. The diameters of proloculi are plotted against the number of specimens.

TABLE 14.—*Summary numerical data for* Pseudofusulina chilensis *n. sp.*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	4	1.600E-01				
VOLUTION HEIGHT	4	4.500E-02	1.820E-04	1.349E-02	2.998E+01	6.745E-03
WALL THICKNESS	4	1.475E-02	1.692E-05	4.113E-03	2.788E+01	2.056E-03
SEPTAL SPACING	3	7.000E+00	3.000E+00	1.732E+00	2.474E+01	1.000E+00
RADIUS VECTOR	8	2.000E-01				
VOLUTION HEIGHT	8	7.212E-02	8.212E-05	9.062E-03	1.256E+01	3.204E-03
WALL THICKNESS	8	1.737E-02	1.484E-05	3.852E-03	2.217E+01	1.362E-03
SEPTAL SPACING	7	7.286E+00	5.714E-01	7.559E-01	1.038E+01	2.857E-01
RADIUS VECTOR	19	2.500E-01				
HALF-LENGTH	4	2.975E-01	4.892E-03	6.994E-02	2.351E+01	3.497E-02
VOLUTION HEIGHT	19	8.337E-02	2.130E-04	1.460E-02	1.751E+01	3.348E-03
WALL THICKNESS	19	1.984E-02	1.314E-05	3.625E-03	1.827E+01	8.316E-04
SEPTAL SPACING	13	9.077E+00	3.744E+00	1.935E+00	2.132E+01	5.366E-01
HL/RV	4	1.190E+00	7.827E-02	2.798E-01	2.351E+01	1.399E-01
RADIUS VECTOR	30	3.200E-01				
HALF-LENGTH	11	4.155E-01	6.947E-03	8.335E-02	2.006E+01	2.513E-02
VOLUTION HEIGHT	30	1.125E-01	1.111E-04	1.054E-02	9.366E+00	1.924E-03
WALL THICKNESS	30	2.657E-02	4.122E-05	6.420E-03	2.417E+01	1.172E-03
TUNNEL WIDTH	8	1.746E+02	5.854E+02	2.419E+01	1.385E+01	8.554E+00
SEPTAL SPACING	18	1.128E+01	5.389E+00	2.321E+00	2.058E+01	5.472E-01
HL/RV	11	1.298E+00	6.784E-02	2.605E-01	2.006E+01	7.853E-02
RADIUS VECTOR	33	4.000E-01				
HALF-LENGTH	12	6.008E-01	1.846E-02	1.359E-01	2.261E+01	3.922E-02
VOLUTION HEIGHT	33	1.471E-01	3.285E-04	1.812E-02	1.232E+01	3.155E-03
WALL THICKNESS	33	3.473E-02	6.570E-05	8.106E-03	2.334E+01	1.411E-03
TUNNEL WIDTH	8	2.336E+02	1.402E+03	3.745E+01	1.603E+01	1.324E+01
SEPTAL SPACING	21	1.267E+01	9.633E+00	3.104E+00	2.450E+01	6.773E-01
HL/RV	12	1.502E+00	1.154E-01	3.397E-01	2.261E+01	9.806E-02
RADIUS VECTOR	33	5.000E-01				
HALF-LENGTH	12	8.475E-01	2.135E-02	1.461E-01	1.724E+01	4.218E-02
VOLUTION HEIGHT	33	1.964E-01	3.888E-04	1.972E-02	1.004E+01	3.433E-03
WALL THICKNESS	33	4.861E-02	8.056E-05	8.975E-03	1.847E+01	1.562E-03
TUNNEL WIDTH	8	3.080E+02	1.795E+03	4.237E+01	1.376E+01	1.498E+01
SEPTAL SPACING	21	1.510E+01	1.989E+01	4.460E+00	2.954E+01	9.732E-01
HL/RV	12	1.695E+00	8.539E-02	2.922E-01	1.724E+01	8.436E-02
RADIUS VECTOR	33	6.300E-01				
HALF-LENGTH	12	1.202E+00	1.931E-02	1.390E-01	1.156E+01	4.012E-02
VOLUTION HEIGHT	33	2.451E-01	8.741E-04	2.956E-02	1.206E+01	5.147E-03
WALL THICKNESS	33	6.458E-02	9.481E-05	9.737E-03	1.508E+01	1.695E-03
TUNNEL WIDTH	6	4.587E+02	8.189E+03	9.050E+01	1.973E+01	3.694E+01
SEPTAL SPACING	21	1.881E+01	4.006E+01	6.329E+00	3.365E+01	1.381E+00
HL/RV	12	1.909E+00	4.866E-02	2.206E-01	1.156E+01	6.368E-02
RADIUS VECTOR	30	7.900E-01				
HALF-LENGTH	12	1.545E+00	5.019E-02	2.240E-01	1.450E+01	6.467E-02
VOLUTION HEIGHT	30	3.035E-01	7.756E-04	2.785E-02	9.176E+00	5.085E-03
WALL THICKNESS	30	8.087E-02	8.012E-05	8.951E-03	1.107E+01	1.634E-03
TUNNEL WIDTH	4	5.713E+02	2.172E+04	1.474E+02	2.580E+01	7.369E+01
SEPTAL SPACING	17	2.118E+01	4.203E+01	6.483E+00	3.061E+01	1.572E+00
HL/RV	12	1.956E+00	8.042E-02	2.836E-01	1.450E+01	8.186E-02
RADIUS VECTOR	17	1.000E+00				
HALF-LENGTH	6	2.130E+00	8.120E-02	2.850E-01	1.338E+01	1.163E-01
VOLUTION HEIGHT	17	3.610E-01	8.462E-04	2.909E-02	8.058E+00	7.055E-03
WALL THICKNESS	17	9.229E-02	9.660E-05	9.828E-03	1.065E+01	2.384E-03
SEPTAL SPACING	10	2.280E+01	4.818E+01	6.941E+00	3.044E+01	2.195E+00
HL/RV	6	2.130E+00	8.120E-02	2.850E-01	1.338E+01	1.163E-01
RADIUS VECTOR	5	1.260E+00				
HALF-LENGTH	3	2.850E+00	1.573E-01	3.966E-01	1.392E+01	2.290E-01
VOLUTION HEIGHT	5	4.074E-01	1.596E-03	3.995E-02	9.807E+00	1.787E-02
WALL THICKNESS	5	9.880E-02	8.570E-05	9.257E-03	9.370E+00	4.140E-03
SEPTAL SPACING	2	2.000E+01	3.200E+01	5.657E+00	2.828E+01	4.000E+00
HL/RV	3	2.262E+00	9.908E-02	3.148E-01	1.392E+01	1.817E-01

similar but the fauna more varied, including *Millerella* sp. and *Schubertella* sp., in addition to the other forms.

Designation of types.—The specimen illustrated on plate 15, figure 1 and plate 16, figure 4 is designated the holotype (USNM 188290). The other specimens studied are paratypes (USNM 188291–306).

Pseudofusulina sp. A

Plate 13, figures 7–9

Description.—This form is known from only four oriented and several random sections and cannot be described properly. The meager numerical data are summarized in table 15 and figure 17.

The shell starts with a large proloculus in the 300- to 400-μm range (fig. 17) and expands rapidly

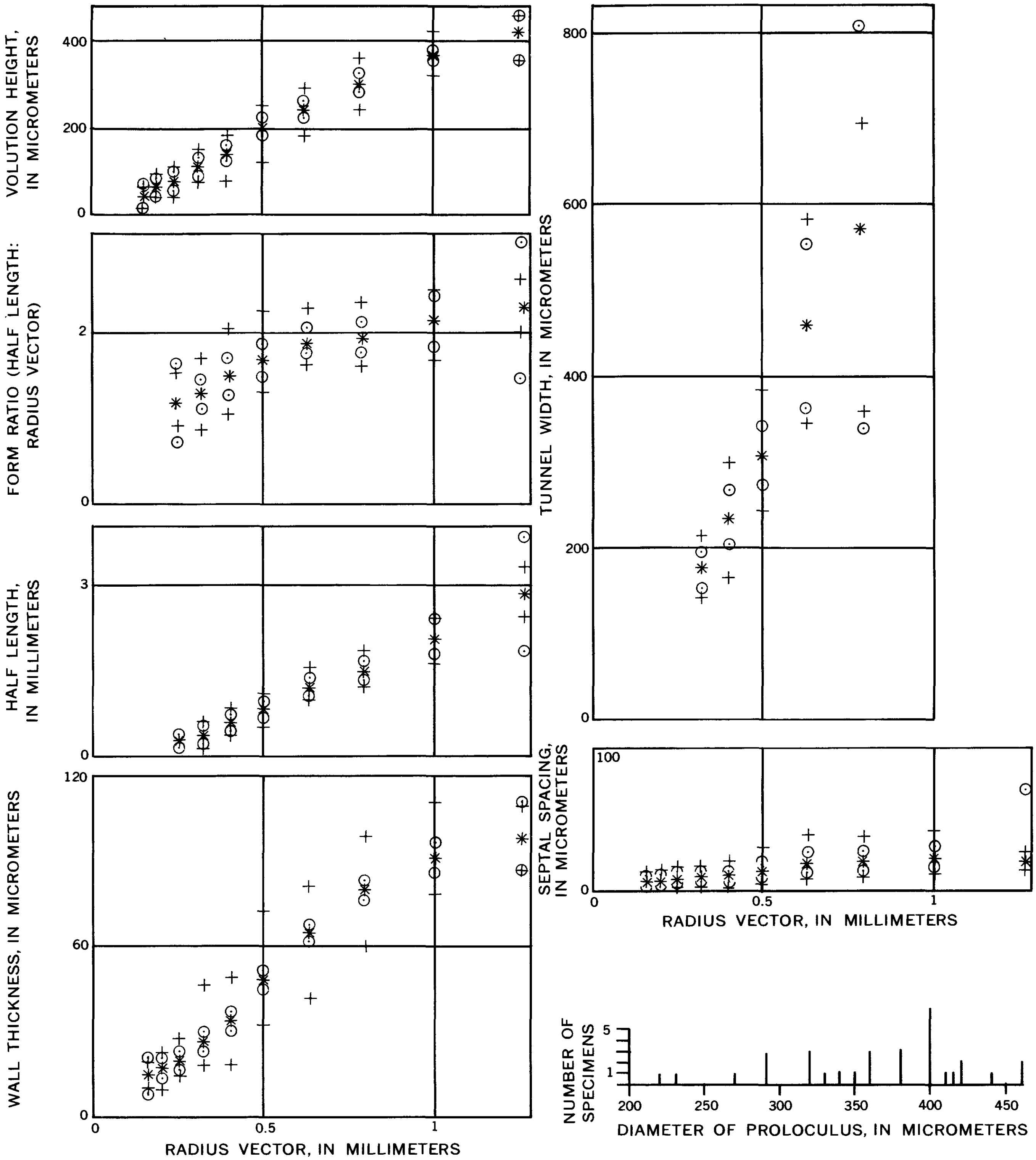


FIGURE 16—Summary graphs for *Pseudofusulina chilensis* n. sp. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 14. The diameters of proloculi are plotted against the number of specimens.

TABLE 15.—*Summary numerical data for* Pseudofusulina *sp. A*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	4	2.500E-01				
VOLUTION HEIGHT	4	8.700E-02	7.267E-05	8.524E-03	9.798E+00	4.262E-03
WALL THICKNESS	4	2.400E-02	2.067E-05	4.546E-03	1.894E+01	2.273E-03
SEPTAL SPACING	2	1.400E+01	2.000E+00	1.414E+00	1.010E+01	1.000E+00
RADIUS VECTOR	4	3.200E-01				
VOLUTION HEIGHT	4	1.232E-01	1.623E-04	1.274E-02	1.033E+01	6.369E-03
WALL THICKNESS	4	3.450E-02	5.100E-05	7.141E-03	2.070E+01	3.571E-03
SEPTAL SPACING	3	1.333E+01	2.333E+00	1.528E+00	1.146E+01	8.819E-01
RADIUS VECTOR	4	4.000E-01				
VOLUTION HEIGHT	4	1.495E-01	1.830E-04	1.353E-02	9.049E+00	6.764E-03
WALL THICKNESS	4	4.325E-02	1.189E-04	1.090E-02	2.521E+01	5.452E-03
SEPTAL SPACING	3	1.500E+01	3.000E+00	1.732E+00	1.155E+01	1.000E+00
RADIUS VECTOR	4	5.000E-01				
VOLUTION HEIGHT	4	1.977E-01	1.080E-03	3.287E-02	1.662E+01	1.643E-02
WALL THICKNESS	4	6.300E-02	6.800E-05	8.246E-03	1.309E+01	4.123E-03
SEPTAL SPACING	3	1.767E+01	4.333E+00	2.082E+00	1.178E+01	1.202E+00
RADIUS VECTOR	3	6.300E-01				
VOLUTION HEIGHT	3	2.223E-01	1.424E-03	3.774E-02	1.697E+01	2.179E-02
WALL THICKNESS	3	6.467E-02	1.603E-04	1.266E-02	1.958E+01	7.311E-03
SEPTAL SPACING	2	2.000E+01	1.800E+01	4.243E+00	2.121E+01	3.000E+00
RADIUS VECTOR	3	7.900E-01				
VOLUTION HEIGHT	3	2.743E-01	4.400E-03	6.634E-02	2.418E+01	3.830E-02
WALL THICKNESS	3	8.033E-02	7.633E-05	8.737E-03	1.088E+01	5.044E-03
SEPTAL SPACING	2	2.400E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RADIUS VECTOR	3	1.000E+00				
VOLUTION HEIGHT	3	3.443E-01	2.826E-03	5.316E-02	1.544E+01	3.069E-02
WALL THICKNESS	3	8.233E-02	5.633E-05	7.506E-03	9.116E+00	4.333E-03
RADIUS VECTOR	2	1.260E+00				
VOLUTION HEIGHT	2	3.885E-01	3.645E-04	1.909E-02	4.914E+00	1.350E-02
WALL THICKNESS	2	9.200E-02	8.000E-06	2.828E-03	3.074E+00	2.000E-03

with loose coiling. One deep tangential section measures 10.2 mm in length by 3.4 mm in diameter at six volutions. The wall is composed of tectum and fairly coarse keriotheca (pl. 13, fig. 9b), and it thickens rapidly to about 90 μm in the outer volutions. Only incipient rugosity is apparent.

The septa are unevenly spaced and irregularly but tightly fluted, forming chamberlets even in the equatorial area.

The tunnel is low and indistinct, marked by chomata on the proloculus but by only sporadic pseudochomata in the remainder of the shell.

Comparison and remarks.—*Pseudofusulina* sp. A resembles *P. chilensis* n. sp. in many characters—the proloculus diameter, irregularity of septa fluting, rate of inflation, and poor development of rugosity. The less regular coiling and more rapid thickening of the wall in the inner volutions gives these specimens a different appearance, but the data available are not sufficient for accurate definition. The specimens are, therefore, left unassigned.

Material studied.—Four oriented specimens and many random slices in 30 thin sections were studied. The specimens occur in sample f22492 associated with *Triticites tarltonensis* n. sp. and *Schwagerina* sp. aff. *S. muñaniensis* Dunbar and Newell, 1946.

Genus CHALAROSCHWAGERINA Skinner and Wilde, 1965

Chalaroschwagerina tarltonensis Douglass and Nestell, n. sp.

Plate 17, figures 1–9; plate 18, figures 1–4

Diagnosis.—Shell small for the genus, attaining lengths of nearly 10 mm and widths of nearly 4 mm in six volutions. The shape is inflated fusiform, the coiling tight in the first volution or so and then expanding rather rapidly through the rest of the shell. The spirotheca thickens rapidly and is composed of a tectum and coarse keriotheca. Phrenothecae are common but are not prominent in some specimens. The septa are closely spaced and strongly fluted, especially in the lower part of each chamber and toward the poles.

Description.—Summaries of the numerical data are given in table 16 and figure 18. The volution height increases rapidly throughout most of the shell (fig. 18) after ½ to 1½ volutions of rather tight coiling. The form ratio remains almost constant throughout the growth of the shell (fig. 18), averaging close to 1.5, but some specimens have as great a form ratio as 2.3 in the outer volutions.

The proloculus is generally large, 200–400 μm (fig. 18), but one specimen, otherwise typical, has a proloculus of only 140 μm.

The wall thickens rapidly to more than 130 μm in

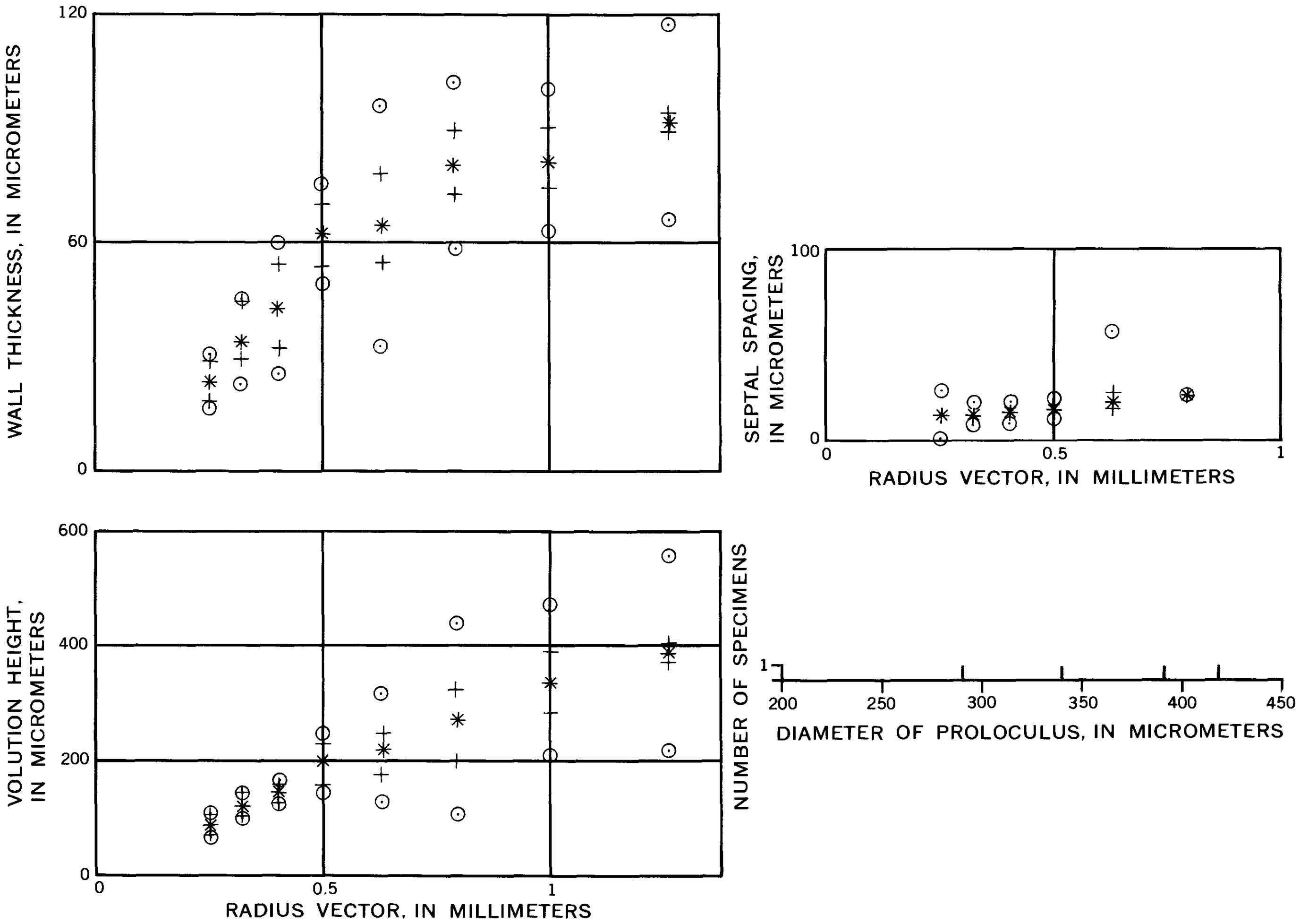


FIGURE 17.—Summary graphs for *Pseudofusulina* sp. A. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙—⊙), and observed maximum and minimum (+—+) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 15. The diameters of proloculi are plotted against the number of specimens.

the outer volutions (fig. 18) and is composed of a tectum and coarse keriotheca (pl. 18, figs. 1–4). Phrenothecae are common (pl. 17, figs. 1–6) but are not obvious on all specimens.

The septa are closely spaced (fig. 18) and are tightly fluted. The fluting is more intense in the lower part of the chambers and in the poles. The fluting is irregular, and no cuniculi were found.

The tunnel is indistinct, and no meaningful measurements of its width were obtained. It occupies only the lower part of the chamber, commonly attaining less than half the chamber height. Some epithecal deposits form pseudochomata sporadically, and some thickening of the septa may occur in the axial region.

Comparison and remarks.—The several attributes suggested for the recognition of *Chalaroschwagerina* (Skinner and Wilde, 1965, p. 72) are all present in *C. tarltonensis* n. sp. Some of the specimens of *C. pulchra* Skinner and Wilde are of the same general size as *C. tarltonensis,* but *C. pulchra* is a larger species that expands more rapidly, develops a larger form ratio, and has more regularly fluted septa. There is some resemblance to the form described by Roberts (1949, p. 231) as *Pseudofusulina meloformata.* His species could probably be assigned to *Chalaroschwagerina,* although it is hard to be sure in the absence of any equatorial sections. *P. meloformata* may not expand as rapidly from the juvenarium. It does not attain as large a size or develop as thick a wall as *C. tarltonensis.* The form described as *Schwagerina soluta* Skinner and Wilde (1965, p. 52) bears considerable resemblance to *Chalaroschwagerina,* as noted by its authors. It has a tight

TABLE 16.—*Summary of numerical data for* Chalaroschwagerina tarltonensis *n. sp.*

[The data are presented at standard radii. All numbers are expressed in exponential notation. The number of digits recorded does not imply degree of accuracy]

Character	Number of specimens	Mean	Variance	Standard deviation	Coefficient of variability	Standard error of mean
RADIUS VECTOR	3	1.600E-01				
VOLUTION HEIGHT	3	5.067E-02	1.493E-04	1.222E-02	2.412E+01	7.055E-03
WALL THICKNESS	3	1.533E-02	4.333E-06	2.082E-03	1.359E+01	1.202E-03
SEPTAL SPACING	2	7.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RADIUS VECTOR	7	2.000E-01				
HALF-LENGTH	2	3.100E-01	1.620E-02	1.273E-01	4.106E+01	9.000E-02
VOLUTION HEIGHT	7	7.829E-02	8.157E-05	9.032E-03	1.154E+01	3.414E-03
WALL THICKNESS	7	2.243E-02	7.952E-06	2.820E-03	1.257E+01	1.066E-03
SEPTAL SPACING	3	9.000E+00	1.000E+00	1.000E+00	1.111E+01	5.774E-01
HL/RV	2	1.550E+00	4.050E-01	6.364E-01	4.106E+01	4.500E-01
RADIUS VECTOR	10	2.500E-01				
HALF-LENGTH	3	3.800E-01	3.900E-03	6.245E-02	1.643E+01	3.606E-02
VOLUTION HEIGHT	10	1.014E-01	3.027E-04	1.740E-02	1.716E+01	5.502E-03
WALL THICKNESS	10	2.590E-02	1.521E-05	3.900E-03	1.506E+01	1.233E-03
SEPTAL SPACING	7	1.000E+01	2.667E+00	1.633E+00	1.633E+01	6.172E-01
HL/RV	3	1.520E+00	6.240E-02	2.498E-01	1.643E+01	1.442E-01
RADIUS VECTOR	12	3.200E-01				
HALF-LENGTH	4	4.825E-01	2.292E-03	4.787E-02	9.922E+00	2.394E-02
VOLUTION HEIGHT	12	1.383E-01	3.044E-04	1.745E-02	1.261E+01	5.037E-03
WALL THICKNESS	12	3.333E-02	1.842E-05	4.292E-03	1.288E+01	1.239E-03
SEPTAL SPACING	8	1.075E+01	1.071E+00	1.035E+00	9.629E+00	3.660E-01
HL/RV	4	1.508E+00	2.238E-02	1.496E-01	9.922E+00	7.480E-02
RADIUS VECTOR	12	4.000E-01				
HALF-LENGTH	4	5.925E-01	9.692E-03	9.845E-02	1.662E+01	4.922E-02
VOLUTION HEIGHT	12	1.880E-01	7.136E-04	2.671E-02	1.421E+01	7.712E-03
WALL THICKNESS	12	4.108E-02	2.227E-05	4.719E-03	1.149E+01	1.362E-03
SEPTAL SPACING	8	1.200E+01	2.286E+00	1.512E+00	1.260E+01	5.345E-01
HL/RV	4	1.481E+00	6.057E-02	2.461E-01	1.662E+01	1.231E-01
RADIUS VECTOR	12	5.000E-01				
HALF-LENGTH	4	7.225E-01	3.149E-02	1.775E-01	2.456E+01	8.873E-02
VOLUTION HEIGHT	12	2.423E-01	1.356E-03	3.683E-02	1.520E+01	1.063E-02
WALL THICKNESS	12	5.400E-02	1.491E-04	1.221E-02	2.261E+01	3.525E-03
SEPTAL SPACING	8	1.588E+01	8.982E+00	2.997E+00	1.888E+01	1.060E+00
HL/RV	4	1.445E+00	1.260E-01	3.549E-01	2.456E+01	1.775E-01
RADIUS VECTOR	12	6.300E-01				
HALF-LENGTH	4	9.725E-01	4.222E-02	2.055E-01	2.113E+01	1.027E-01
VOLUTION HEIGHT	12	3.006E-01	2.106E-03	4.590E-02	1.527E+01	1.325E-02
WALL THICKNESS	12	6.542E-02	2.377E-04	1.542E-02	2.357E+01	4.451E-03
SEPTAL SPACING	8	1.888E+01	1.441E+01	3.796E+00	2.011E+01	1.342E+00
HL/RV	4	1.544E+00	1.064E-01	3.262E-01	2.113E+01	1.631E-01
RADIUS VECTOR	12	7.900E-01				
HALF-LENGTH	4	1.250E+00	1.007E-01	3.173E-01	2.538E+01	1.586E-01
VOLUTION HEIGHT	12	3.630E-01	2.446E-03	4.946E-02	1.362E+01	1.428E-02
WALL THICKNESS	12	7.517E-02	1.389E-04	1.178E-02	1.568E+01	3.402E-03
SEPTAL SPACING	8	2.350E+01	1.657E+01	4.071E+00	1.732E+01	1.439E+00
HL/RV	4	1.582E+00	1.613E-01	4.016E-01	2.538E+01	2.008E-01
RADIUS VECTOR	12	1.000E+00				
HALF-LENGTH	4	1.655E+00	1.582E-01	3.977E-01	2.403E+01	1.989E-01
VOLUTION HEIGHT	12	4.104E-01	3.912E-03	6.255E-02	1.524E+01	1.806E-02
WALL THICKNESS	12	8.967E-02	9.261E-05	9.623E-03	1.073E+01	2.778E-03
SEPTAL SPACING	8	2.463E+01	1.741E+01	4.173E+00	1.694E+01	1.475E+00
HL/RV	4	1.655E+00	1.582E-01	3.977E-01	2.403E+01	1.989E-01
RADIUS VECTOR	10	1.260E+00				
HALF-LENGTH	3	2.337E+00	2.312E-01	4.809E-01	2.058E+01	2.776E-01
VOLUTION HEIGHT	10	4.459E-01	1.164E-02	1.079E-01	2.420E+01	3.412E-02
WALL THICKNESS	10	1.060E-01	1.436E-04	1.198E-02	1.130E+01	3.789E-03
SEPTAL SPACING	7	2.829E+01	4.857E+01	6.969E+00	2.464E+01	2.634E+00
HL/RV	3	1.854E+00	1.456E-01	3.816E-01	2.058E+01	2.203E-01
RADIUS VECTOR	4	1.580E+00				
VOLUTION HEIGHT	4	5.067E-01	1.085E-02	1.042E-01	2.055E+01	5.208E-02
WALL THICKNESS	4	1.362E-01	7.669E-04	2.769E-02	2.033E+01	1.385E-02
SEPTAL SPACING	2	3.050E+01	2.450E+01	4.950E+00	1.623E+01	3.500E+00

juvenarium of about one volution on two of the specimens illustrated. The septal fluting is irregular but more intense than in *C. tarltonensis*, and the form ratio is larger than in *C. tarltonensis*.

Material studied.—Seventeen thin sections from sample f22491 contain 12 specimens on which measurements were made. The specimens are fractured, and many are distorted. They occur in a calcarenite bearing abundant rounded to subrounded calcareous grains, many of which are derived from echinodermal debris. Some fragments of Bryozoa and brachiopods are present, and an indeterminate textularid was noted.

Designation of types.—The specimen illustrated on plate 17, figure 6, and plate 18, figure 3, is designated the holotype (USNM 188286). The other spe-

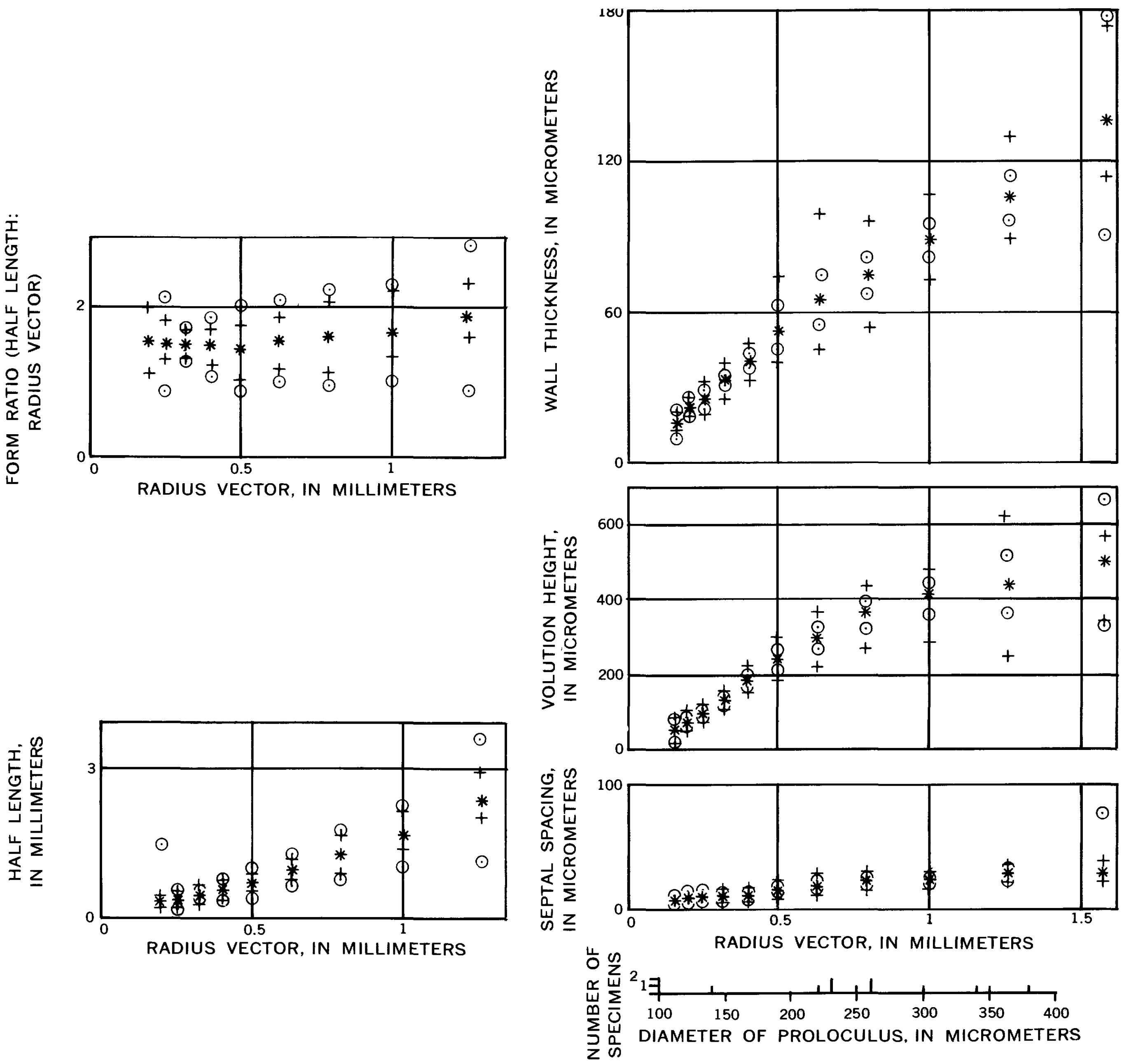


FIGURE 18.—Summary graphs for *Chalaroschwagerina tarltonensis* n. sp. Each characteristic is plotted against the radius vector. This shows the changes for each character during the ontogeny. The mean (*), confidence limits on the mean (⊙ — ⊙), and observed maximum and minimum (+ — +) are shown at each standard radius. The numerical values for the means and confidence limits and the number of specimens on which each is based are given in table 16. The diameters of proloculi are plotted against the number of specimens.

cimens studied are paratypes (USNM 188281–285 and 188287–289).

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[Italic page numbers indicate description and major references]

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PLATES 1-18

Contact photographs of the plates in this report are available at cost from
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PLATE 1

[Figs. 1–7 from Isla Guarello and figs. 8, 9 from Isla Tarlton; all × 10]

FIGURE 1. Calcisiltite with crushed fusulinids and other shell debris. Collection f22498, slide 15.

2. Fine-grained silty limestone with compressed and fractured fusulinids. Collection f22497, slide 41.

3. Fine-grained silty limestone with abundant fusulinids and fragments of fusulinids. Collection f22483, slide 6.

4–6. Fine-grained silty limestone with fusulinids and abundant shell debris. Collection f22498, slides 28, 90, and 19.

7. Pseudo-oolite with fusulinids and other shell debris. Collection f22480, slide 20.

8–9. Calcarenite with fusulinids and rounded calcareous grains including crinoidal debris. Collection f22491, slides 14 and 15.

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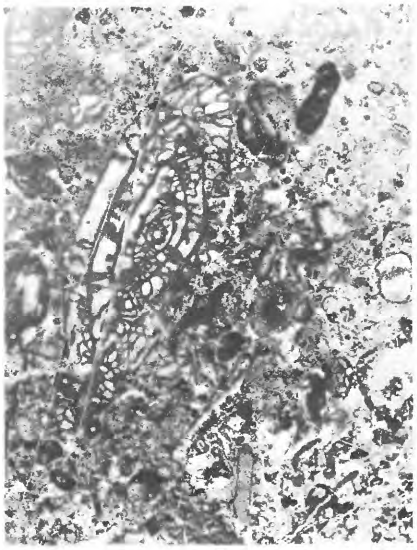

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REPRESENTATIVE LITHOLOGIES OF THE LIMESTONES FROM ISLA GUARELLO AND ISLA TARLTON

PLATE 2

[All figures × 50 except fig. 32 × 10]

FIGURES 1–19. *Schubertella* sp. (p. 7).
From locality 33, Isla Guarello.
1. Axial section, collection f22490, slide 48, USNM 188332.
2. Axial section, collection f22498, slide 15, USNM 188333.
3. Axial section, collection f22498, slide 37, USNM 188334.
4. Axial section, collection f22498 slide 40, USNM 188335.
5. Tangential section, collection f22488, slide 13, USNM 188336.
6. Equatorial section, collection f22498, slide 15, USNM 188337.
7. Equatorial section, collection f22498, slide 16, USNM 188338.
8. Equatorial section, collection f22498, slide 16A, USNM 188339.
9. Equatorial section, collection f22498, slide 102, USNM 188340.
10. Equatorial section, collection f22483, slide 4, USNM 188341.
11. Axial section, collection f22490, slide 51, USNM 188342.
12. Axial section, collection f22490, slide 43, USNM 188343.
13. Subaxial section, collection f22490, slide 57, USNM 188344.
14. Tangential section, collection f22490, slide 61, USNM 188345.
15. Subequatorial section, collection f22490, slide 50, USNM 188346.
16. Equatorial section, collection f22490, slide 59, USNM 188347.
17. Equatorial section, collection f22490, slide 51, USNM 188348.
18. Subequatorial section, collection f22490. slide 59, USNM 188349.
19. Subequatorial section, collection f22490, slide 26, USNM 188350.

20–23. *Eoschubertella* (?) sp. 1 (p. 7).
From locality 33, Isla Guarello collection f22498, axial sections.
20. Slide 38, USNM 188351.
21. Slide 16A, USNM 188352.
22. Slide 40, USNM 188353.
23. Slide 105, USNM 188354.

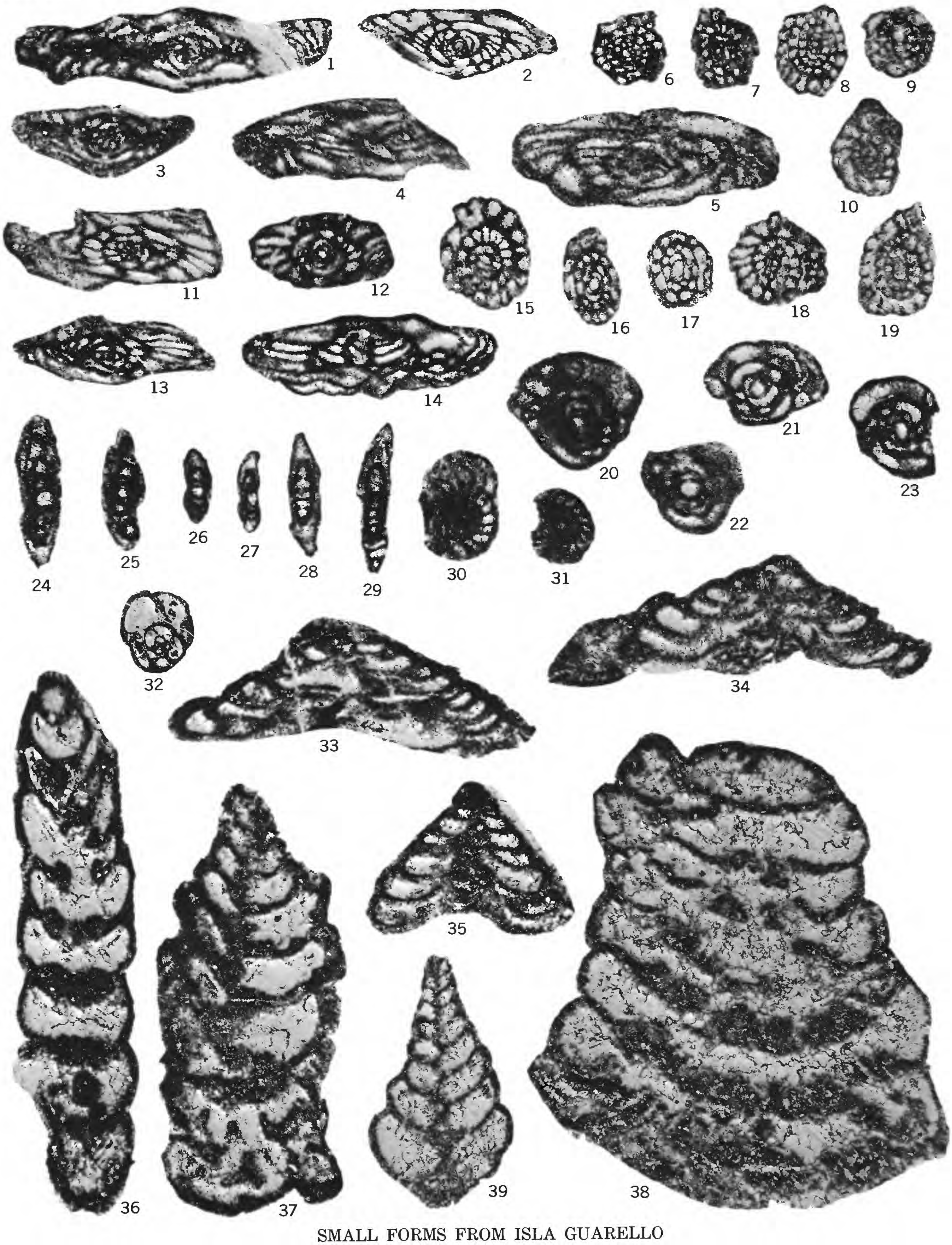
24–31. *Millerella* sp. (p. 7).
From locality 33, Isla Guarello collection f22490 (fig. 24) and collection f22498 (figs. 25–31).
24. Axial section, slide 38, USNM 188355.
25. Axial section, slide 26, USNM 188356.
26. Axial section, slide 41, USNM 188357.
27. Axial section, slide 13, USNM 188358.
28. Subaxial section, slide 41. USNM 188359.
29. Subaxial section, slide 100, USNM 188360.
30. Equatorial section, slide 22, USNM 188361.
31. Equatorial section, slide 24, USNM 188362.

32. *Bradyina* sp. (p. 7).
From locality 33, Isla Guarello collection f22480, slide 26, equatorial section, USNM 188363.

33–35. *Tetrataxis* spp. (p. 7).
From locality 33, Isla Guarello.
33. Slide 31. Collection f22498. USNM 188364.
34. Slide 29. Collection f22490. USNM 188365.
35. Slide 11. Collection f22484. USNM 188366.

36–38. *Climacammina* spp. (p. 7).
From locality 33, Isla Guarello.
36. Slide 8. Collection f22471. USNM 188367.
37. Slide 90. Collection f22498. USNM 188368.
38. Slide 25. Collection f22490. USNM 188369.

39. Textularid undet.
From locality 33, Isla Guarello collection f22471, slide 8, USNM 188370.



SMALL FORMS FROM ISLA GUARELLO

PLATE 3

FIGURES 1–7. *Triticites prima* Douglass and Nestell, n. sp. (p. 8).

From locality 33, Isla Guarello collection f22472.

1a, b. Axial section of the holotype × 20 and × 50, slide 23, USNM 188195.

2. Axial section × 20, slide 20, USNM 188196.

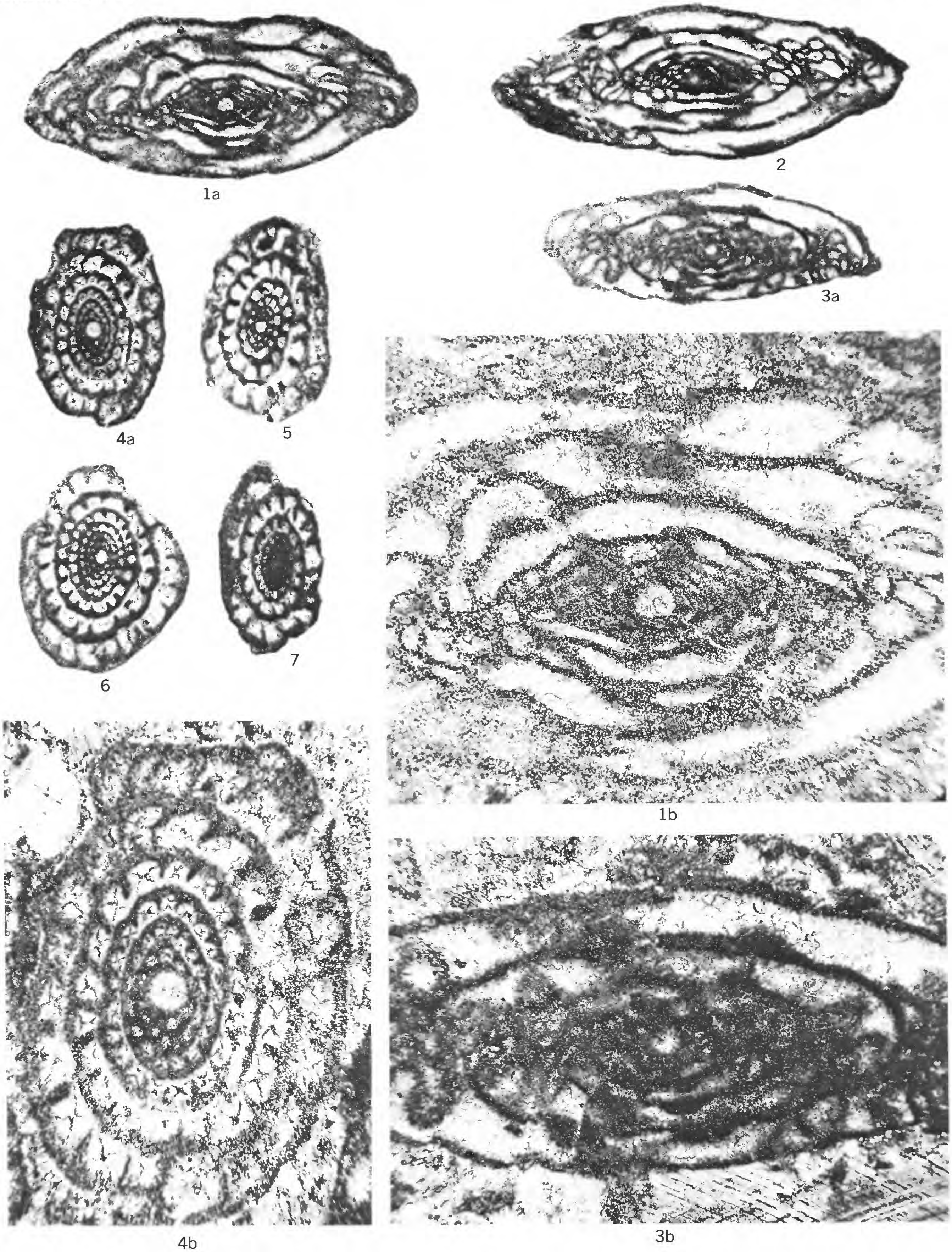
3a, b. Axial section × 20 and × 50, slide 21, USNM 188197.

4a, b. Equatorial section × 20 and × 50, slide 24, USNM 188198.

5. Equatorial section × 20, slide 18, USNM 188199.

6. Equatorial section × 20, slide 25, USNM 188200.

7. Equatorial section × 20, slide 10, USNM 188201.



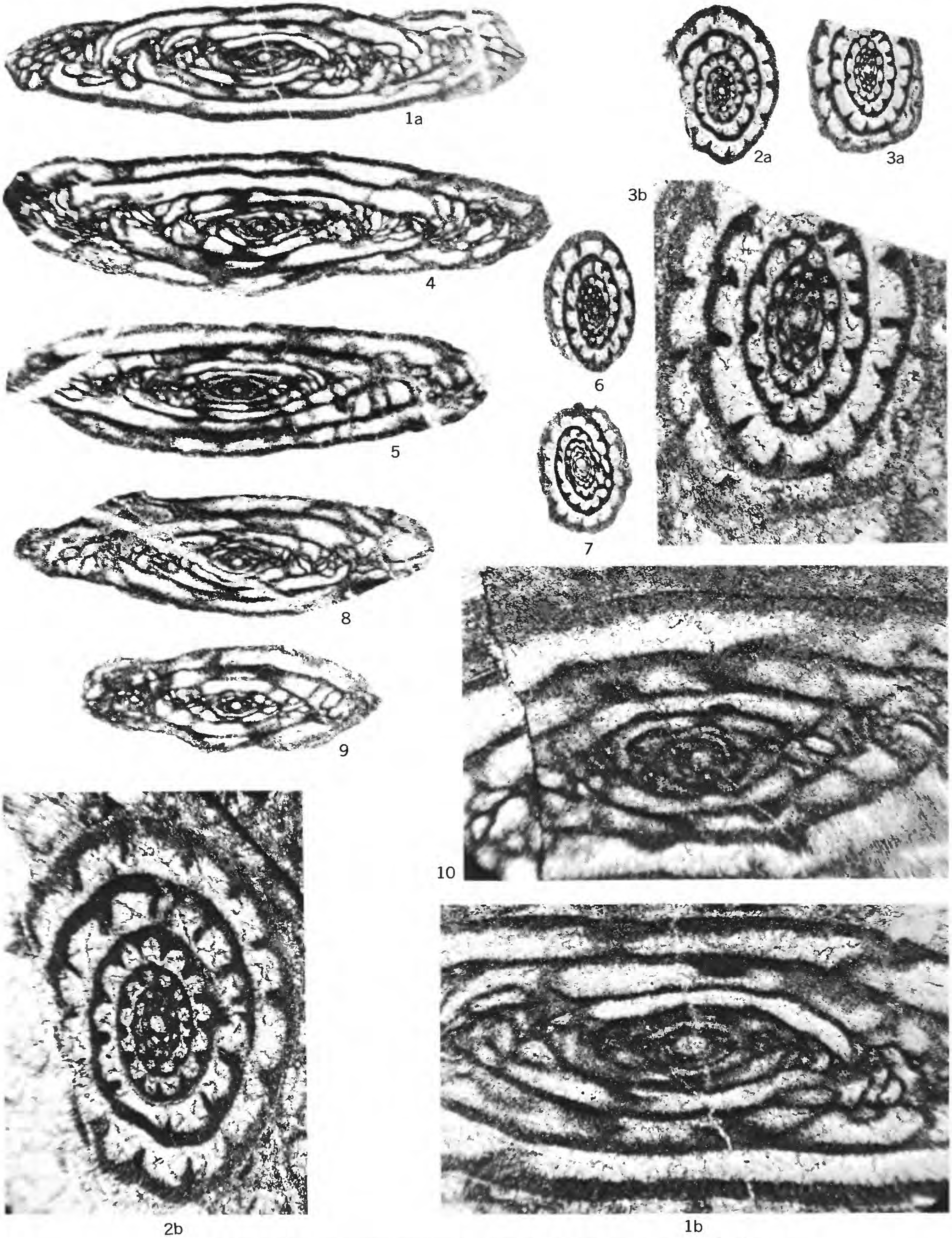
TRITICITES PRIMA DOUGLASS AND NESTELL, N. SP.

PLATE 4

FIGURES 1–10. *Triticites eleuteriensis* Douglass and Nestell. n. sp. (p. 8).

From locality 33, Isla Guarello collection f22473.

1a, b. Axial section of the holotype × 20 and × 50, slide 23, USNM 188202.
2a, b. Equatorial section × 20 and × 50, slide 2, USNM 188203.
3a, b. Equatorial section × 20 and × 50, slide 7, USNM 188204.
4. Axial section × 20, slide 24, USNM 188205.
5. Axial section × 20, slide 29, USNM 188206.
6. Equatorial section × 20, slide 8, USNM 188207.
7. Equatorial section × 20, slide 4, USNM 188208.
8. Axial section × 20, slide 30, USNM 188209.
9. Axial section × 20, slide 25, USNM 188211.
10. Axial section × 50, slide 15, USNM 188211



TRITICITES ELEUTERIENSIS DOUGLASS AND NESTELL, N. SP.

PLATE 5

FIGURES 1–6. *Triticites* sp. aff. *T. titicacaensis* Dunbar and Newell, 1946 (p. 13).

From locality 33, Isla Guarello collection f22475.

1a, b. Axial section × 20 and × 50, slide 25, USNM 188212.

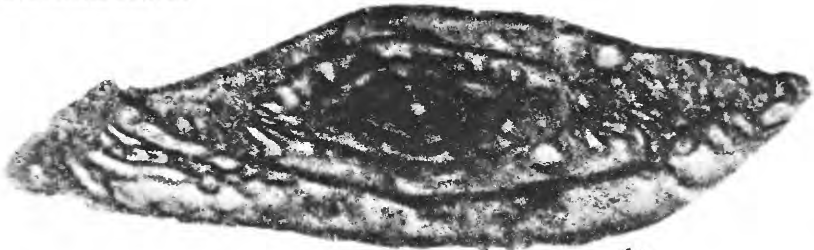
2a, b. Equatorial section × 20 and × 50, slide 11, USNM 188213.

3. Axial section × 20, slide 18, USNM 188214.

4. Equatorial crushed section × 20, slide 27, USNM 188215.

5. Deep tangential section of a deformed specimen showing tight septal fluting, × 20, slide 26, USNM 188216.

6. Shallow tangential section showing tunnel and chomata, × 20, slide 25, USNM 188117.



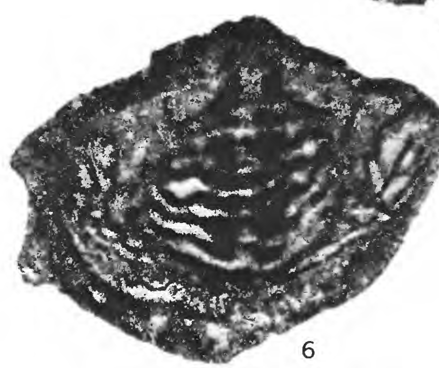
1a

2a

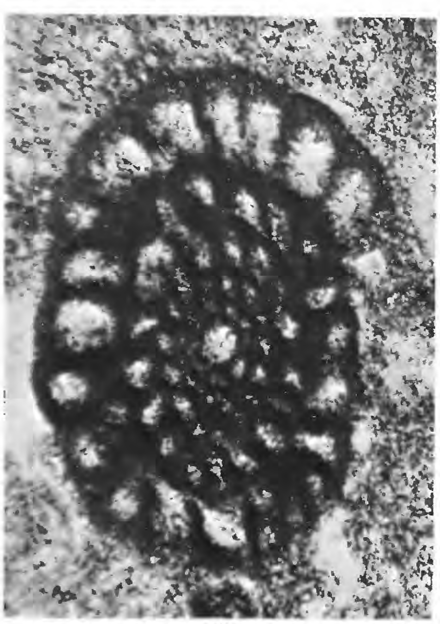
3

4

5



6



2b

1b

TRITICITES SP. AFF. *T. TITICACAENSIS* DUNBAR AND NEWELL

PLATE 6

FIGURES 1–6. *Triticites* sp. A (p. 13).

From locality 33, Isla Guarello collection f22479.

1a, b. Axial section × 20 and × 50, slide 7, USNM 188218.

2. Eroded axial section × 20, slide 2, USNM 188219.

3a, b. Axial section × 20, and × 50, slide 3, USNM 188220.

4. Deformed axial section × 20, slide 6, USNM 188221.

5. Equatorial section × 20, slide 8, USNM 188222.

6. Equatorial section × 20, slide 10, USNM 188223.

7–14. *Triticites magallanensis* Douglass and Nestell, n. sp. (p. 14).

From locality 33, Isla Guarello collection f22488.

7a, b. Equatorial section × 10 and × 50, slide 10, USNM 188224.

8. Equatorial section × 10, slide 13, USNM 188225.

9. Equatorial section × 10, slide 9, USNM 188226.

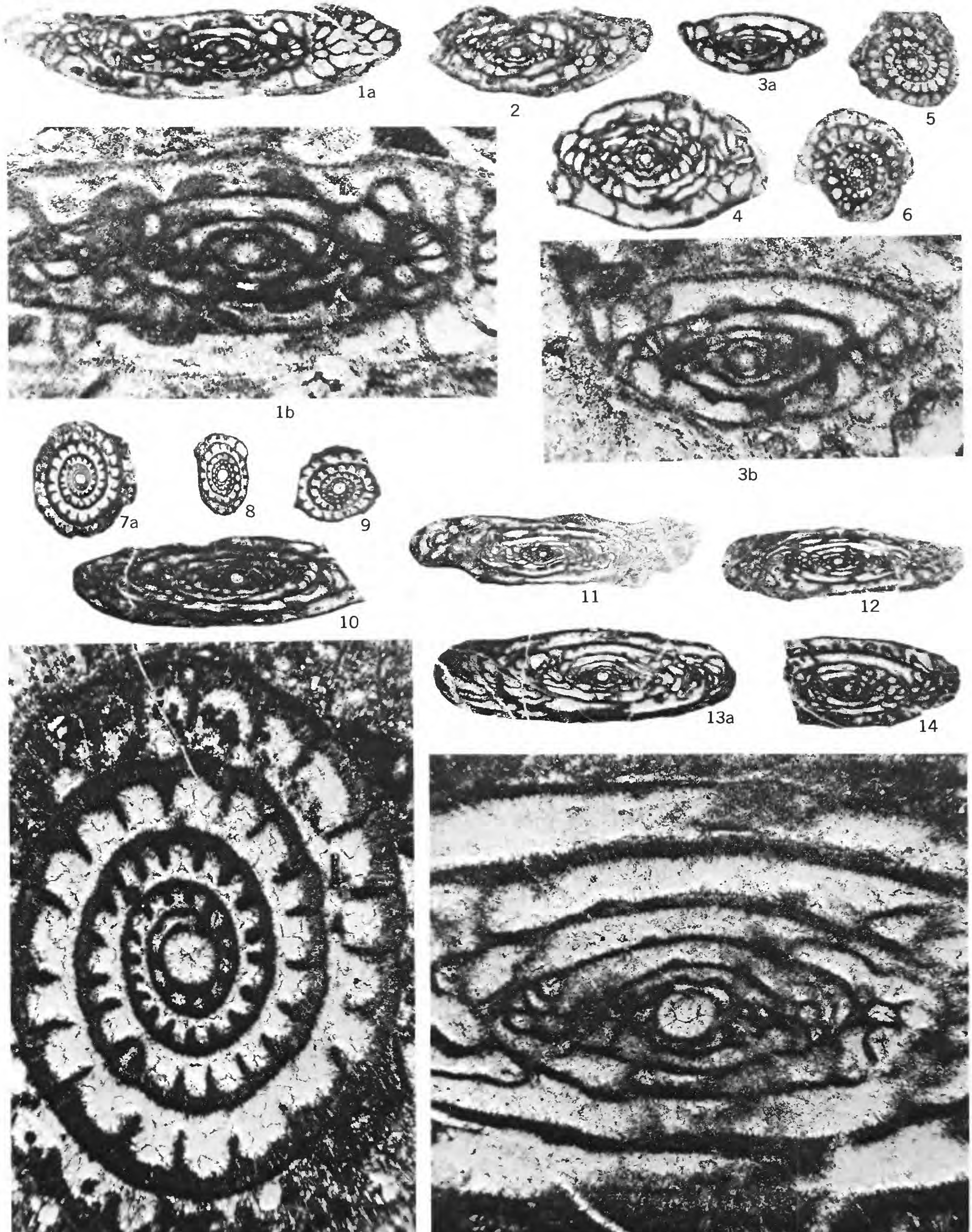
10. Axial section × 10, slide 7, USNM 188227.

11. Axial section × 10, slide 6, USNM 188228.

12. Axial section × 10, slide 2, USNM 188229.

13a, b. Axial section × 10 and × 50 of holotype, slide 1, USNM 188230.

14. Axial section × 10, slide 5, USNM 188231.



TRITICITES SP. A AND *T. MAGALLANENSIS* DOUGLASS AND NESTELL, N. SP.

PLATE 7

FIGURES 1–9. *Triticites chilensis* Douglass and Nestell, n. sp. (p. 15).

From locality 33, Isla Guarello collection f22480.

1a, b. Axial section × 10 and × 50, slide 7, USNM 188232.

2a, b. Axial section of holotype × 10 and × 50, slide 10, USNM 188233.

3. Axial section of a deformed specimen × 10, slide 1, USNM 188234.

4. Axial section × 10, slide 2, USNM 188235.

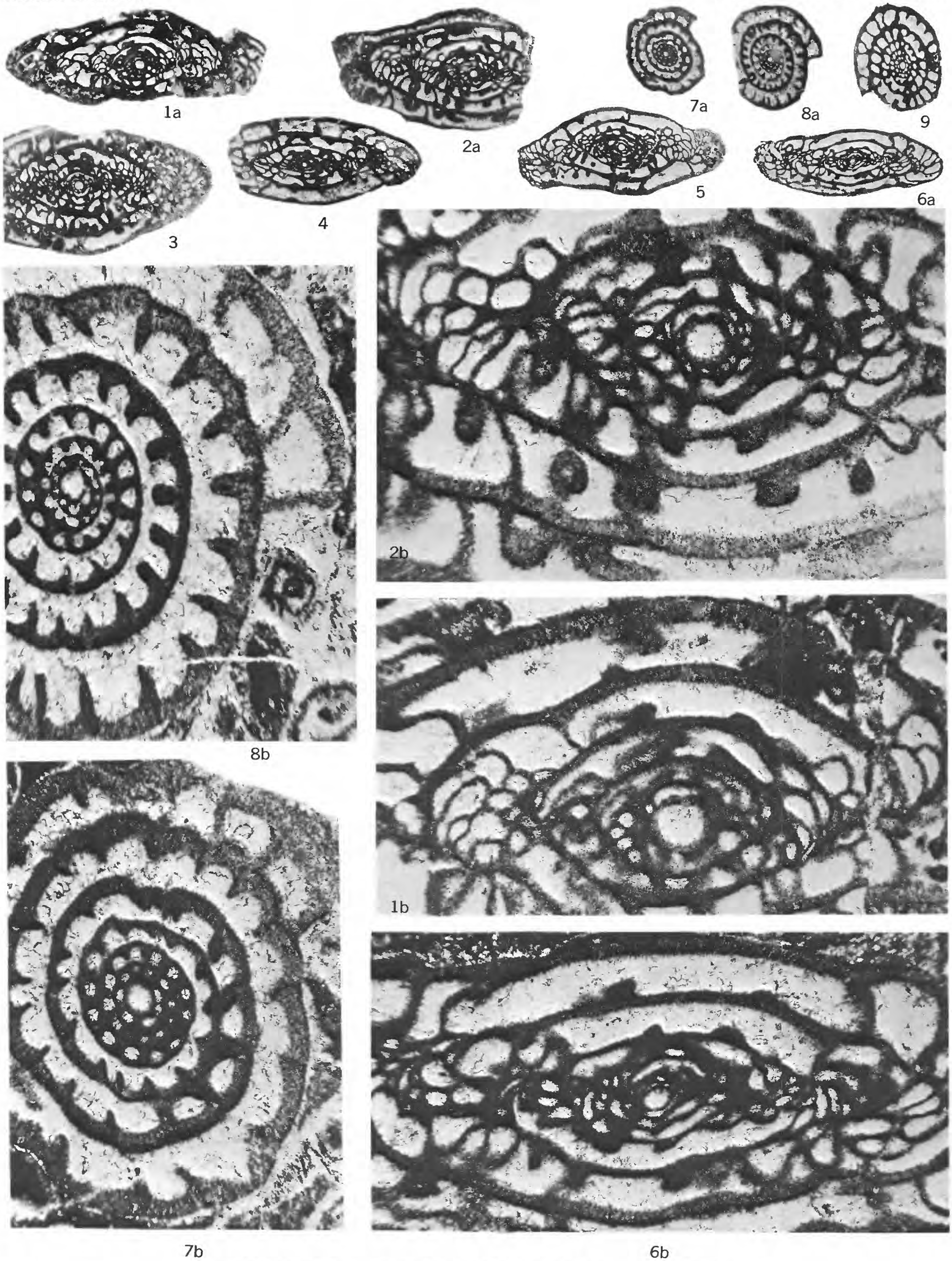
5. Axial section × 10, slide 8, USNM 188236.

6a, b. Axial section × 10 and × 50, slide 12, USNM 188237.

7a, b. Equatorial section × 10 and × 50, slide 22, USNM 188238.

8a, b. Equatorial section × 10 and × 50, slide 20, USNM 188239.

9. Equatorial section × 10, slide 18, USNM 188240.



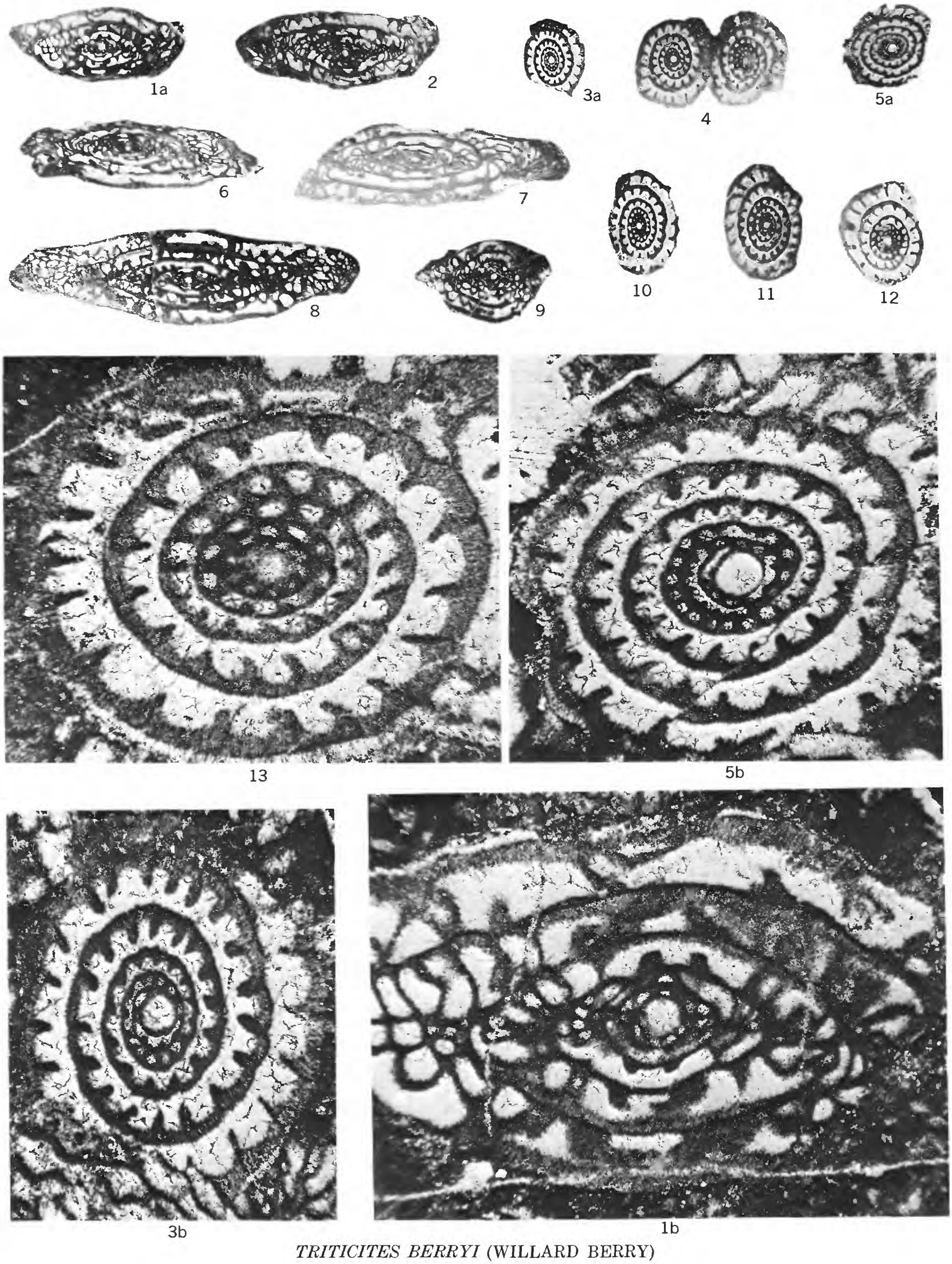
TRITICITES CHILENSIS DOUGLASS AND NESTELL, N. SP.

PLATE 8

FIGURES 1–13. *Triticites berryi* (Willard Berry) 1933 (p. 23).

From locality 33, Isla Guarello collection f22482.

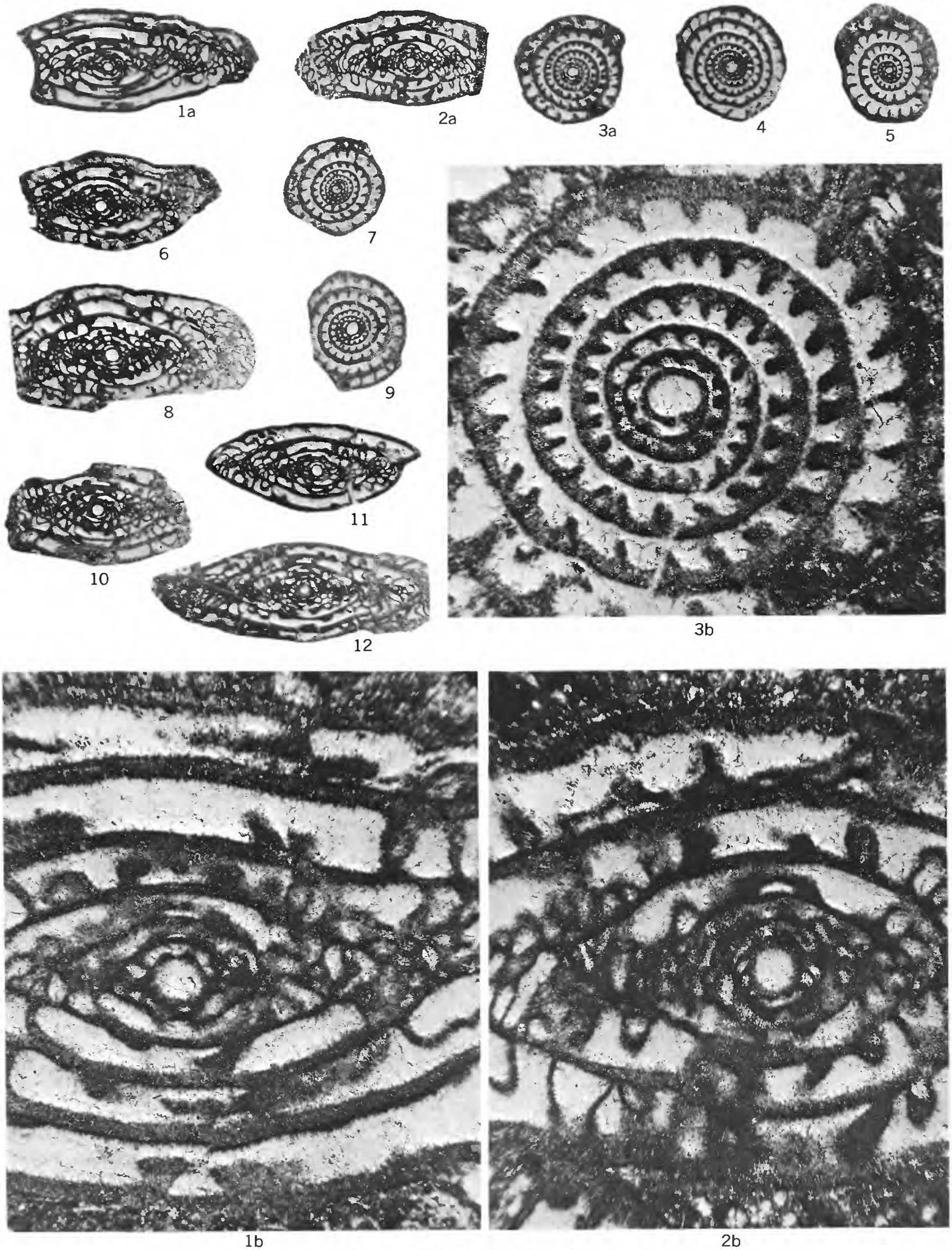
1a, b. Axial section × 10 and × 50, slide 4, USNM 188268.
2. Axial section × 10, slide 5, USNM 188269.
3a, b. Equatorial section × 10 and × 50, slide 17, USNM 188270.
4. Two equatorial sections × 10, slide 15, USNM 188271.
5a, b. Equatorial section × 10 and × 50, slide 14, USNM 188272.
6. Axial section × 10, slide 3, USNM 188273.
7. Axial section × 10, slide 13, USNM 188274.
8. Axial section × 10, slide 7, USNM 188275.
9. Axial section × 10, slide 6, USNM 188276.
10. Equatorial section × 10, slide 22, USNM 188277.
11. Equatorial section × 10, slide 21, USNM 188278.
12. Equatorial section × 10, slide 20, USNM 188279.
13. Equatorial section × 50, slide 24, USNM 188280.



TRITICITES BERRYI (WILLARD BERRY)

PLATE 9

FIGURES 1–12. *Triticites australis* Douglass and Nestell, n. sp. (p. 23).
From locality 33, Isla Guarello collection f22500.
1a, b. Axial section of holotype × 10 and × 50, slide 2, USNM 188256.
2a, b. Axial section × 10 and × 50, slide 5, USNM 188257.
3a, b. Equatorial section × 10 and × 50, slide 22, USNM 188258.
4. Equatorial section × 10, slide 17, USNM 188259.
5. Equatorial section × 10, slide 18, USNM 188260.
6. Axial section × 10, slide 1, USNM 188261.
7. Equatorial section × 10, slide 29, USNM 188262.
8. Axial section × 10, slide 10, USNM 188263.
9. Equatorial section × 10, slide 28, USNM 188264.
10. Axial section × 10, slide 7, USNM 188265.
11. Axial section × 10, slide 9, USNM 188266.
12. Axial section × 10, slide 3, USNM 188267.



TRITICITES AUSTRALIS DOUGLASS AND NESTELL, N. SP.

PLATE 10

FIGURES 1–10. *Triticites guarellensis* Douglass and Nestell, n. sp. (p. 25).

From locality 33, Isla Guarello collections f22497 (figs. 9, 10) and f22498 (figs. 1–8).

1a, b. Axial section × 10 and × 50 of the largest relatively undistorted specimen sectioned, slide 18, USNM 188322.

2. Axial section × 10, slide 3, USNM 188323.

3a, b. Equatorial section × 10 and × 50, slide 73, USNM 188324.

4. Axial section × 10, slide 4, USNM 188325.

5. Equatorial section × 10, slide 71, USNM 188326.

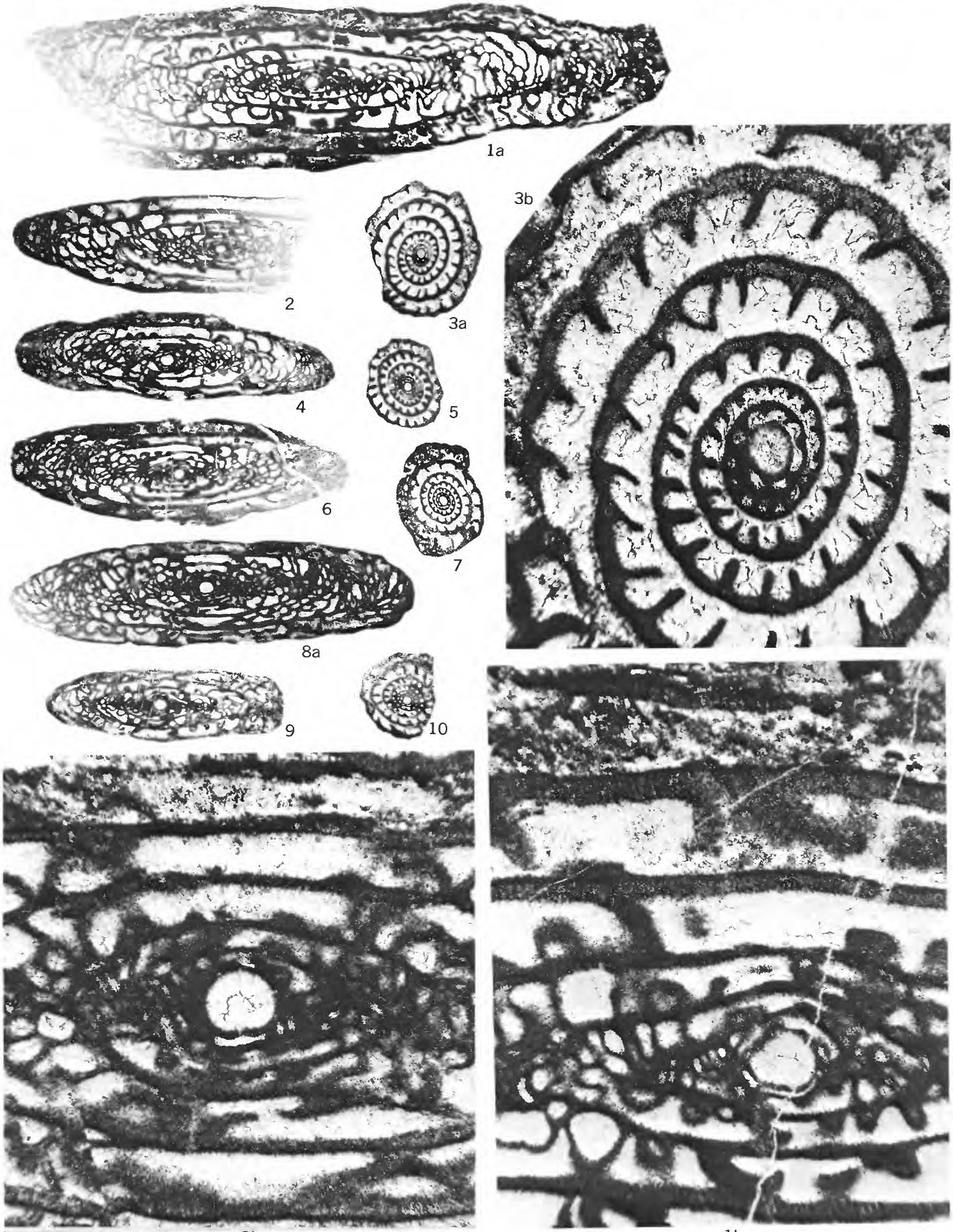
6. Axial section × 10, slide 9, USNM 188327.

7. Equatorial section × 10, slide 11, USNM 188328.

8a, b. Axial section of holotype × 10 and × 50, slide 54, USNM 188329.

9. Axial section × 10, slide 32, USNM 188330.

10. Equatorial section × 10, slide 8, USNM 188331.



TRITICITES GUARELLENSIS DOUGLASS AND NESTELL, N. SP.

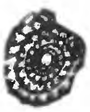
PLATE 11

FIGURES 1–6. *Triticites tarltonensis* Douglass and Nestell, n. sp. (p. 25).
From locality 34, Isla Tarlton collection f22492.
1a, b. Axial section of holotype × 10 and × 50, slide 1, USNM 188307.
2a, b. Axial section × 10 and × 50, slide 4, USNM 188308.
3. Axial section × 10, slide 2, USNM 188309.
4. Equatorial section × 10, slide 17, USNM 188310.
5. Equatorial section × 10, slide, 24, USNM 188312.
6a, b. Equatorial section × 10 and × 50, slide 19, USNM 188312.

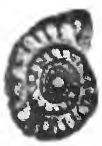
1a

2a

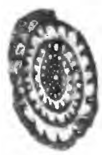
3



4

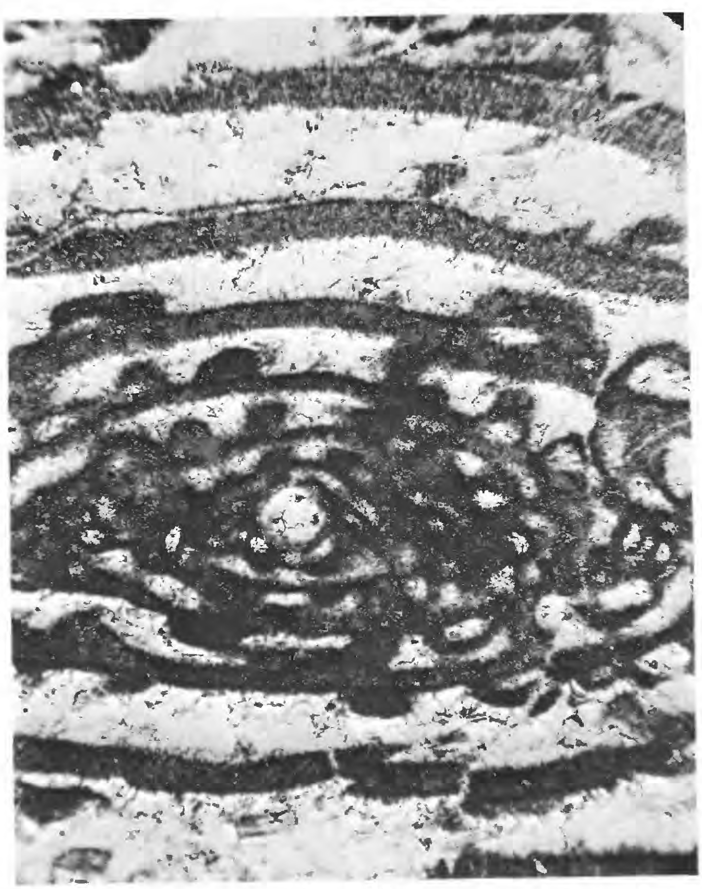


5

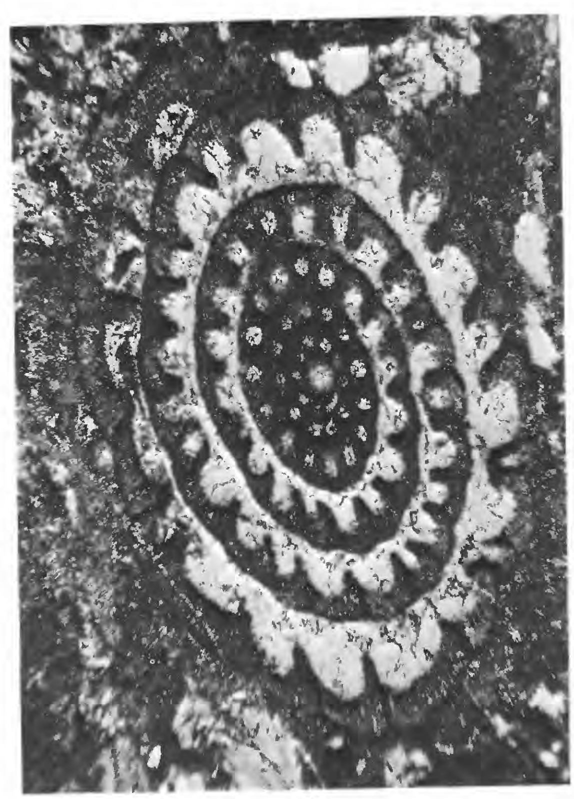


6a

2b



1b



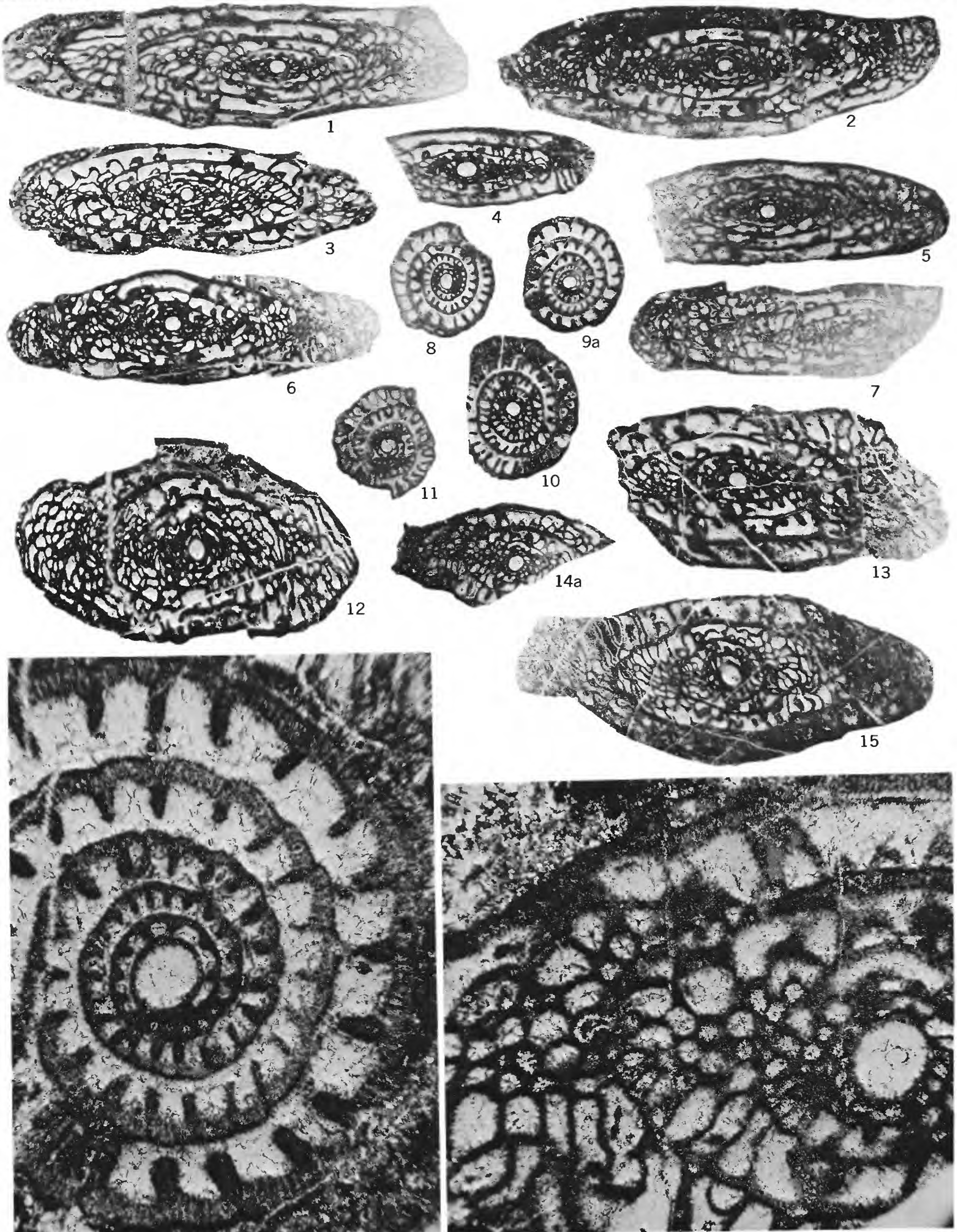
6b

TRITICITES TARLTONENSIS DOUGLASS AND NESTELL, N. SP.

PLATE 12

FIGURES 1–10. *Schwagerina patagoniensis* Douglass and Nestell n. sp. (p. 33).
From locality 33, Isla Guarello collection f22483.
1. Axial section of holotype × 10, slide 3, USNM 188241.
2. Axial section × 10, slide 7, USNM 188242.
3. Axial section × 10, slide 1, USNM 188243.
4. Axial section × 10, slide 11, USNM 188244.
5. Axial section × 10, slide 5, USNM 188245.
6. Axial section × 10, slide 6, USNM 188246.
7. Axial section × 10, slide 2, USNM 188247.
8. Equatorial section × 10, slide 15, USNM 188248.
9a, b. Equatorial section × 10 and × 50, slide 16, USNM 188249.
10. Equatorial section × 10, slide 12, USNM 188250.

11–15. *Schwagerina* sp. A (p. 34).
From locality 33, Isla Guarello collection f22484.
11. Equatorial section × 10, slide 8, USNM 188251.
12. Crushed axial section × 10, slide 5, USNM 188252.
13. Fractured axial section × 10, slide 4, USNM 188253.
14a, b. Axial section × 10 and × 50, slide 1, USNM 188254.
15. Spiral axial section × 10, slide 2, USNM 188255.

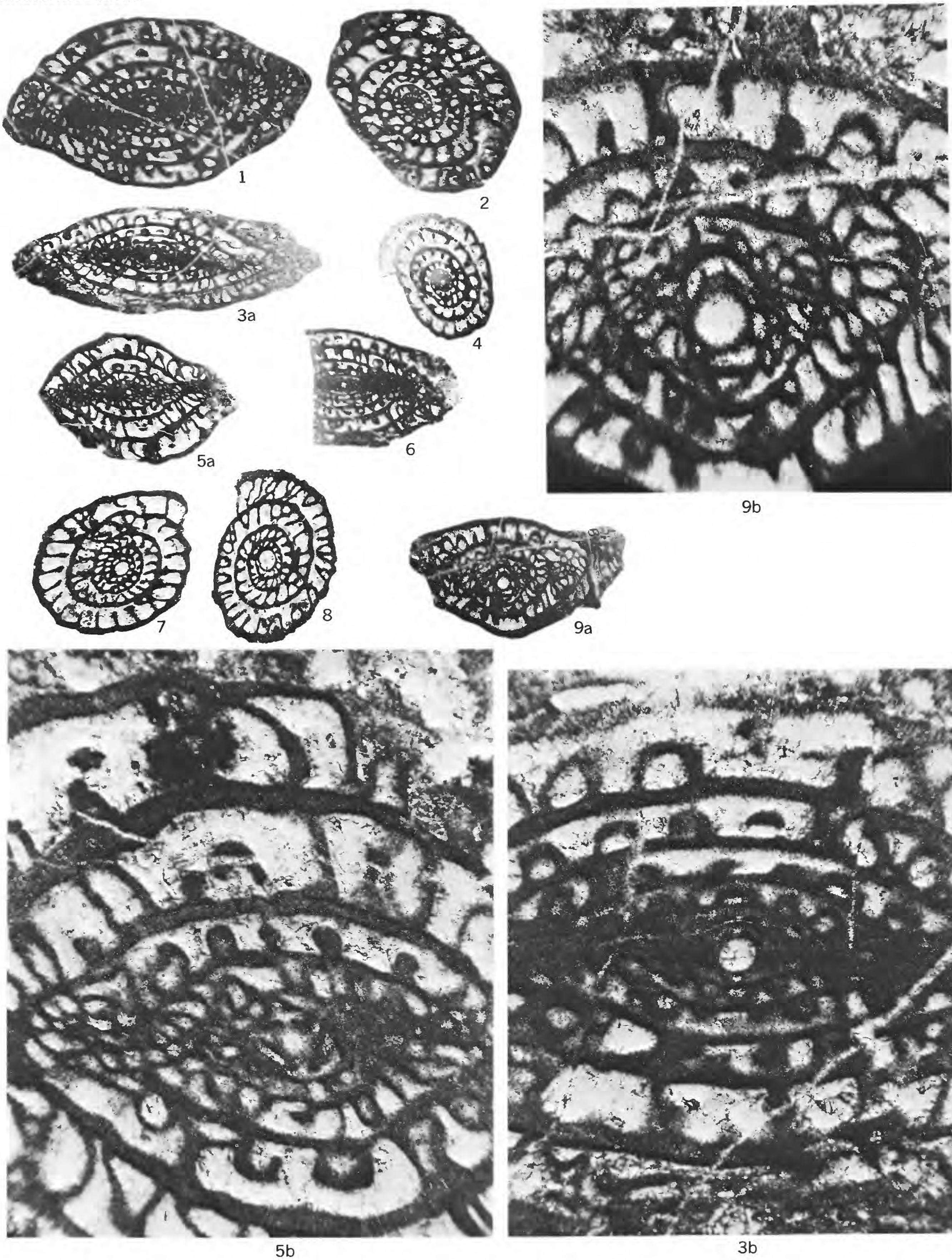


SCHWAGERINA PATAGONIENSIS DOUGLASS AND NESTELL, N. SP. AND *SCHWAGERINA* SP. A

PLATE 13

FIGURES 1–6. *Schwagerina* sp. aff. *S. muñaniensis* Dunbar and Newell, 1946 (p. 34).
From locality 34, Isla Tarlton collection f22492.
1. Axial section × 10, slide 28, USNM 188313.
2. Equatorial section × 10, slide 26, USNM 188314.
3a. b. Axial section × 10 and × 50, slide 8, USNM 188315.
4. Equatorial section × 10, slide 23, USNM 188316.
5a, b. Axial section × 10 and × 50, slide 9, USNM 188317.
6. Axial section × 10, slide 10, USNM 188318.

7–9. *Pseudofusulina* sp. A (p. 41).
From locality 34, Isla Tarlton collection f22492.
7. Equatorial section × 10, slide 22, USNM 188319.
8. Equatorial section × 10, slide 21, USNM 188320.
9a, b. Axial section × 10 and × 50, slide 11, USNM 188321.

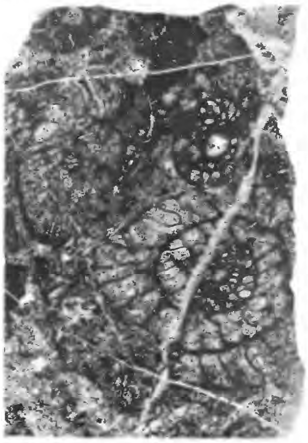


SCHWAGERINA SP. AFF. *S. MUÑANIENSIS* DUNBAR AND NEWELL AND *PSEUDOFUSULINA* SP. A

PLATE 14

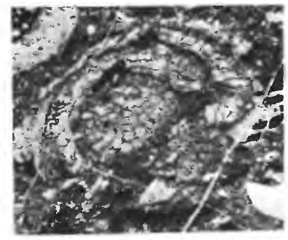
FIGURES 1–2. *Schwagerina*? sp. aff. *S.*? *patens* Dunbar and Newell, 1946 (p. 34).
From locality 34, Isla Tarlton collection f22493.
1. Equatorial sections × 10, slide 3, USNM 188371.
2a, b. Axial section × 10 and × 50, slide 1, USNM 188372.

3–6. Corals from locality 33, Isla Guarello.
3a, b. Transverse section × 10 and × 50, collection f22497, slide 17, USNM 188373.
4. Transverse section × 10, collection f22488, slide 14, USNM 188374.
5. Longitudinal section × 10, collection f22488, slide 1, USNM 188375.
6. Transverse section × 10, collection f22488, slide 2, USNM 188376.



1

2a

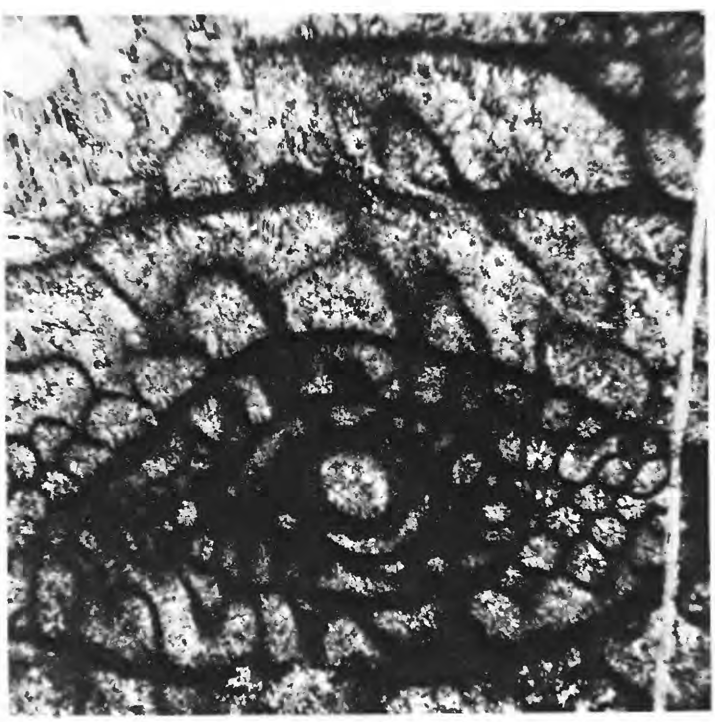


4

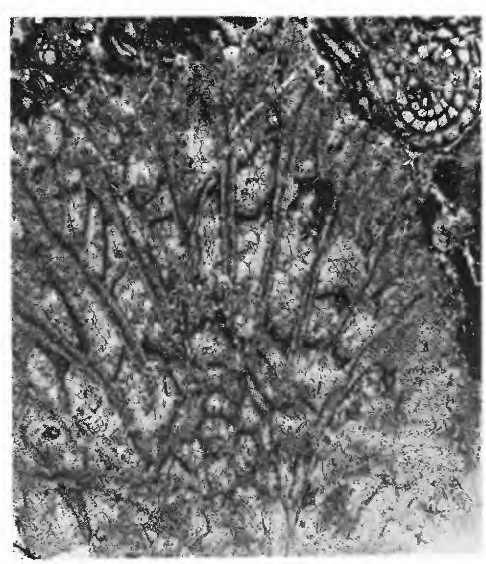
3a

3b

5



2b



6

SCHWAGERINA(?) SP. AFF. *S.* (?) *PATENS* DUNBAR AND NEWELL AND CORALS

PLATE 15

FIGURES 1–17. *Pseudofusulina chilensis* Douglass and Nestell, n. sp. (p. 34).

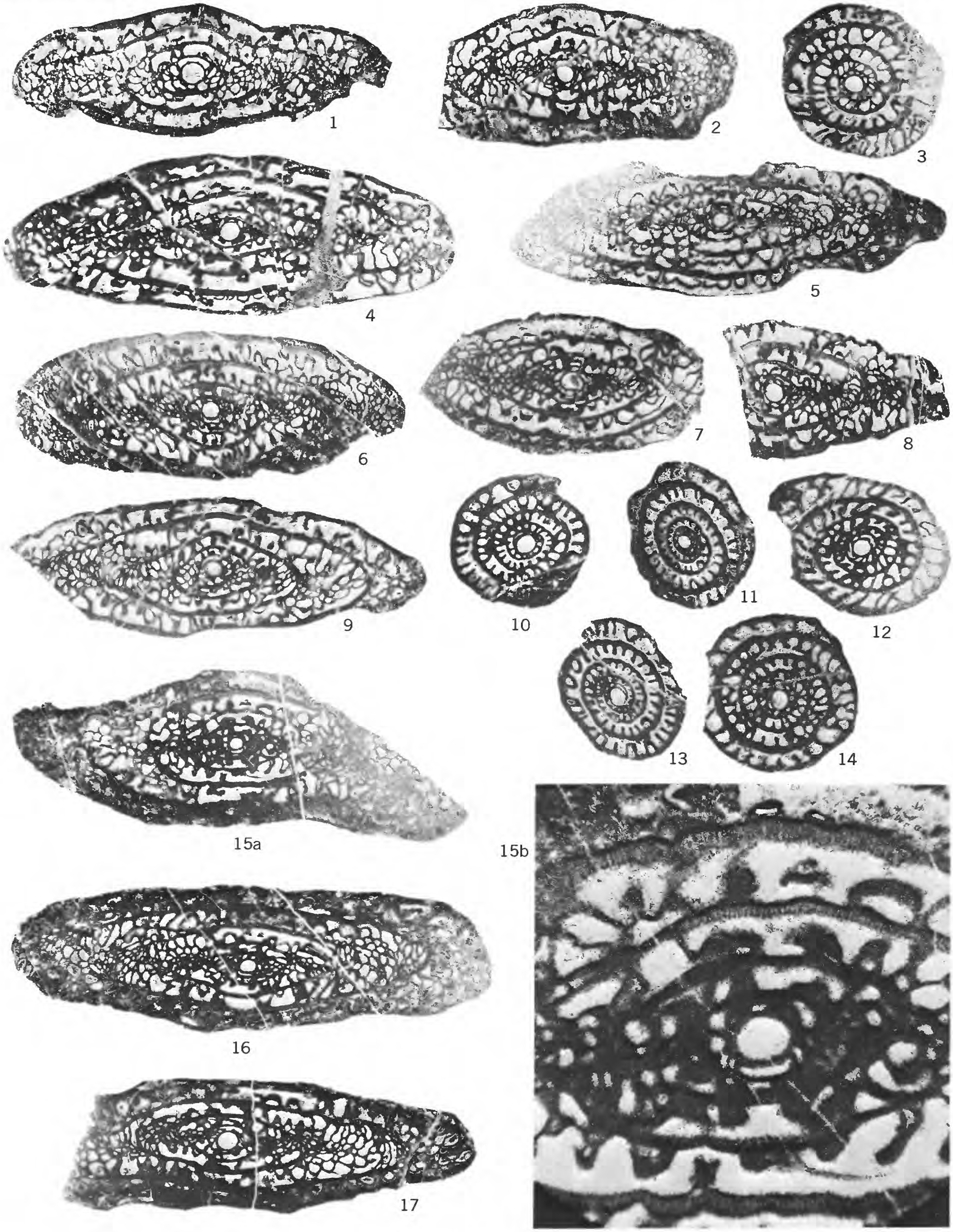
1–14. From locality 33, Isla Guarello collection f22497.

1. Axial section of holotype × 10, slide 30 (see also pl. 16, fig. 4), USNM 188290.
2. Axial section × 10, slide 33, USNM 188291.
3. Equatorial section × 10, slide 26, USNM 188292.
4. Axial section × 10, slide 38, USNM 188293.
5. Axial section × 10, slide 39, USNM 188294.
6. Axial section × 10, slide 34, USNM 188295.
7. Axial section × 10, slide 5, USNM 188296.
8. Half of axial section × 10, slide 2 (see also pl. 16, fig. 3), USNM 188297.
9. Axial section × 10, slide 37, USNM 188298.
10. Equatorial section × 10, slide 41 (see also pl. 16, fig. 1), USNM 188299.
11. Equatorial section × 10, slide 23 (see also pl. 16, fig. 2), USNM 188300.
12. Equatorial section × 10, slide 25, USNM 188301.
13. Equatorial section × 10, slide 24, USNM 188302.
14. Equatorial section × 10, slide 16, USNM 188303.

15–17. From locality 33, Isla Guarello collection f22498.

15a, b. Axial section × 10 and × 50, slide 27, USNM 188304, showing primitive rugosity of the wall.

16. Axial section × 10, slide 28, USNM 188305.
17. Axial section × 10, slide 20, USNM 188306.

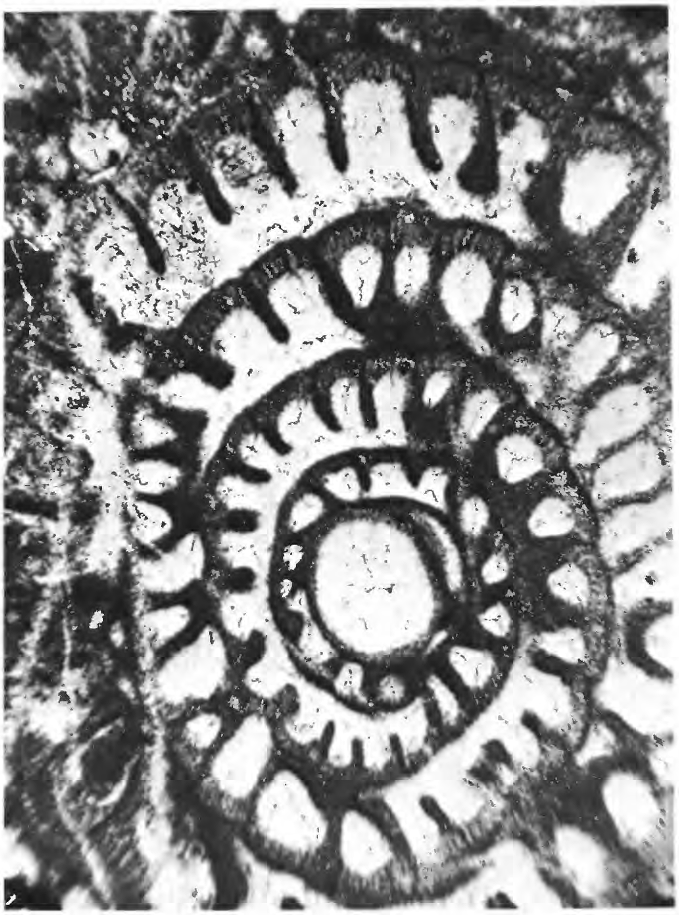


PSEUDOFUSULINA CHILENSIS DOUGLASS AND NESTELL, N. SP.

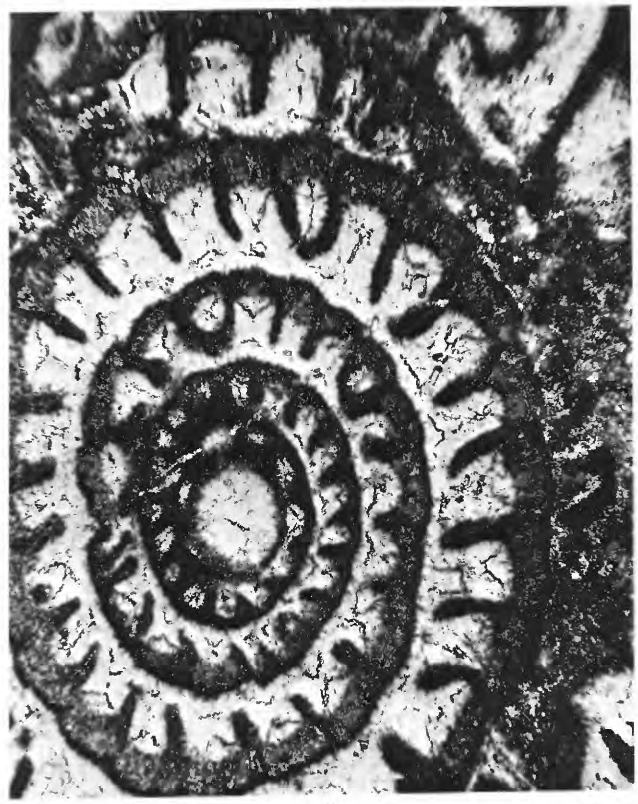
PLATE 16

[All figures × 50]

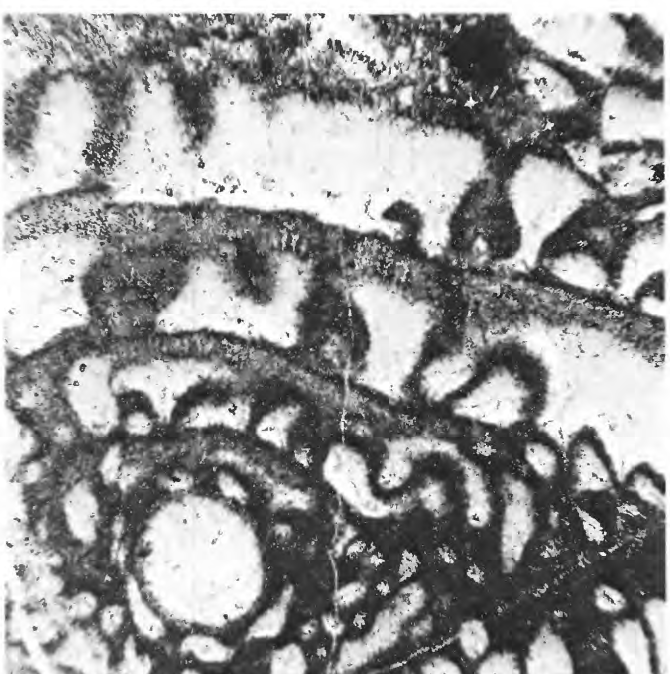
FIGURES 1–4. *Pseudofusulina chilensis* Douglass and Nestell, n. sp. (p. 34).
From locality 33, Isla Guarello collection f22497.
1. Equatorial section, slide 41 (see also pl. 15, fig. 10).
2. Equatorial section, slide 23 (see also pl. 15, fig. 11).
3. Axial section, slide 2 (see also pl. 15, fig. 8).
4. Axial section of holotype, slide 30 (see also pl. 15, fig. 1).



1



2



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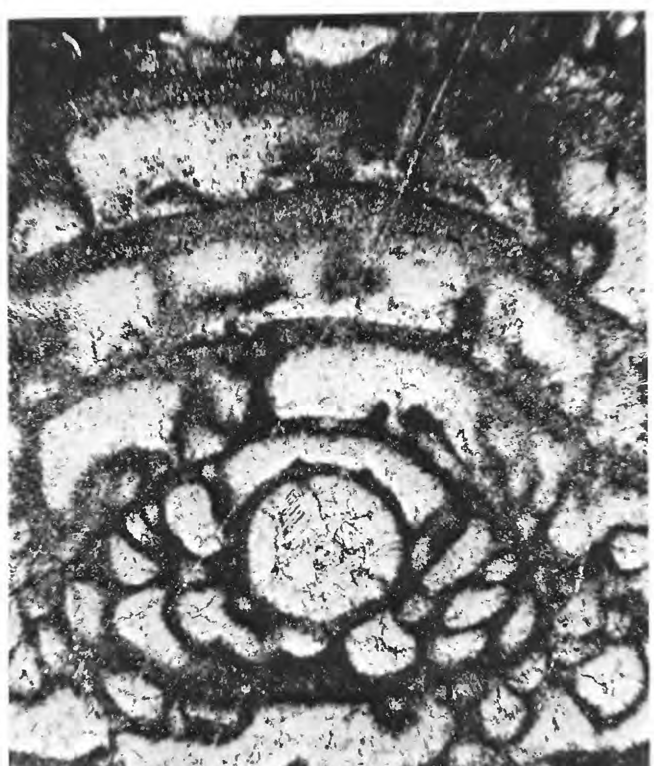


4

PSEUDOFUSULINA CHILENSIS DOUGLASS AND NESTELL, N. SP.

PLATE 17

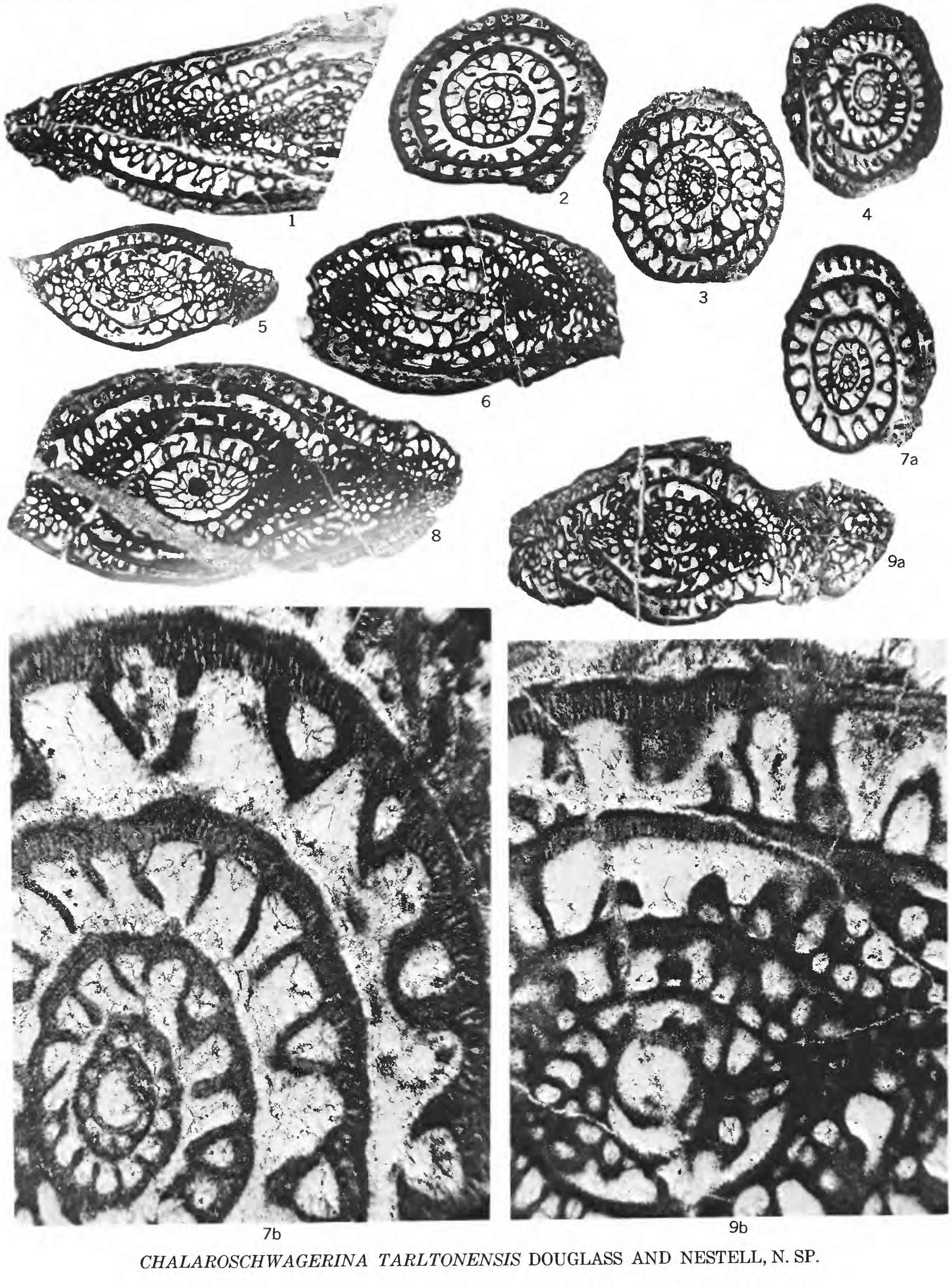
FIGURES 1–9. *Chalaroschwagerina tarltonensis* Douglass and Nestell, n. sp. (p. 43).
From locality 34, Isla Tarlton collection f22491.

1. Axial section × 10, slide 3, USNM 188281.
2. Equatorial section × 10, slide 10 (see also pl. 18, fig. 1), USNM 188282.
3. Equatorial section × 10, slide 2, USNM 188283.
4. Equatorial section × 10, slide 8 (see also pl. 18, fig. 2), USNM 188284.
5. Axial section × 10, slide 4 (see also pl. 18, fig. 4), USNM 188285.
6. Axial section of holotype × 10, slide 11 (see also pl. 18, fig. 3), USNM 188286.

7a, b. Equatorial section × 10 and × 50, slide 1, USNM 188287.

8. Deep tangential section × 10, slide 15, USNM 188288.

9a, b. Axial section × 10 and × 50, slide 7, USNM 188289.



CHALAROSCHWAGERINA TARLTONENSIS DOUGLASS AND NESTELL, N. SP.

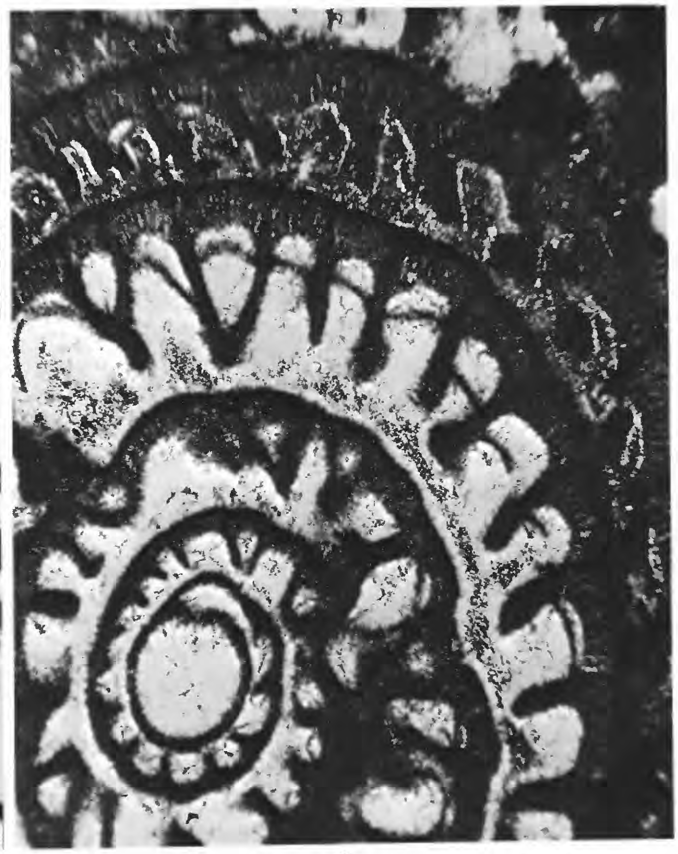
PLATE 18

[All figures × 50]

FIGURES 1–4. *Chalaroschwagerina tarltonensis* Douglass and Nestell, n. sp. (p. 43).
From locality 34, Isla Tarlon collection f22491.

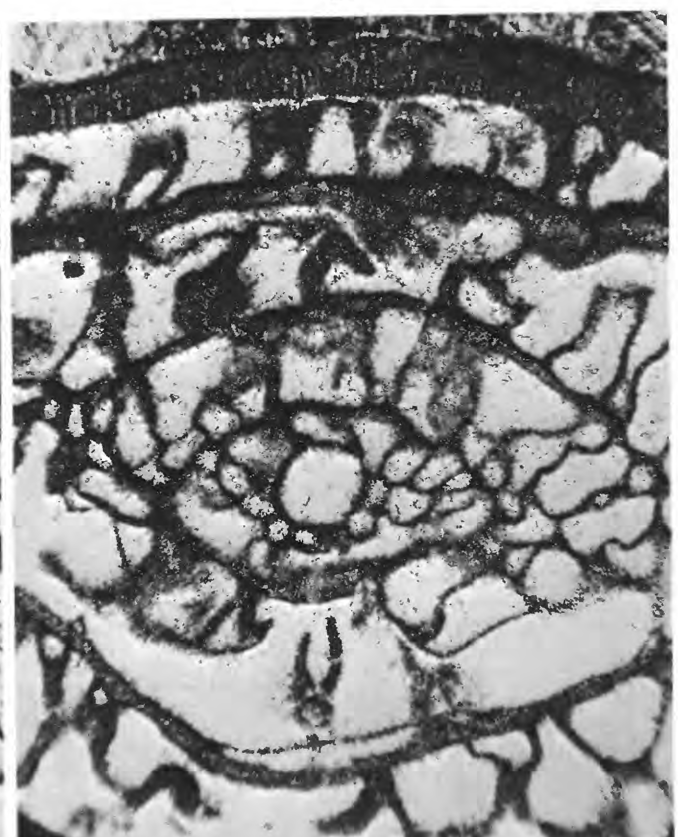
1. Equatorial section of specimen on plate 17, figure 2.
2. Equatorial section of specimen on plate 17, figure 4.
3. Axial section of holotype, plate, 17, figure 6.
4. Axial section of specimen on plate 17, figure 5.

1



2

3



4

CHALAROSCHWAGERINA TARLTONENSIS DOUGLASS AND NESTELL, N. SP.