LEIDSE GEOLOGISCHE MEDEDELINGEN, Deel 47, Aflevering 1, pp. 115—161, 1-11-1971

FUSULINIDS FROM UPPERMOST MYACHKOVIAN AND KASIMOVIAN STRATA OF NORTHWESTERN SPAIN

BY

A. C. VAN GINKEL*

ABSTRACT

The uppermost marine fusulinid-bearing strata in northwestern Spain are found in the area of the upper Río Pisuerga in northern Palencia and in the area of the lower Río Cares in Oviedo (Asturia). The youngest fusulinid faunas in the Pisuerga area belong to the *Protriticites* Zone; they indicate a Lower Kasimovian age. In the area of the lower Río Cares fusulinids belong to the *Triticites* Zone; they indicate an Upper Kasimovian age. The *Protriticites* Zone of Spain is defined as the time-span between the first occurrence of *Protriticites* and the first occurrence of *Triticites*. One new species – *Triticites* (*Montiparus*) *fischeri* – and one new subspecies – *Triticites* (*Triticites*) *ohioensis* Thompson subsp. *benshi* – both occurring in the *Triticites* Zone of the Río Cares area, are described.

ACKNOWLEDGEMENTS

Unfortunately, most of the Russian literature on the present subject is absent in the Netherlands scientific libraries. Through the kind help of Dr. Charles Ross (Western Washington State College, U.S.A.) and Dr. F. Kahler (Klagenfurt, Austria) I was able to consult the papers of Miklukho-Maklay (1949), Bensh (1962), and Bogush (1963). These Russian papers were of utmost importance for the identification of the Spanish fusulinid fauna as well as for the relative age determination of the rock samples. Mr. W. C. Laurijssen who so skillfully prepared the photographic plates, is thanked for his devoted attention.

INTRODUCTION

Formerly, this author (van Ginkel, 1965) was of the opinion that the fusulinid-bearing rocks of the *Protriticites* Zone, which occur in the upper Río Pisuerga area of Palencia, represent the uppermost strata in northwestern Spain deposited in an open marine environment. However, Mr. M. M. Fischer in 1965 took a rock sample from marine strata in the Río Cares area of Oviedo (Asturia) which contained a true *Triticites* fauna, so this supposition could no longer be maintained. Thin sections of another rock sample from the lower Río Cares area, apparently from the same formation and handed to me by Dr. E. Martinez García of the Salamanca University (Spain) in 1970, induced this author to review the stratigraphically youngest fusulinids of the Río Pisuerga area and to compare them with those found in the Río Cares area. This is the scope of the present paper.

The Protriticites and Triticites Zones in northwestern Spain
In northwestern Spain the *Protriticites* Zone is defined as the time-span between the first occurrence of *Protriticites* and the first occurrence of *Triticites*. Though in this paper the genus *Obsoletes* Kireeva is included in the genus *Protriticites* Putrya, acceptance of the former would not affect the concept of the *Protriticites* Zone as defined here. The strata with *Triticites* in the Río Cares area are doubtless deposited within the time-span comprising the *Triticites* Zone, since the genus *Pseudofusulina* characteristic for the directly overlying zone is not yet present. Moreover, the species themselves point to a fairly low position in the *Triticites* Zone.

Possible time-equivalent rocks in the U.S.S.R. of the Spanish rock sequence comprising the Protriticites Zone and part of the Triticites Zone
Correlation of the Spanish rocks comprising the *Protriticites* Zone and the lower part of the *Triticites* Zone with Russian strata is hampered by the apparently uncertain position in the Donetz basin of the

* Geological Institute, Dept. of Stratigraphy & Palaeontology, University of Leiden, The Netherlands.

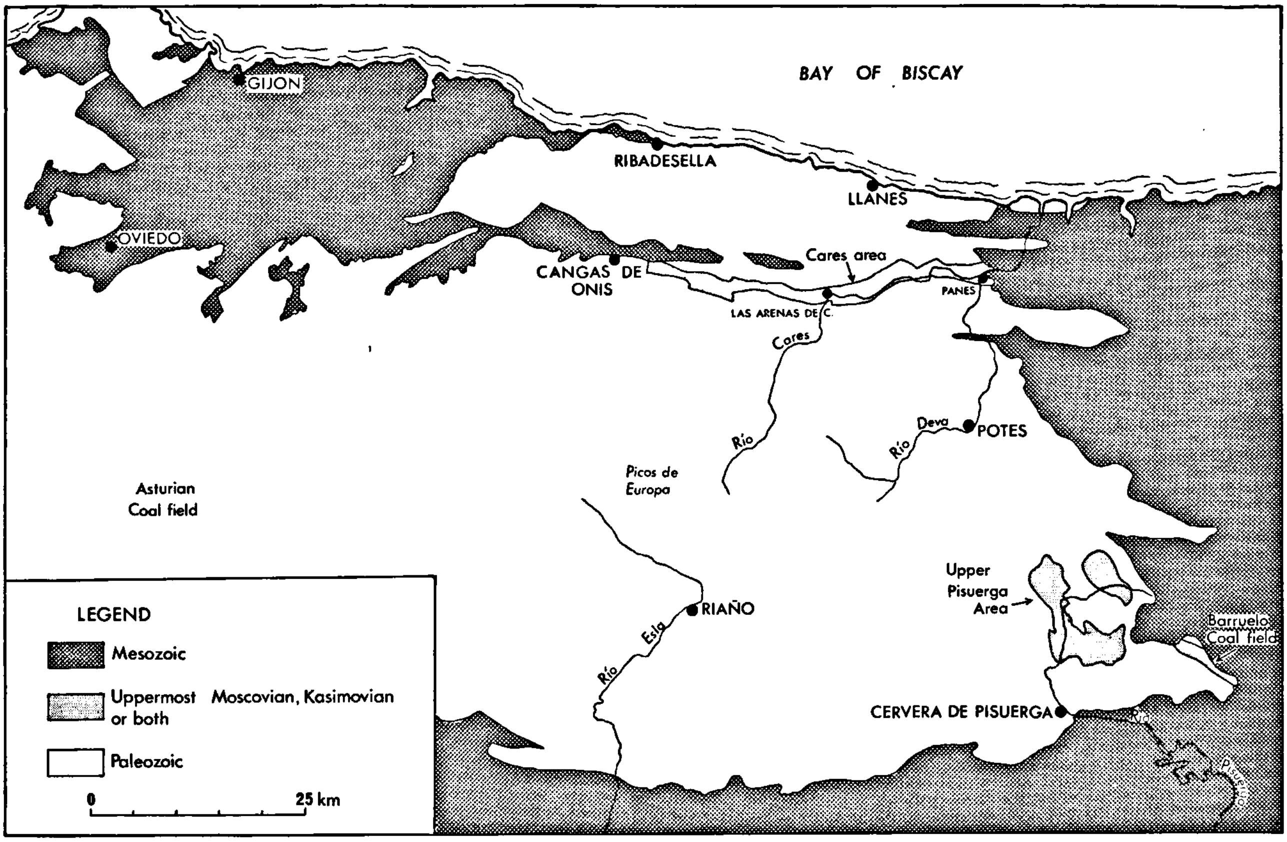


Fig. 1.

base of the Kasimovian stage of the Moscow platform (=horizon of *Teguliferina* of A. Ivanov). Usually this base is correlated with strata immediately above the N_2 Limestone or with the upper part of the N_2 Limestone of the C_3^1 (N) = Isaev suite of the Donetz. In other papers, however, this boundary is reported much higher, i.e. at the base of the C_3^2 (O) = Avilov suite (Kireeva, 1953; Bogush, 1963). With regard to the top of the Kasimovian, it is believed by Aisenverg et al. (1960) that it coincides with the O_4^1 Limestone of the C_3^2 (O) = Avilov suite.

According to the "Lexique stratigraphique international" the Kasimov stage as recognized on the Moscow platform has been subdivided from top to bottom as follows:

Yauza beds; 12–16 m; with a.o.:
Triticites arcticus Schellw.

Dorogomilov beds; 4–12 m; with a.o.:
Triticites irregularis Schellw.
Tr. acutus Dunb.

Khamovniki beds; 12–21 m; with a.o.:
Triticites (*Montiparus*) *montiparus* Ehrenb.
Quasifusulina longissima Moell.

Krevyakino beds; 13–23 m; with a.o.:
Quasifusulina longissima Moell.
Fusulina intermedia Gryzl. *et* Raus.

It may be noted that the Krevyakino beds rest disconformably on the Myachkov beds which could be one reason for the uncertainty with regard to this boundary in the Donetz basin. The Schelkovo beds above the Yauza beds have been included in the Kasimovian by some authors; others consider these beds as the base of the Gzhelian stage. Fusulinid Foraminifera have apparently not been found in the Schelkovo beds.

A general zonation of the Upper Carboniferous* of Russia as based on fusulinid Foraminifera has been given by various Russian students on this subject. The zonations given by respectively Rauser-Chernoussova (1938–1941), Schlikova (1948) and Rosovskaya (1958) are probably most currently used. The following comparison of zonations by fusulinids of the Upper Carboniferous is after Rosovskaya (1958, p. 61, Fig. 1).

The list of fusulinid species from the Kasimov stage as given above (viz. Lexique stratigraphique) suggests that the Krevyakino and Khamovniki beds belong to the C_3A Zone of Rosovskaya (=Zone of *T.* (*M.*) *montiparus* and *Protriticites*). The Dorogomilov- and Yauza beds belong apparently to her C_3B Zone (= Zone of *Tr. acutus* and *Tr. irregularis*). The beds

* Upper Carboniferous to be understood here and on the following pages in the Russian sense.

<table>
<tr><td colspan="2">Rauser-
Chernoussova
1938–1940</td><td colspan="2">Schlikova
1948</td><td colspan="2">Rosovskaya
1958</td></tr>
<tr><td colspan="2">C_3^{III}
Schwagerina
beds</td><td colspan="2"></td><td colspan="2">P_1
Schwagerina
horizon</td></tr>
<tr><td colspan="2">C_3^{II}

Pseudofusulina beds
with *Ps. sokensis*
Ps. baituganensis
(30 m)</td><td colspan="2">C_3^{II}

Pseudofusulina
beds with
Ps. sokensis
Ps. baituganensis</td><td colspan="2">C_3E

zone with
Daixina sokensis
and *D. baituganensis*
(32–37 m)</td></tr>
<tr><td rowspan="5">Triticites beds C_3^I</td><td>C_3^{I-d}

horizon with
T. jigulensis
(55–65 m)</td><td rowspan="5">Triticites beds C_3^I</td><td>$C_3^{I\ 5}$

horizon with
T. jigulensis
T. volgensis
(50-65 m)</td><td colspan="2">C_3D

zone with
T. jigulensis
(20–48 m)</td></tr>
<tr><td>C_3^{I-c}

horizon with
T. stuckenbergi
(30–40 m)</td><td>$C_3^{I\ 4}$

horizon with
T. stuckenbergi
(30–45 m)</td><td colspan="2">C_3C

zone with
T. stuckenbergi
(30–48 m)</td></tr>
<tr><td>C_3^{I-b}
horizon with
T. arcticus and
T. schwagerini-formis
(80–90 m)</td><td>$C_3^{I\ 3}$
horizon with
T. acutus
(72–90 m)</td><td>C_3B^3
C_3B^2
C_3B^1</td><td>C_3B
zone with
T. acutus and
T. irregularis
(80–85 m)</td></tr>
<tr><td rowspan="2">C_3^{I-a}

horizon with
T. montiparus
F-lla pulchra
(80–100 m)</td><td>$C_3^{I\ 2}$

horizon with
F-lla pulchra
F-lla usvae
(21–35 m)</td><td colspan="2" rowspan="2">C_3A

zone with
T. montiparus
and
Protriticites</td></tr>
<tr><td>$C_3^{I\ 1}$

horizon with
F-lla bocki
ex gr. F
schwagerinoides
(40–50 m)</td></tr>
</table>

Fig. 2. Comparison of the stratigraphic zonal schemes of the Upper Carboniferous of the Samara bend after Rosovskaya 1958.

with *Protriticites* but yet without *Triticites* (= beds of prae-*Triticites* of Stepanov) are sometimes recorded as the lower subzone of the C3A Zone. When such a procedure is followed, the upper subzone of C3A is often presented as the Subzone of *Tr.* (*M*) *montiparus*. It must be kept in mind, however, that zonations vary from author to author depending amongst other things on the area to which the zonation applies. The lowermost division of the Kasimov stage (Krevyakino beds) probably belongs to this *Protriticites* Subzone as far as this may be inferred from the few species given. According to Putrya (1956) the N_3, N_4 and N_5 Limestones of the C_3^1 (N) = Isaev suite of the Donetz basin belong to the lower part of the C_3A Zone (i.e. beds still without *Triticites*). The upper part or upper subzone of the C_3A Zone should start with the O_1 Limestone of the C_3^2 (O) = Avilov suite, since it is in this particular limestone that the earliest *Triticites* occur.

The Kasimov stage which is the lowermost stage of the Upper Carboniferous is succeeded by the Gzhelian stage (= Horizon of *Omphalotrochus* of A. Ivanov). Like the Kasimovian stage, the Gzhelian stage has its type area on the Moscow platform. The decision taken at the session on the unification of the stratigraphy of the Russian Carboniferous (1951) with regard to the Gzhelian, was that this stage should comprise from bottom to top the following fusulinid zones: 1) Zone of *Triticites stuckenbergi,* 2) Zone of *Tr. jigulensis* and 3) Zone of *Pseudofusulina.* It is not known to this author whether these zones are actually found in the type area.

Directing our attention once more to the paper of Aisenverg et al. (1960) on the stratigraphy of the Donetz basin, it is evident from the faunal lists given, that the C_3c Zone of Brazhnikova and Potievskaja (1959), although correlated with basal strata of the Gzhelian stage, does not contain *Tr. stuckenbergi,* which species appears only in the C_3d Zone (viz. *Tr.* ex gr. *stuckenbergi*). On the contrary, the faunal list of the C_3c Zone includes *Tr.* ex gr. *arcticus* and *Tr. acutus,* species which should be more characteristic for a lower zone, i.e. the Zone of *Tr. acutus.* The relative importance of other faunal elements – note

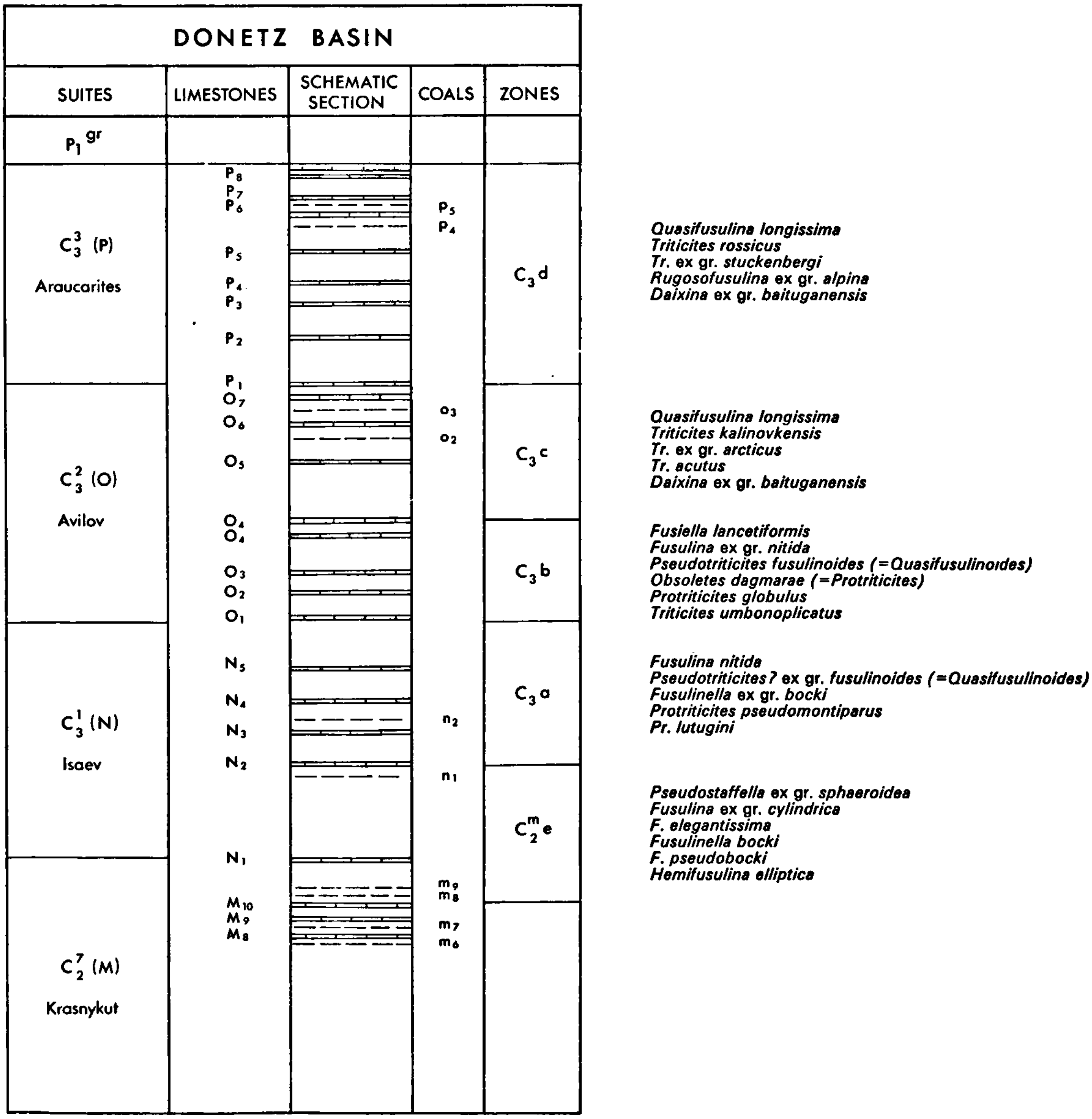


Fig. 3.

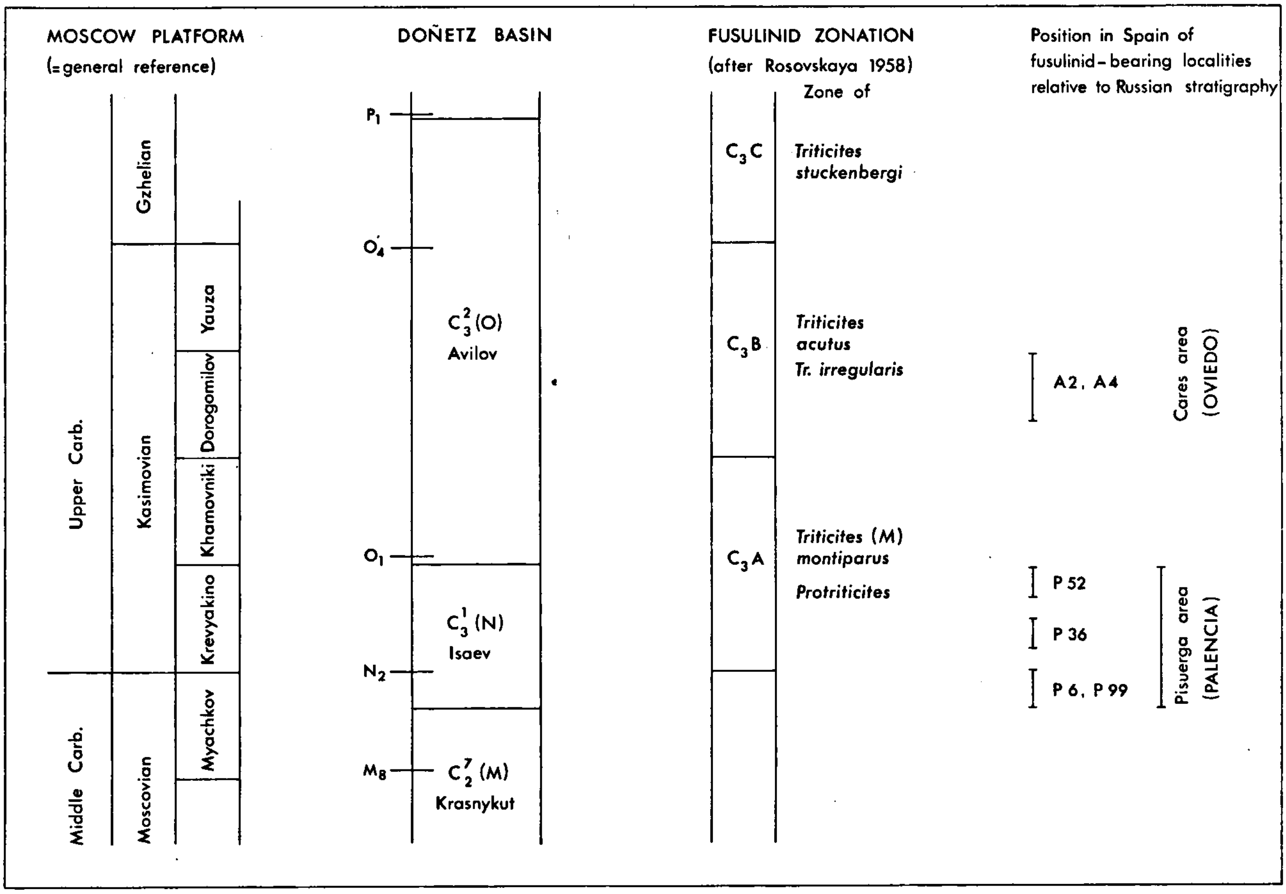


Fig. 4. P6 should read P5.

the presence of *Daixina baituganensis* in the C3c Zone – have probably led to the conclusion that the boundary between the Kasimovian and the Gzhelian in the Donetz basin should be put immediately above the O4[1] Limestone of the Avilov suite. The following figure (Fig. 3) shows the relevant part of the stratigraphic column of the Donetz basin as presented by Aisenverg et al. (1960) together with the most important fusulinid species of each faunal zone (Aisenverg et al., 1960, faunal lists). This stratigraphic interval should cover the total interval of the Myachkov beds of the Moscovian, the Kasimovian and the Gzhelian of the Moscow platform.

Although the knowledge of this author on the stratigraphy of the Upper Carboniferous of the U.S.S.R. is scanty and not up to date, it is nevertheless considered desirable to present a table – right or wrong – to show the probable stratigraphic position of the Spanish faunas in terms of the Russian stratigraphic nomenclature (Fig. 4). Data which should support the probable correlation of the Spanish fusulinid-bearing strata relative to the Russian standard (Moscow platform) are presented in the following paragraphs.

ON THE RELATIVE AGE OF THE FUSULINID BEARING LOCALITIES OF THE UPPER RIO PISUERGA (PALENCIA)

1) Locality P 5 (= Urbaneja Limestone Member)

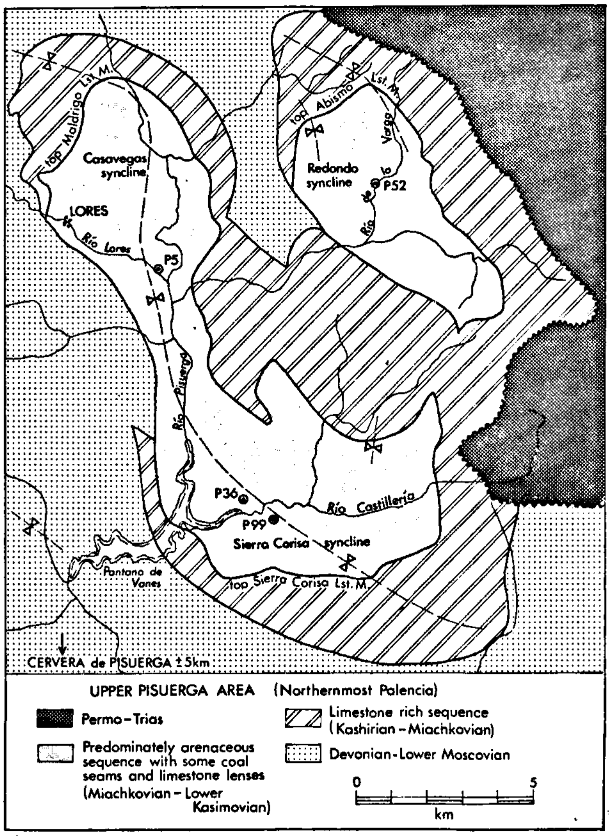


Fig. 5.

The Urbaneja Limestone Member is exposed less than 1 km from Urbaneja immediately N of the road which connects Urbaneja with Lores. It is separated by a sequence of about 1200 m of continental-paralic sediments from the stratigraphically lower Lores Limestone Member of Myachkovian age (van Ginkel, 1965). Since it constitutes the uppermost rock-unit of the Casavegas syncline, data on its relative age are important to the problem as to which chrono-stratigraphic level marine sedimentation continued in the upper Río Pisuerga area. In order to solve this problem more samples were collected recently, as former sampling had failed to produce any fusulinid Foraminifera (van Ginkel, 1965). The time-consuming laboratory operations on numerous samples resulted in a collection of eight specimens of fusulinid Foraminifera (Pl. I, Figs. 1–7, 14). These specimens belong to:

Staffellinae
Fusulinella sp.
Fusulina sp.

Remarks regarding the probable age of this assemblage
Fusulinella sp. – The genus *Fusulinella*, though a common and characteristic element of Middle Carboniferous fusulinid faunas, is not restricted to the Middle Carboniferous. *Fusulinella* ex gr. *bocki* and *F.* ex gr. *schwagerinoides* may extend into the C_3^{I1} Zone of the U.S.S.R. (Schlikova, 1948); this means into strata probably equivalent to the middle or upper part of the C_3^1 (N) = Isaev suite of the Donetz basin.

Fusulina sp. – *Fusulina* sp. is close to *F. pakhrensis* Rauser-Chernoussova, which species has been reported to occur in the upper part of the Myachkovian of the Moscow platform. Our species has a smaller form ratio.

Though conclusions cannot be definite, the most probable equivalents in the U.S.S.R. of the Urbaneja Limestone seem to be:

top of Myachkovian (Moscow platform)
N_1 or N_2 Limestone of the C_3^1 (N) = Isaev suite (Donetz basin).
Zone: ? Base of *Protriticites* Zone (Spain)

2) Locality P 99
Locality P 99, situated about 1300 m E of the village Vañes, is one of the outcropping limestones in the valley of the Río Castillería. Stratigraphically, it occurs about 100–200 m above the Sierra Corisa Limestone Member of Myachkovian age (van Ginkel, 1965; Appendix 2, Loc. P 22–2 and Loc. P 22-3). It represents the uppermost member of massive limestone of the Sierra Corisa syncline but is yet below the so-called Estalaya beds and Loc. P 36.

Locality P 99 contains the following fusulinid Foraminifera (Pl. I, Figs. 8–13; Pl. II, Figs. 1–3):

Staffella cf. *moelleri* Ozawa
Staffella mochaensis van Ginkel
Staffella sp.
Fusulinella sp.

Discussion on probable age
The fusulinids of Loc. P 99 are not very useful to determine their relative age within narrow limits. New in this list is *Fusulinella* sp., the presence of which was overlooked in 1965 (van Ginkel, 1965; Appendix 1). Unfortunately, the samples contained only very few specimens of *Fusulinella*. The sagittal section figured is the only centered section we possess. Yet, the very presence of *Fusulinella* forces to reconsider the age of Loc. P 99. This age was given as: "Probably lower to middle part of Kasimovian" (van Ginkel, 1965, Appendix 2). Stratigraphic evidence points to a correlation with the Urbaneja Limestone (Loc. P 5). Moreover, both the Urbaneja Limestone and the limestone Loc. P 99 contain Algae of the same algal Zone VI of Rácz (Rácz, 1965)*. The fusulinids in both limestones do not contradict such a correlation.

3) Locality P 36
Locality P 36 is an outcrop of marly limestone 375 m E of the bridge across the lake of Vañes along the road from Vañes to San Felices. It is at approximately the same stratigraphical level as the so-called Estalaya beds and together they constitute the stratigraphically highest horizons of the Sierra Corisa syncline.

Loc. P 36 contains the following fusulinid Foraminifera (Pl. II, Figs. 4–7; Pl. III, Figs. 1–5):

Pseudostaffella sp.
Fusulina cf. *bella* Semikhatova *et* Melnikova (= *Beedeina*? ex gr. *conspecta* Rauser, in van Ginkel, 1965, p. 166)
Fusiella cf. *lancetiformis* Putrya
Protriticites sp. (= *Obsoletes*? sp. aff. *O. mirabilis* Kireeva, in van Ginkel, 1965, p. 166)

Remarks on this assemblage with respect to relative age
Pseudostaffella sp. – Although the genus *Pseudostaffella* is characteristic for the Middle Carboniferous, according to Putrya (Putrya, 1956, p. 24) isolated specimens belonging to this genus may cross the boundary between Middle- and Upper Carboniferous, as they are occasionally found in the prae-*Triticites* beds of the Donbass (N_2–N_5 Limestones of the C_3^1 (N) suite). It may be noted that *Pseudostaffella* sp. is fairly rare in Loc. P 36.

Fusulina cf. *bella* Semikhatova *et* Melnikova. – Our specimens compare closely with *Fusulina bella* Semikh. *et* Mel. which species has been reported by these

* The samples which I handed to Dr. L. Rácz for examination of the algal flora came from Loc. P 99 and not from Loc. P. 36 (cf. Rácz, 1965, p. 250). Moreover, he mistook Loc. P 2 for the Urbaneja Limestone. Loc. P 2 is nearly devoid of Algae. The samples which Dr. L. Rácz studied and which he both placed in his Zone VI are from Loc. P 99 and the Urbaneja Limestone (Loc. P 5).

authors from the Lower Myachkovian. The rather brief original description of this species does not allow to make a close comparison. Yet *F. bella* apparently has slightly fewer volutions and a larger form ratio. Formerly I was of the opinion that this species could be derived from some advanced *Beedeina*. At present, after examining more material, I believe that it is closer to the type species of *Fusulina*. The genus *Fusulina* may extend into the Kasimovian. *Fusulina complicata* Gryzlova, *F. kljasmica* Gryzlova and *F. conspecta* Rauser-Chernoussova found in Kasimovian strata seem to be rather typical *Fusulina*. Others may represent links toward *Quasifusulina* Chen which species are often grouped in the genus *Quasifusulinoides* Mikl.-Makl., Rauser *et* Rosovskaya.

Fusiella cf. *lancetiformis* Putrya. – *Fusiella* of the group *lancetiformis* Putrya appear in middle Myachkovian strata. They cross the boundary of the Upper Carboniferous. *Fusiella* of this group are apparently still present in the C3b zone of Brazhnikova and Potievskaja (i.e. in the upper part of the Kasimovian) (viz. faunal list of Aisenverg et al. 1960).

Protriticites sp. – In 1965 this species was assigned by the present author to *Obsoletes* although it was realized that by the absence of visible mural pores it could not at all be regarded as a typical representative of this genus.

Nevertheless, the thin wall, general outline of the test, type of septal folding as well as the shape of the chomata point to a close relationship with *Obsoletes mirabilis* Kireeva. The Spanish species might be considered as a possible ancestral species. This is not contradicted by the stratigraphic occurrence of both species. *Obsoletes mirabilis* is reported from the O_1 Limestone of the C_3^2 (O) = Avilov suite of the Donetz basin, whereas the assemblage of Loc. P 36 points to a slightly older age. In turn the Spanish species can only have descended from a species belonging to *Fusulinella*. Rjazanov (1958b) in his paper on *Protriticites* Putrya 1948 stated that he could follow the development of *Protriticites* into *Obsoletes* in stratigraphic sections of the Donetz basin. It seems therefore probable that *Obsoletes* is taxonomically polyphyletic. This is inadmissible. The distinction between both genera lies in a single character, i.e. the relative development of the tectoria which apparently are better developed in the stratigraphically somewhat older *Protriticites*. This gradual reduction of tectoria probably took place along different lineages, representing a parallel evolutionary trend. Taking into account the short life-span of both genera, the resulting classification is highly horizontal. In my opinion the splitting of *Protriticites* into the genera *Protriticites* and *Obsoletes* leads to a rather artificial classification in the sense that the ancestor – descendant relations are too much neglected in favour of their immediate utility in biostratigraphy. For these reasons it is considered preferable to adhere to the broader concept of *Protriticites* as given by Putrya in 1948. As a consequence this leads to the inclusion of *Obsoletes* Kireeva, 1952 in *Protriticites* Putrya, 1948.

The present species from Spain, although not showing mural pores, is obviously very close to several species of *Protriticites* s. l., and its inclusion in this genus seems justified. Most similar is *Protriticites mirabilis* (Kireeva); more remotely similar to the Spanish species are *Protriticites obsoleta* (Schellwien) reported from the *Omphalotrochus*- and *Cora* horizons of the U.S.S.R. and *Protriticites praesimplex* (Lee) from the Yanghukou Limestone of the Penchi series.

Protriticites Putrya sensu Putrya is common from the N_3 Limestone of the C_3^1 (N) = Isaev suite up to and including the O_2 Limestone of the C_3^2 (O) = Avilov suite. Isolated occurrences are reported from the N_1, N_2, O_3 and O_4 Limestones.

Considering the assemblage of fusulinid Foraminifera of Loc. P 36, its most probable equivalents in the U.S.S.R. seem to be:

base of Kasimovian (Moscow platform)
N_3 Limestone of the C_3^1 (N) = Isaev suite (Donetz)
Zone: *Protriticites* Zone (Spain)
Base of C3A Zone of Rosovskaya, 1958 (U.S.S.R.)

It is of interest to note that a fauna of gastropods is known from the Estalaya beds which according to Dr. Butusova (written comm.) indicate a Kasimovian age for these strata.

4) Locality P 52 (= Corros Limestone Member)
The Corros Limestone Member is a dark grey to blackish, muddy limestone lense which is exposed at the junction of the streamlets Varga and Lombatero, 1800 m NNE of Santa Maria de Redondo. It occurs near the top of a succession of turbidites in the Redondo syncline and is overlain by a sequence of about 1400 m of continental-paralic facies.

The following fusulinid Foraminifera have been found (Pl. V, Figs. 1–12):

Pseudotriticites cf. *lebedevi* (Putrya)
(= *Pseudotriticites* sp. of van Ginkel, 1959, p. 710)
(= *Beedeina* ? ex gr. *acuta* Lee of van Ginkel, 1965, p. 135)
Protriticites sp.

Discussion on probable age
Pseudotriticites cf. *lebedevi* (Putrya). – The genus *Pseudotriticites* Putrya, 1940 was rejected by the present author in 1965, following Rjazanov (1958a) who devoted a publication to this genus.

At present, however, I am not certain that we should abandon its use in fusulinid classification. By comparing the type species of *Pseudotriticites* (= *Fusulina donbassica* Putrya) with the type species of *Beedeina* (= *Fusulinella girtyi* Dunbar and Condra), the morphological differences between both seem to justify the grouping of the species similar to *F. donbassica* in an independent genus. The species close to *F. donbassica* most probably arose from *Beedeina*

Galloway, 1933 as redefined by Ishii (1958). *Pseudotriticites* apparently has a short range in time. According to Putrya (1956, p. 24), *Pseudotriticites* may be found in the N_2-N_5 limestone members of the C_3^1 (N) = Isaev suite of the Donbass. Up to the present, few species have been described which might be assigned to this genus. Apart from the type species, there are three species according to Rjazanov: *Fusulina lebedevi* Putrya, *F. stepanovi* Putrya and *F. genbizkii* Putrya. To this list one might perhaps add *F. siviniensis* Raus. and *F. acuta* Lee, though the latter is a *Schwagerina* according to Sheng (viz. Fossilium Catalogus, pars 113, p. 542). *F. siviniensis* Raus. is reported from the top of the Myachkovian of the A.S.S.R. (U.S.S.R.) Most species assigned to *Pseudotriticites* belong to *Putrella*, *Quasifusulinoides* or *Hemifusulina*. The Spanish species from the Corros Limestone is wholly similar to Rjazanovs *F. lebedevi* Putrya (Rjazanov, 1958a). He reported this species from the N_4 Limestone of the Belokalitvinsk area.

Protriticites sp. – The Spanish species compares rather well with *Protriticites plicatus* subsp. *bella* Kireeva and *P. umbonoreticulatus* Kireeva, both of which are reported to occur in the N_5 Limestone of the Isaev suite of the Donetz basin. However, our specimens are more advanced with respect to their wall-structure (viz. p. 126). In view of the latter character it conforms to a number of species assigned to the genus *Obsoletes* Kireeva, 1952. For reasons explained elsewhere in this paper (p. 121) the latter genus is here considered synonymous to the prior *Protriticites* Putrya, 1948. Of all species originally assigned to *Obsoletes*, the Spanish species seems to be most close to *O. gapeevi* Kireeva and *O. confusus* Kireeva. Both species occur in the O_1 Limestone of the C_3^2 (O) = Avilov suite of the Donetz basin. More remotely similar is *Protriticites lutugini* Kireeva from the N_3 Limestone.

The most probable equivalents in the U.S.S.R. of the Corros Limestone seem to be:

Lower Kasimovian (top of Krevyakino beds) (Moscow platform)
N_5 Limestone of the C_3^1 (N) = Isaev suite (Donetz basin)
Zone: *Protriticites* Zone (Spain)
C_3A Zone of Rosovskaya (1958) (U.S.S.R.)

5) Locality P 6
The fusulinids of Loc. P 6 are from a thin limestone lense which crops out in the river Rubagón between Brañosera and Barruelo de Santullàn. Stratigraphically it occurs more than 1000 m above the Brañosera Limestone Member of Myachkovian age (van Ginkel, 1965, Appendix 2, Loc. P 38), and about 100 m below the Peñacorba Coal Member.

It contains the following Foraminifera (Pl. III, Figs. 6, 7; Pl. IV, Figs. 1–3):

Staffella sp.
Protriticites? sp.

Remarks on relative age
The fusulinid fauna is not sufficient to determine the relative age within narrow limits. The spindle-shaped fusulinids which are extremely rare in our thin sections could perhaps belong to the genus *Protriticites*. They could represent an early growthstage or they might be close to some of the smaller species of this genus. The wall, without mural pores but also unlike the fusulinellid wall structure, is rather similar to the wall in the inner whorls of advanced *Protriticites*. With respect to the age of this sample, *Staffella* sp. is also of little use, since not much is known about the – slow ? – evolutionary trends of this genus in the Middle- and Upper Carboniferous.

It is nevertheless considered worthwhile to present this fauna because we know that the underlying partly turbiditic succession, i.e. between the Brañosera Limestone and the limestone of the present locality, yielded brachiopod faunas which according to Winkler Prins point to a Kasimovian age (Wagner and Winkler Prins, 1971).

ON THE RELATIVE AGE OF THE FUSULINID BEARING LOCALITIES OF THE LOWER RIO CARES (OVIEDO, ASTURIA)

1) Locality A 4
At the outskirts of the village Las Arenas de Cabrales in the valley of the Río Cares and on the road to Camarmeña, a short road section yielded abundant specimens of fusulinids from muddy limestone in which a pebbly mudstone occurs (1 m). The present locality is situated in the same formation as our locality A 2, 20 km to the east, near Panes. Locality A 4 has been sampled by Mr. M. M. Fischer in 1965 and subsequent examination of his samples showed the presence of the first true *Triticites* recorded from Spain. The single species present is classified as *Triticites* (*Montiparus*) *fischeri* sp. nov. (Pl. VI, Figs. 1–9; Pl. VII, Figs. 1–7).

Comments on relative age of Locality A 4
Species of the subgenus *Montiparus* Rosovskaya, which are the earliest *Triticites* of the *Triticites* Zone in the U.S.S.R., almost certainly evolved from species belonging to *Protriticites*. They still possess an upper tectorium which is absent in more advanced *Triticites*. Contrary to *Protriticites*, they have a keriotheca instead of straight mural pores. The oldest *Triticites* in the U.S.S.R. are those found in the O_1 Limestone of the C_3^2 (O) = Avilov suite of the Donetz basin. The range of *Triticites* (*Montiparus*) is from the C_3A Zone into the C_3B_1 Zone (zonal division of Rosovskaya, 1958). Our species is probably closest to *Tr.* (*M.*) *umbonoplicatus* Raus. *et* Belj. and *Tr. ? peculiaris* Gryzlova. The former species has been described from the C_3B_1 Zone of the Samara bend (U.S.S.R.); the latter is known from the top of the Galanin series of the Kasimovian. The lower part of the C_3B Zone possibly corresponds to the O_2 or O_3 Limestones of the C_3^2 (O) = Avilov suite of the Donetz basin and to the Dorogomilov beds of the Kasimovian.

Provided that these correlations are correct, the most probable equivalents in the U.S.S.R. of Loc. A 4 are:

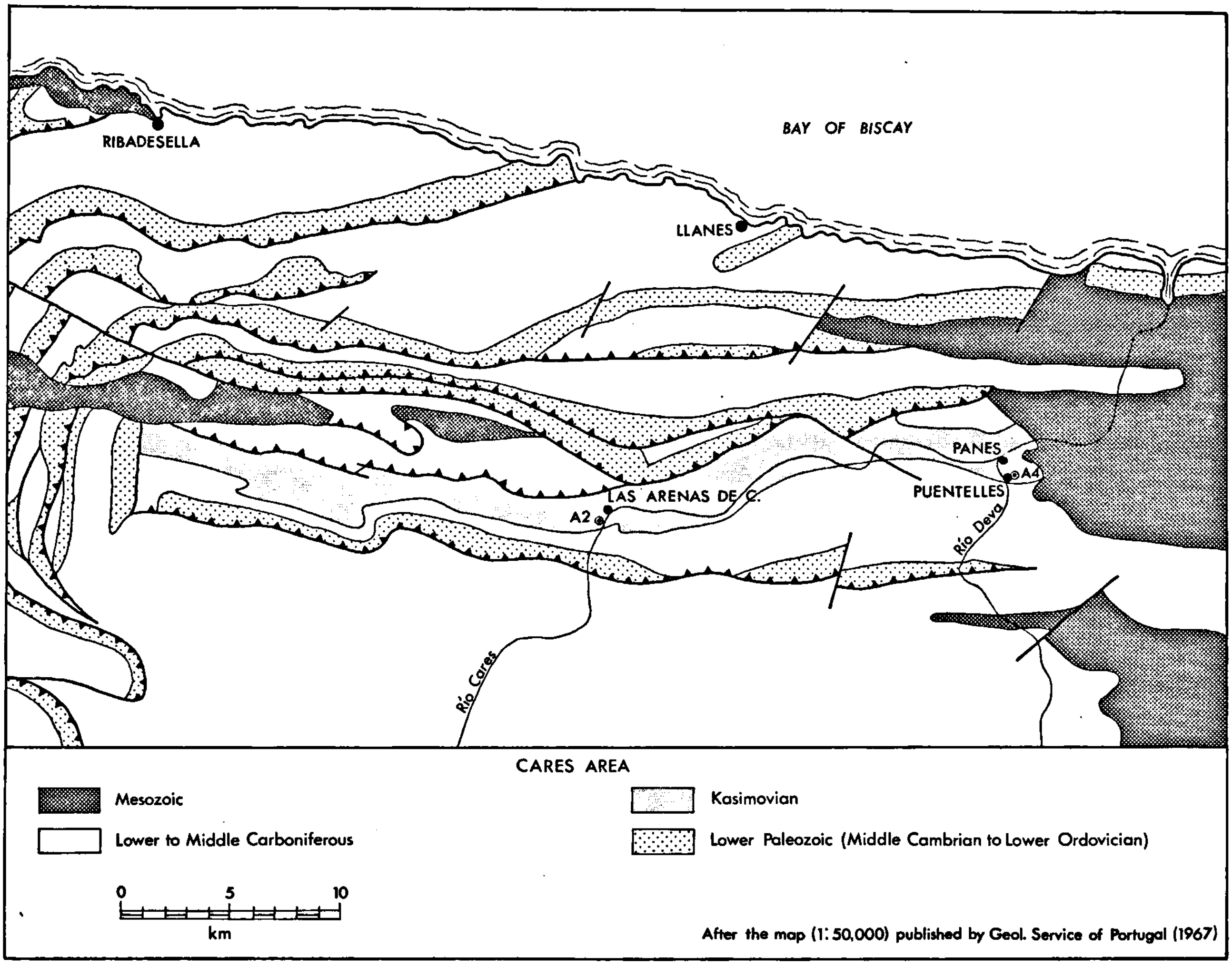


Fig. 6.

O_2–O_3 Limestones of the C_3^2 (O) = Avilov suite (Donetz Basin)
lower part of Upper Kasimovian (Dorogomilov beds) (Moscow Platform)
Zone: *Triticites* Zone (Spain)
C_3B_1 Zone of Rosovskaya, 1958 (U.S.S.R.)

2) Locality A 2
The fusulinids of A 2 are from the same formation as those found in A 4. The A 2 locality is about three km S of Panes in the hamlet Puentellés at the roadside of Panes to Potes. Rock specimens from this locality came in my possession through Dr. E. Martinez García who in 1970 showed me some thin sections of this limestone of Puentellés.

The following fusulinid Foraminifera have been found (Pl. VII, Figs. 8–13; Pl. VIII, IX and X):

Triticites (*Triticites*) *ohioensis* Thompson subsp. *benshi* subsp. nov.
Staffellinae

Comments on relative age of Locality A 2
Tr. (*Tr.*) *ohioensis* Thompson has originally been described from the Cambridge Limestone Member of the Conemough series which is at about the middle of the Missourian stage (Zone of *Tr. irregularis*). Rosovskaya (1958) mentions *Tr.* (*Tr.*) cf. *ohioensis* from her C_3B Zone. In Bogush (1963) *Ferganites ohioensis* (Thompson) is shown to occur above his *Obsoletes* Zone. This might imply that these strata with *F. ohioensis* are younger than the O_2 Limestone of the Donetz Basin. Our specimens are almost identical to those described and figured by Bensh from south Fergana which he compares with the subspecies *schiensis* of Miklukho-Maklaj and which he reported to occur in the upper part of the Cimisbel suite (Bensh, 1962).

As the most probable equivalents of Loc. A 2 are regarded:

O_3 Limestone of the C_3^2 (O) = Avilov suite (Donetz Basin; U.S.S.R.)
Upper Kasimovian (Dorogomilov beds) (Moscow platform; U.S.S.R.)
Missourian (middle Missourian?) (U.S.A.)
Zone: *Triticites* Zone (Spain)
C_3B Zone of Rosovskaya, 1958 (U.S.S.R.)
Triticites Zone; *Tr. irregularis* Subzone (U.S.A.)

DESCRIPTION OF SPECIES

Fusulina sp.
Pl. I, Figs. 6, 7, 14

Locality: P 5

Description: One axial section and two sagittal sections show the following characteristics.

The outline of the axial section changes from short fusiform (1st wh.), fusiform (2nd wh.), fusiform to elongate rhomboidal (3–4th wh.), fusiform (5th wh.) to fusiform to elongate fusiform (5.5 wh.). Lateral sides convex or straight.

Septal folding fairly high. First whorl of axial section shows curving septa in the polar areas; in the 2–3rd whorl, septa are clearly folded at the poles and part of the lateral sides; folding extends over the whole length of the shell from the 3.5 whorl; the sagittal sections show the first septal loop in the 2–4th whorl. Relative wavelength is about 15 in the 4–5th whorl.

Chomata present up to and including the 3rd whorl; in subsequent whorls rudimentary or absent. Height of chomata decreases from $^1/_2$ over $^1/_3$ to $^1/_5$ of the height of chambers from the first to the third volution respectively; their width varies from $1–^1/_2$ (1st wh.) and $^1/_2–^1/_5$ (1.5–3rd wh.) relative to their maximum possible extension.

Axial filling seems to be present but is only very slightly developed.

The wall consists of a diaphanotheca and a lower tectorium; in the first whorl the lower tectorium is hardly discernible; it is thin with respect to the diaphanotheca in inner three whorls; in subsequent whorls it is often as thick as or even thicker than the diaphanotheca. In outer whorls mural pores are occasionally, and only faintly visible.

Remarks: The present species is most similar to *Fusulina pakhrensis* Rauser Chernoussova from which it differs in having a smaller form ratio.

Pseudostaffella sp.
Pl. II, Figs. 4, 5

Locality: P 36

Description: The two axial sections in our collection show a relatively large proloculum and only 3.5–4 whorls. They have moderately developed umbilical depressions. Periphery is arched or straight to arched in the first whorl and straight to arched or straight in subsequent whorls. Chomata with generally steep slopes at the side of the tunnel; they extend up to the poles and occupy much of the lumen of chambers; height varies from 0.40–0.45 (0.5–1.5 wh.), 0.40–0.60 (2–3rd wh.) and 0.60–0.65 (3–4th wh.) of the corresponding chamber lumen. Tunnel path symmetric. Axis of coiling retains original position throughout growth.

Wh.n.	0	1		2		3	4	
Specimen 4(1)	34	78		138		215	263	R.v.
4(2)	40	92		150		205	240	
			77		56			G.r.
			63		37			
				0.87		0.92	0.86	F.r.
		0.75		0.78		0.87	0.87	

Remarks: Of all species of *Pseudostaffella* in northwestern Spain, the present species occurs at the highest stratigraphic level. If both specimens are full-grown, which is assumed, their conspicuous characteristics are: smallness, few volutions with a fairly large proloculum, high and wide chomata. Correspondence in characteristics with any of the known species of this genus is not so close as to permit identification. It is, however, somewhat similar to *Pseudostaffella keytei* (Roth and Skinner, 1930) and *Ps. khotunensis* Rauser-Chernoussova, 1951. They might perhaps represent young specimens of *Ps. sphaeroidea* Ehr. subsp. *cuboides* Rauser, a species known from the top of the Sierra Corisa Limestone Member (Loc. P 22–3) in this same area.

Measurements:

Wh.n.	0	1		2		3		4		5		6	
Specimen: 3	138	197		285		402		561		720	871		R.v.
4	126	201		293		419		603		837		1089	
5	117	239		402	419								
			45		41		40		28				G.r.
			46		43		44		39		30		
			68										
		17		34		36		34		36	29		W.th.
		13		17		26		40		50		34	
		17		23	25								
		1.53		2.15		2.31		2.47		2.50	2.68		F.r.
		12		21		26		28		35		36	S.c.

Staffella sp.
Pl. IV, Figs. 1–13

Locality: P 6

Description: Radius vector: 500- 825 (6-7th wh.)
Form ratio: 0.70-0.85
Number of whorls: 6-7.5

Rather shallow umbilical depressions; whorls completely involute, occasionally partly evolute in the 7th whorl; percentages of angularity of periphery for 7 specimens from 1st to 7th volution respectively:

*S.							
S. (A.)			5		25	50	20
A.	55	35	15	75	75	50	80
A. (blp.)	35	55	70	15			
blp.	10	10	5	10			
P. (blp.)			5				
P.							

Spirotheca smooth in inner 5–6th whorls; septal grooves may be seen in subsequent whorls. Septa perpendicular to wall or somewhat forwardly inclined; occasionally curved in inner three to four whorls.

Chomata wide, probably reaching the poles in inner whorls; their height varies from $^{1}/_{4}$ to $^{1}/_{2}$ of height of chambers up to the 6th whorl; in subsequent whorls height may decrease to about $^{1}/_{10}$ of chamber height. They are steep or slightly sloping at the side of the tunnel.

Tunnel path slightly asymmetric; width of tunnel is 10–30 %, 20–30 % and 40–50 % of total length of corresponding whorls in the 4–5.5wh., 6–6.5 wh. and 7th wh. respectively.

In the outer whorls mural pores have occasionally been observed; except for chomata secondary deposits are absent.

Measurements: See Table 1

Remarks: The present species might be new; unfortunately some papers on the Staffellinae, for instance those of Rosovskaya (1963) and Durkina (1959), were not available to this author for which reason the necessary comparisons could not be completed. Some specimens show a superficial resemblance to *Staffella moelleri* Ozawa; others compare rather well with some specimens of *St. mochaensis* van Ginkel. In the shape of the inner whorls and the development of the chomata it is often closely similar to the Lower Permian species *St. yobarensis* Ozawa.

Triticites (*Montiparus*) *fischeri* sp. nov.
Pl. VI, Figs. 1–9; Pl. VII, Figs. 1–7

Type specimen: Specimen 5 (Pl. VI, Fig. 4) is designated as the holotype

* S. = straight; S. (A.) = arched to straight; A. = arched; A. (blp.) = bluntly pointed to arched; blp. = bluntly pointed; P. (blp.) = pointed to bluntly pointed; P. = pointed.

Locality: A 4

Description: Radius vector: 785-1050 μ (4.5-5th wh.)
Form ratio: 2.25-3.70 ibid.
Number of whorls: 4.5-5.5

From 1st to 5th whorl, test changes from oval to short fusiform (1st wh.), short fusiform, fusiform or rhomboidal to elongate rhomboidal (2nd wh.), fusiform or elongate rhomboidal (3rd wh.) to elongate fusiform (4–5th wh.). Lateral sides slightly convex or straight from the 2nd whorl onwards; in outer whorls of axial sections and notably towards the poles the wall is often quite irregular (wavy); in sagittal sections the spirotheca is smooth throughout growth (no septal furrows).

Septal folding starts at poles of 1–2nd whorl; folding progresses into the median area from 1–2.5 whorl but extends not yet over the tunnel; folding extends over the tunnel from 2–3.5 whorl although the intensity of folding here is very weak and contact between adjacent septa is rather exceptional. A very intense and highly irregular "cauliflower" type of folding is observed at the poles of the 3.5–5th whorl or stated otherwise when the form ratio has a value of at least 2.5. Sagittal sections may show some septal loops; they are invariably absent in the inner two whorls; the first septal loop generally appears in the 3–3.5 whorl; they may be absent throughout growth however. Septal pores* have been observed in various specimens.

Chomata may extend to the poles in the 1st whorl; on average they cover $^{1}/_{2}$ to $^{3}/_{4}$ of the lateral slopes in the inner two whorls; in the last whorl width is reduced to $^{1}/_{10}$–$^{1}/_{5}$ of the lateral slopes. The chomata are fairly high; on average they occupy $^{1}/_{3}$, $^{1}/_{2}$ and $^{1}/_{3}$ of the height of chambers in the 0.5 wh., 1–3.5 wh. and 4–4.5 wh. respectively. They show a rather symmetric outline; symmetric chomata may appear as early as the 1st whorl though asymmetric chomata are not uncommon up to the 3.5 whorl; generally steep slopes at the tunnel side.

Tunnel path almost symmetric to asymmetric; average and range of maximum deviation of symmetry respectively 17° and 7–28° (N = 12). The tunnel height on average is $^{1}/_{4}$ to $^{1}/_{3}$ of the corresponding chamber height; their width relative to the total length of corresponding whorls is on average about $^{1}/_{10}$; the proportion of tunnel height and tunnel width decreases from an average of $^{1}/_{2}$ (1st wh.) to $^{1}/_{4}$ (4th wh.).

Axis of coiling maintains original position throughout growth and is generally straight.

Wall in early whorls consists of a protheca (tectum and porous lower layer) and a porous secondary deposit on top of the protheca; this upper tectorium

* Septal pores are observed also in *Protriticites* of Loc. P 52. The presence of this characteristic apparently is quite common in both genera.

is often seen to be in continuity with the chomata; occasionally, however, it is clearly separated from the chomata. The chomata may show a layered construction. The thickness of the protheca in inner three whorls varies from 8–17 μ (1st wh.), 15–21 μ (2nd wh.) and 21–34 μ (3rd wh.). The wall in outer whorls shows a typical keriotheca, i.e. trabecula thicken downwards and short trabecula are intercalated between the long ones at the roof of the wall. The upper tectorium is absent beyond the 3–4th whorl. Mural pores are indistinct in the inner 0.5–2.5 whorls, clearly discernible from the 1–3.5 whorl whereas a typical keriotheca appears in the 3–4th whorl. Width of pores as measured at the basal side of the wall varies from 2–4.5 μ (3 rd wh.), 4–8.5 μ (4th wh.) and 4–17 μ (5th wh.); number of pores per 100 μ length of wall again measured at the basal side of the wall varies from 8–11 (3rd wh.), 6–10 (4th wh.) and 5–9 (5th wh.).

Measurements: See Table 2

Remarks: Of all species hitherto described from northwestern Spain, most similar to the present species is undoubtedly *Protriticites* sp. of the Corros Limestone Member (Loc. P 52). Reexamination of the wall of *Protriticites* of Loc. P 52 showed that its composition might be understood as a prior state leading to the more advanced wall of *Tr.* (*M.*) *fischeri.* This is shown in the following table which presents a comparison between the wall of *Protriticites* of Loc. P 52 and *Triticites* (*Montiparus*) of Loc. A 4:

	Wh.n.	Thickness of wall: Total	Protheca only	Composition of wall	
				(1) Upper tectorium (2) Protheca	Typical keriotheca appears in the 3–4th whorl. Number of pores per 100 μ = 5-10 in 4–5th whorl.
	1	13–34	8–17		
	2	21–46	15–21	Upper tectorium disappears beyond	
A 4	3	27–50	21–34	3–4th whorl.	
	4	34–59			
	5	42–59			
	1	8–17	4–7	(1) Upper tectorium	
	2	12–25	10–11	(2) Protheca	
P 52	3	15–30	11–14	Possibly lower tectorium locally present; in 5th wh. these secondary layers can occasionally still be distinguished.	No keriotheca but coarse mural pores from 4–5th wh. Number of pores per 100 μ = 10–13 in 4-5th whorl.
	4	19–39	15–17		
	5	27–50			

Both species differ from *Protriticites* of the N_1–N_3 suites of the Donbass (U.S.S.R.), i.e. the oldest representatives of this genus in the U.S.S.R., in having no clearly developed and thick lower tectorium. Our Spanish species are in this respect at an evolutionary higher level. Formerly the present author mistook the protheca for the lower tectorium, as follows from the description of the wall of *Protriticites* of Loc. P 52 in van Ginkel (1965, p. 168). Other differences with the Corros Limestone specimens are the larger proloculum, the larger diameter for corresponding whorls and the on average slightly smaller number of whorls of *Tr.* (*M.*) *fischeri.* Moreover, the septal folding is still more intense, progressing farther towards the median area whereas the chomata are somewhat less conspicuous.

Outside Spain there are a number of species which are very similar and probably closely related to *Tr.* (*M*) *fischeri* sp. nov. These are *Tr.* (*M.*) *umbonoplicatus* Raus. *et* Belj. and *Tr. ? peculiaris* Gryzlova from the U.S.S.R., and *Tr.* (*M*). *hataii* Igo from Japan. More remotely similar is *Tr. winterensis* Thompson, Verville and Lokke which species nevertheless is worth noting since this species has been made the type of the subgenus *Iowanella* of *Kansanella* by Thompson.

I am fairly much convinced that some lineages in the genus *Protriticites* lead to *Triticites* (*Montiparus*) which is supported by comparing the P 52 population of *Protriticites* with the A 4 population of *Triticites* (*Montiparus*). A possible ancestral species to our A 4 population might be a species close to *Protriticites magnus* (Kireeva). Descendant lineages from the A 4 population, supposing there have been any such lineages, might have evolved into species of the group *Triticites arcticus* (Schellwien), e.g. into a species like *Tr. fortissimus* Rauser-Chernoussova. *Tr.* (*M.*) *fischeri* differs from *Tr. ? peculiaris* Gryzlova in the wall structure of the latter species, which apparently consists of simple straight mural pores even in outer whorls. Moreover our species contains slightly less volutions and on average has a somewhat different – less cylindrical – shape in the adult. *Tr.* (*M.*) *umbonoplicatus* Raus. *et* Belj. is generally more inflated with a smaller form ratio, has on average a slightly greater number of whorls and a somewhat smaller proloculum and possesses slightly thicker walls. *Tr.* (*M.*) *hataii* Igo has a greater number of whorls, a slightly smaller proloculum and on average a somewhat larger form ratio. Presence of upper tectorium apparently is more persistent (up to the outer whorls in the median area). The tunnel angle is smaller. Igo's species obviously fits the concept of the subgenus *Montiparus* and is here assigned to it.

Triticites (*Triticites*) *ohioensis* Thompson subsp. *benshi* subsp. nov.
Pl. VIII, Figs. 1–8; Pl. IX, Figs. 1–8; Pl. X, Figs. 1–5

Type specimen: Specimen 13 (Pl. X, Fig. 1) is designated as the holotype

Locality: A 2

Description: Radius vector: 725–1200 μ
Form ratio: 4.50–5.70
Number of whorls: 6–7

From 1st to 7th whorl, test changes from short fusiform or short fusiform to rhomboidal (1st wh.), fusiform or elongate rhomboidal (2nd wh.), fusiform or elongate fusiform (3rd wh.), elongate fusiform (4th wh.), to elongate fusiform or elongate subcylindrical (5–7th wh.). In sagittal sections the spirotheca is smooth in inner 3–4.5 whorls; in subsequent whorls some, mostly shallow septal furrows may be observed.

In the innermost whorls a rapid progression of septal fluting from the polar towards the median area is observed; septa straight to strongly twisted at poles from 0.5–1st whorl, folded only in the polar regions from 0.5–1.5 whorl, progressing into the median area from 1–2.5 whorl, extending to near the equatorial plane from 1.5–3rd whorl. In subsequent whorls the intensity of folds in the median area gradually decreases, eventually leading to a retraction of folds towards the poles in the outer whorls; septal fluting slightly wavy in the median area from the 2.5–5.5 whorl, receding towards the poles and straight in part of the median area from the 3–6th whorl. In sagittal sections septal loops are absent. The slightly irregular folding in all our specimens conforms wholly with the folding shown in the type-species of *Triticites* i.e. *T. secalicus* (Say). Septal pores are common and easily visible in the polar areas of outer whorls.

Chomata may extend to the poles in the first half whorl; on average they cover $^1/_4$ to $^3/_4$ of the lateral slopes in the innermost whorl; in the last two whorls width is reduced to $^1/_{20}$–$^1/_6$ of the lateral slopes. The chomata are of medium height; on average they occupy $^1/_3$ of the height of chambers up to the 4th whorl and $^1/_5$ of the height of chambers in the 5–6th whorl. They show a rather symmetric outline; symmetric chomata may be present from the start, i.e. in the first half whorl, but generally appear in the 1–2.5 whorl; asymmetric chomata may be observed up to the 2–4th whorl. They are steep or slightly sloping at the side of the tunnel.

Tunnel path almost symmetric to asymmetric; average and range of maximum deviation of symmetry respectively 19.5° and 10–34° (N = 12). The tunnel height on average is $^1/_4$ to $^1/_3$ of the corresponding chamber height; their width relative to the total length of corresponding whorls is about $^1/_{10}$ in inner four whorls and about $^1/_7$ in the 5–6th whorl; the proportion of tunnel height and tunnel width decreases from about $^4/_{10}$ in the first whorl to about $^1/_{10}$ in the fifth whorl.

Axis of coiling maintains original position throughout growth and is straight or, rarely, slightly bent.

The wall consists of a protheca and a secondary deposit on top of it. From the 2.5–4th whorl mural pores are clearly visible. A typical keriotheca, i.e. a downward thickening of the alveolar walls combined with the intercalation of shorter trabecula near the roof of the wall, is observed occasionally only; this might be due to the often slightly recrystallized state of the wall. The secondary deposit on top of the protheca might be considered either as an upper tectorium or as the very thin, sheet-like continuation of the chomata; this "upper tectorium" may be absent in outer whorls, or is only locally present; in inner 1–2 whorls it is seen not only at the lateral sides but also below the tunnel. Width of pores as measured at the basal side of the wall varies from 2–10.5 μ (4th wh.), 4–10.5 μ (5th wh.) and 6–13 μ (6th wh.); number of pores per 100 μ length of wall varies from 5–8 (4th wh.), 6–8 (5th wh.) and 6–8 (6th wh.).

Measurements: See Table 3

Remarks: The present new subspecies most probably is closely related to *Triticites ferganensis* of the U.S.S.R. (South Fergana) which was presented as new by Miklukho-Maklay in 1948 (Fossilium Catalogus, Pars 112, Teil 2, p. 470). Unfortunately Miklukho-Maklay's paper of 1948 was not available to this author. In 1949 Miklukho-Maklay published a description of a variety of this species occurring in the same strata: *Tr. ferganensis* var. *schiensis* var. nov. In 1959 the variety *schiensis* was brought to species level and included in the genus *Ferganites* of Miklukho-Maklay: *Ferganites schiensis*. In 1962 Bensh presented his find in South Fergana of a population of specimens which he considered sufficiently similar to identify it as belonging to *Tr. ferganensis schiensis* M.-Maklay or *Ferg. schiensis* M.-Maklay. Bensh again lowered it to subspecies rank but did not assign it to the species *Tr. ferganensis* M.-Maklay but to *Tr. ohioensis* Thompson: *Tr. ohioensis schiensis* Miklukho-Maklay.

The present author is of the opinion that:

1. the population found by Bensh in South Fergana almost wholly matches our Spanish population from Loc. A 1 as described above, differing only in minor details.
2. Bensh's forms and the species *schiensis* of M.-Maklay yet differ in such measure as to allow discrimination of the two at subspecies level.
3. Bensh's procedure who assigns this Fergana population as a subspecies to *Tr. ohioensis* Thompson 1936 is to be followed, since this species of the U.S.A. is apparently quite close to the Fergana- as well as to the Spanish specimens.

Consequently we have the species *Tr. ohioensis* Thompson in the U.S.A. and a subspecies *Tr. ohioensis schiensis* for M.-Maklay's population from Fergana and another subspecies *Tr. ohioensis benshi* for Bensh's population from Fergana and the Spanish population.

A comparison between given measurements of these four populations is presented below.

	Tr. ohioensis Thompson	*Tr. ohioensis schiensis* M.-Maklay	*Tr. ohioensis benshi* subsp. nov.	
	———	= *Tr. ferganites schiensis* M.M. 1949 = *Ferganites schiensis* M.M. 1959	Bensh popul. from Fergana = *Tr. ohioensis schiensis* of Bensh 1962	popul. from Spain (loc. A2)
proloculum	55–95 av. 60	up to 100	90–170	120–236
number of whorls	8	5	6–7.5	6–7
diameter or radius-vector	r.v. / diam. 1 66 / 0.12 2 118 / 0.20 3 182 / 0.34 4 307 / 0.56 5 498 / 0.92 6 767 / 1.46 7 1080 / 2.00	r.v. / diam. 0.20–0.30 0.35–0.47 0.58–0.70 0.85–1.10 1.48–1.50	r.v. / diam. 0.60–1.06	r.v. / diam. 111–216 / 0.20–0.30 184–335 / 0.35–0.60 260–498 / 0.50–0.90 352–687 / 0.70–1.20 519–871 / 1.00–1.60 710–971 / 1.40–1.80
	length 9 mm diam. 2 mm	length 6.8 mm diam. 1.5 mm	length 7.3–9.3 mm diam. 1.8–2.1 mm	length 7–11 mm diam. 1.4–2.2 mm
formratio or L/D	f.r. 1 2 3 2.3 4 5 3.0–3.4 6 7 4.0–4.5	L/D 4.3–4.5	L/D 2.0–2.8	f.r. 1.4–1.9 1.9–2.8 2.1–3.2 2.5–4.0 3.2–4.8 4.2–5.8 4.3–5.6
thickness of spirotheca	1 5 2 9 3 12 4 21 5 26 6 44 7 53	——— (fairly thick)	outer whorls: 55–70	12–21 17–34 22–42 28–52 40–67 44–67

Fig. 7.

REFERENCES

Aisenverg, D. E., et al., 1960. Carboniferous stratigraphy of the Donetz basin. C. R. 4me Congr. Carb., Heerlen (1958), tome 1, pp. 1–13.

Bensh, F. R., 1962. Pozdnekamennougol'nye i Rannepermskie fuzulinidi severnoy Fergany. Izdatel. Akad. Nauk, Uzbekskoy SSR, pp. 186–252.

Bogush, O. I., 1963. Foraminifery i stratigrafiya Srednego i Verkhnego Karbona vostochnoi chasti Alayskoge Khrebta. Akad. Nauk SSR, Sibirskoé Otdel., Inst. Geologii i Geofiziki, Trudy, no. 9.

Ginkel, A. C. van, 1959. The Casavegas section and its fusulinid fauna. Leidse Geol. Med., 24/2, pp. 705–720.

Ginkel, A. C. van, 1965. Carboniferous fusulinids from the Cantabrian Mountains (Spain). Leidse Geol. Med., 34, pp. 1–225.

Kahler, F. and G., 1966. Fossilium Catalogus, I: Animalia, pars 111–114; W. Junk, 's-Gravenhage.

Kireeva, G. D., 1950. Nouvelles espèces du Fusulinidae des calcaires des séries $C_3{}^1$ et $C_3{}^2$ du bassin du Donetz. Dept. for Coal Exploration (Ugletekhizdat), Mater. Stratigr. Paleontol. Donetz basin, pp. 193–214 (trad. B.R.G.M. 4373).

Kireeva, G. D., 1953. O Nizhney granitse Verkhnego Karbona v Donetskom Basseyne. Akad. Nauk SSSR, Doklady, vol. 88/1, pp. 117–119.

Lexique stratigraphique international, vol. II, U.R.S.S.; Centre national de la recherche scientifique; Paris.

Miklukho-Maklay, A. D., 1949. Verkhnepaleozoyskie fuzulinidy Sredney Azii (Fergana, Darvaz i Pamir). Mono. Izd. Leningrad. Gosud. Univ.

Putrya, F. S., 1948 *Protriticites*, nouveau genre de Fusulinidés. L'vovsk. Obshch. Geol. Pal., Ser. No. 1, pp. 89–96 (trad. B.R.G.M. 2232).

Putrya, F. S., 1956. Stratigraphie et Foraminifères du Carbonifère moyen du Donbass oriental. Trudy VNIGRI SSSR, (Mikrofauna SSSR, t. 8) t. 98, pp. 333–485 (trad. B.R.G.M. 1627).

Rácz, L., 1965. Late Palaeozoic calcareous Algae in the Pisuerga basin (N. Palencia, Spain). Leidse Geol. Med., 31, pp. 241–260.

Rjazanov, G. F., 1958a. Le genre *Pseudotriticites* Putrya, 1940. Dokl. Akad. Nauk SSSR, t. 123/5, pp. 933–936 (trad. B.R.G.M. 2083).

Rjazanov, G. F., 1958b. Morphologie et systématique du genre *Protriticites* Putrya, 1948. Dokl. Akad. Nauk SSSR, t. 123/4, pp. 725–755 (trad. B.R.G.M. 2117).

Rosovskaya, S. E., 1958. Fusulinidy i biostratgraficheskoe raschlenenie verkhnekamennougol'nykh otloshenij Samarskoj Luki: Akad Nauk SSSR, Geol. Inst., Trudy, no. 13, pp. 57–120.

Thompson, M. L., 1936. Pennsylvanian fusulinids from Ohio. Journ. Pal., Menasha, Wis., U.S.A., 10, p. 680.

Wagner, R. H. & Winklerprins, C. F., 1971. The stratigraphic succession, flora and fauna of Cantabrian and Stephanian A rocks at Barruelo (prov. Palencia), N.W. Spain. Congrès et Colloques Univ. Liège, Vol. 55, 1970.

TABLES

Abbreviations in tables of measurements

R.v.	=	Radius vector
F.r.	=	Form ratio (proportion of halflength and radius vector)
W.th.	=	Wall thickness
S.c.	=	Septal count
T.a.	=	Tunnel angle
G.r.	=	Percentage increase of the radius vector for each consecutive whorl.
T.h/H	=	The proportion of height of chamber and height of tunnel (× 100)
T.w/L	=	The proportion of length of whorl and width of tunnel (× 100)
T.h/T.w	=	The proportion of width of tunnel and height of tunnel (× 100)
Ch.h/H	=	The proportion of height of chambers and height of chomata (× 100)
Ch.w/lw	=	The proportion of maximum possible extension of chomata along the lateral slopes and actual width of chomata (× 100)

Table 1

Measurements of <u>Staffella</u> sp. from Barruelo de Santullán (Loc. P6)

Axial sections:

Specimen:	Wh.n.	7	8	9	10	11	15	18	Range	Average
R.v.	0	24	22	--	--	21	25	21	21- 25	22.5
	1	59	69	60	80	50	71	61	50- 80	64
	2	107	126	113	141	101	128	113	101-141	118
	3	185	220	172	234	195	204	166	166-234	197
	4	272	377	260	343	276	304	260	260-377	299
	5	377	536	364	503	385	419	352	364-536	419
	6	503		511	695	540	486•	452•	503-695	562
	7			687	796•	645				
G.r.	1	82	82	89	76	100	79	86	76-100	85
	2	73	75	52	66	94	59	46	46- 94	66
	3	47	71	51	46	42	49	57	42- 71	52
	4	38	42	40	46	39	38	35	35- 46	40
	5	33		40	38	40			33- 40	38
	6			34		19				
	7									
F.r.	1	0.46	0.42	0.48	0.47	0.48	0.54	0.46	0.42-0.54	0.47
	2	0.49	0.54	0.52	0.57	0.48	0.48	0.54	0.48-0.57	0.52
	3	0.58	0.60	0.57	0.70	0.47	——	0.64	0.47-0.70	0.59
	4	0.66	0.77	0.71	0.73	0.68	0.73	0.69	0.66-0.77	0.71
	5	0.74	0.79	0.75	0.86	0.70	0.81	0.84	0.70-0.86	0.78
	6	0.67•		0.87	0.84	0.75	0.79•	0.78•	0.75-0.87	0.82
	7			0.71	0.86•	0.85				
	8			0.69•						

Sagittal sections:

Specimen:	Wh.n.	1	2	3	4	5	6	16	17	Range	Average
R.v.	0	39	31	24	27	27	26	25	28	24- 39	28
	1	92	86	63	67	67	76	60	65	60- 92	72
	2	143	151	107	126	122	132	109	122	107-151	126
	3	191	243	164	181	185	206	181	189	164-243	193
	4	297	394	239	285	285	302	276	301	239-394	297
	5	419	553	369	402	385	415	368	452	368-553	420
	6	586•	620•	519	536		578	519	620	519-620	554
	7			637•	603•			570•	821		
G.r.	1	55	76	70	87	81	75	82	87	55- 87	77
	2	34	61	53	43	52	56	65	55	34- 65	52
	3	54	62	46	57	54	47	52	59	46- 62	54
	4	41	40	54	41	35	38	33	50	33- 54	42
	5			41	33		39	41	37	33- 41	38
	6								32		
	7										
S.c.	1	7	7		7				7		7
	2	13			11	10	11	13	11	10-13	11.5
	3	17		14	14	15	13	14	14	13-17	14.5
	4	20	15	15	16	16	17	13	13	13-20	16
	5	19	16	18	17	17	16	15	17	15-19	17
	6	18		18	22		17	16	20	16-22	18.5
	7				24				19		
W.th.	1	10				7	9	7	6	6-10	8
	2	13		8				10	11	8-13	10.5
	3	11		15		13	14	13	14	11-15	13
	4	17		19		16	15	16	19	15-19	17
	5	19		21		15	21	19	22	15-22	19.5
	6			21			17	19	22	17-22	20

Table 2

Measurements of <u>Triticites(Montiparus) fischeri</u> sp. nov.

Axial sections:

Specimen:	Wh.n.	4(1)	9	6(2)	4(2)	5	10	3	8	7	1	2	6(1)	Range	Average
	C	111	100	99	87	81	81	80	80	80	70	66	59	59–111	83
	1	181	227	151	168	151	128	199	164	130	145	151	134	128–227	161
R.v.	2	301	385	268	297	285	234	339	276	235	268	310	251	234–385	287
	3	419	620	486	469	473	394	553	469	373	448	532	419	373–620	471
	4	586•	770•	703	720	737	636	787	796	590	737	628•	653	590–796	707
	5					—	787•		1050	854•	—		1010		
G.r.	1	66	70	77	77	89	83	70	68	81	85	105	87	66–105	80
	2	39	61	81	58	66	68	63	70	59	67	72	67	39– 81	64
	3			45	54	56	62	42	70	58	64		56	42– 70	56
	4														
	1	1.50	1.50	1.42	1.63	1.54	1.44	1.83	1.16	1.47	1.58	1.72	1.62	1.16–1.83	1.53
	2	1.67	1.80	1.94	2.11	2.25	1.66	1.95	1.93	2.00	1.71	1.75	1.91	1.66–2.25	1.89
F.r.	3	2.40	2.60	2.41	2.50	2.43	1.96	2.38	2.04	2.22	1.96	2.00	2.33	1.96–2.60	2.27
	4	3.70	2.76	2.76	2.89	2.69	2.45	3.57	2.11	2.57	2.56	2.87	——	2.11–3.70	2.81
	5						3.16		2.94	2.24•	2.61	2.70	2.76'		
	1	25	34	25	17	25	27	25	21	—	25	25	15	15–34	24
	2	38	34	42	31	38	31	38	34	25	42	38	27	25–42	35
W.th.	3	27	38	45	34	42	30	36	42	34	34	46	50	27–50	38
	4	42	40	59	34	42	—	57	38	36	49	46	46	34–59	44
	5	42			50	55	50		50		59	59	55	42–59	52
Tunnel															
	1	27	24	31	28	33	22	23	33	23	37	22.5	38	22–37	28.5
	2	23	29	32	28	32	26	35	34	23	32	24	32	23–35	29
T.a.	3	36	41	37	34	40	35	47	44	32	35	27	35	27–47	37
	4	40•	—	58	45	—	50	71•	62	49	59	42	53	42–62	52
	5				71•	54•							60		

Specimen:	Wh.n.	4(1)	9	6(2)	4(2)	5	10	3	8	7	1	2	6(1)	Range	Average
	0.5		55	25				22		19	29				
	1	31	39	57	14	35	29		45	40				14–57	34
			24	37	18	31	33	33	15	23	23	29	9		
	2	27			41	40	24	20	22	26	22	32	29	9–41	27
		15		31		28		18	20	31					
T.h/H	3		26	25			24	25		25	33	36		15–36	26
						35				32	28		20		
	4				25					23				20–35	27
							18								
	5														
	0.5		64	48				36		37	50				
	1	45	56	61	31	38	50		62	40				31–64	48
			20	48	30	41	61	50	17	30	45	41	19		
	2	44			55	50	34	21	20	33	33	61	35	17–61	38
		15		38		25		19	17	42					
T.h/T.w	3		21	26			23	15		26	42	64		15–64	29
						26				39	27		18		
	4				15					14				14–39	23
							10								
	5														
	0.5		16	9				14		12	10				
	1	9	10	14	7	12	9		12	11	10			7–16	11
			11	9	7	11	11	8	11	8	8	9	6		
	2	7	9	8	8	9	9	10	11	8	8	7	8	6–11	9
		10		9	11	11		8	12	7		9			
	3		10	8	9	10	12	11	12	9	9	6	8	6–12	10
T.w/L		9		11	10	10		14	11	7	10	7	9		
	4			10	11				15	12	11	9	11	7–15	10
					16		9								
	5														

Specimen:	4(1)	9	6(2)	4(2)	5	10	3	8	7	1	2	6(1)	Range	Average
Chomata														
Wh.n.														
0.5	34	37			32	23			25	50	35		23–50	34
1		62	58	57	50	52	54		55	62	41	48	41–62	54
	45		42	59	46	48		60	36	44		47	36–60	47
2	44	45	46	48	58	52	40	52		37	56	45	37–58	48
Ch.h/H	42	31	42	60		46	56	50	59	58	56	39	31–60	49
3		32	46	58	54	29	54	39		50	47	42	29–58	45
	39	30	41	63		44	33	61		49	53	39	30–63	45
4	31	abs.	21	38	40		25	54		38	46	41	21–54	37
				25	26	48	abs.			37		30		
5						43			25	abs.		20		
0.5	62	100		83	78	71	100		67	100	88	100		
1	68	57	64	56	100	50	100	72	43	100	75	52	43–100	77
	42	64	56	25	44	66	50	64	60	65	51	61		
2	41	47	26	44	66	26	53	52	69	43	25	34	25– 69	49
Ch.w/lw	28	21	25	34	30	34	35	31	52	37	28	32		
3		23	13	23	32	18	27	33	39	34	30	28	13– 52	30
	25		15	21	18	19	18	26	23	25	28	23		
4	15		8	20	17	19	10	13	32	19	17	16	8– 32	19
				19	21	14			9		17	13		
5						20							9– 21	16

Sagittal sections:

Specimen:	14	12	17	15	4(3)	16	11	18	19	13	Range	Average
Wh.n.												
0	106	93	91	90	90	88	79	77	75	71	71–106	86
1	210	197	178	191	197	200	143	172	134	168	134–210	179
2	368	331	332	318	318	348	268	315	223	335	223–368	316
R.v. 3	611	494	536	553	519	536	549	578	402	611	402–611	539
4	787°	653°	787	687°	687°	754	703	729°	653	946	653–946	769
5							971°		—			
1												
G.r. 2	75	68	86	66	61	74	87	83	66	99	61– 99	76
3	66	49	61	74	63	54	105	83	80	82	49–105	72
4			47			41	28		63	55	28– 63	47

Specimen:	14	12	17	15	4(3)	16	11	18	19	13	Range	Average
Wh.n.												
1	22	23	—	28	—	29	19	25	13	23	13–29	23
2	42	25	—	33	27	46	21	35	23	36	21–46	32
W.th. 3	35	36	35	38	29	46	42	41	29	42	29–46	37
4	50	46	36	55	36°	47	50	46	36	50	36–55	46
5		59		56		59	59	63°	43	59	43–59	56
1	10	9	11	8	10	10	8	8	9	10	8–11	9
2	18	18	18	16	21	19	16	17	17	16	16–21	17.5
S.c. 3	21	23	21	19	20	22	22	21	22	20	19–23	21
4	—	21	27	—	22	24	23	24	23	26	21–27	24
5		—			—	—	—			—		

Specimen:	18	16	12	19	15	13	17
Number of pores per 100 micron length of wall (measured at lower side of wall)							
Wh.n.							
3	9	11	8				
4	7	8	7	10	7	6	
5	6	8	5	9	7		7
Width of pores (measured at lower side of wall)							
Wh.n.							
3	2–4.5	2–4.5	2–4.5				
4	4–8.5	4–8.5			2–8.5	4–8.5	
5	8–13	6–17	4–17		8–17		4–8.5

Table 3
Measurements of <u>Triticites(Triticites) ohioensis</u> subsp. <u>benshi</u> subsp. nov.

Axial sections:

Specimen:	Wh.n.	15	5	9	12	8	13	10	2	6	11	14(2)	1	7	3	4	14(1)	Range	Average
R.v.	0	128	108	99	97	95	89	86	85	82	80	76	72	65	64	60	—	60–128	86
	1	191	188	170	155	172	147	160	145	164	147	134	149	130	134	111	164	111–191	154
	2	293	251	301	218	260	251	251	247	268	235	218	268	234	243	184	260	184–301	249
	3	419	352	444	368	369	385	352	369	402	360	331	431	368	364	260	348	260–444	370
	4	565	502	595	536	494	519	469	477	544	532	469	586	586	528	352	519	352–595	517
	5	720	703	837	695	670	754	620	611	745	737	729	779	750	771	519	691	519–837	708
	6	838	904	1005		821	988	737	745	913	871•	955	854•	837	972	700	921	700–1005	872
	7	—•	980•	1189		921	1131•			972•		1013•			1089•	854	921•		
G.r.	1	53	33	77	41	51	71	57	70	63	60	63	80	80	81	66	59	33–81	63
	2	43	40	47	69	42	53	40	49	50	54	52	61	57	50	41	34	34–69	49
	3	35	43	34	45	34	35	33	30	35	48	42	36	59	45	35	49	30–59	40
	4	27	40	41	30	36	45	32	28	37	39	55	33	28	46	48	33	27–55	37
	5	16	29	20		23	31	19	22	22		31		12	26	35	33	12–35	25
	6			18		12										22			
	7																		
F.r.	1	1.66	1.44	1.64	1.94	1.55	1.94	1.41	1.56	1.36	1.50	1.62	1.89	1.63	1.56	1.38	1.72	1.36–1.94	1.61
	2	2.34	1.87	2.22	2.36	1.86	2.07	2.80	2.14	2.00	2.36	2.69	2.48	2.46	2.20	2.05	2.23	1.86–2.80	2.26
	3	2.95	2.11	3.25	2.50	2.12	2.78	3.09	2.23	2.70	2.80	3.19	3.00	2.78	2.89	2.56	3.00	2.11–3.25	2.75
	4	3.71	2.48	3.96	3.02	2.55	3.42	3.98	2.61	3.71	3.54	3.96	3.73	3.16	3.38	3.24	3.64	2.48–3.98	3.38
	5	4.85	3.44	4.05	3.62	3.50	3.50	4.67	3.17	3.95	3.92	4.22	4.26	4.44	4.21	3.81	4.65	3.17–4.85	4.02
	6	5.28	4.62	4.86		4.62	4.21	5.80	4.64	5.30	3.91•	5.20	4.41•	5.37	4.74	4.76	4.64	4.21–5.80	4.93
	7		5.00	4.66		5.19	4.24			5.67•		5.16•			5.15	5.60	5.58•	4.24–5.60	4.97
W.th.	1	13	16	17	19	13	16	15	17	17	13	16	16	19	12	17	—	12–19	15.5
	2	21	21	21	25	19	24	25	22	31	22	25	21	24	22	17	17	17–31	22
	3	36	38	38	36	25	36	34	23	42	23	30	35	42	31	22	27	22–42	32
	4	44	44	38	42	33	40	36	28	42	40	44	48	52	40	35	40	28–52	40
	5	61	67	59	46•	48	50	48	40	63	43	57	55	55	57	50	59	40–67	54
	6	50	61	59		51	65	44	61•	67	55•	59	46•	44	58	59	50	44–67	56
	7			42		43	65•			50		63•			38•	40	57•		

Specimen: Tunnel	Wh.n.	15	5	8	13	10	2	6	11	14(2)	1	7	3	4	14(1)	Range	Average
T.a.	1	35	—	31	40	22	23	24	21	28	31	25	22	20	—	20–40	27
	2	36	28	36	43	33	31	23	28	41	36	29	39	25	28	23–43	33
	3	52	35	35	—	44	35	35	41	53	51	35	52	29	41	29–53	41
	4	65	57	43	48	54	—	51	57	64	62	—	52	43	—	43–65	54
	5	82	73	69	—	—	—	78	90	92	—	—	—	67	86	67–92	80
	6	—	97	80	56	—	87•	95		87		—	—	90	—	56–97	84
T.h/H	0.5	24	27		23				22	12		20	24				
	1	40						27			25	25	19	37		12–40	25
		48		34	20	18	34	24					19	28			
	2	43	30	25	22	45	35	37			20		21	31		18–48	30
		32	30	33		44		27		20							
	3	30	32	36	20		26	45	28	24			48	46		20–48	33
		20	25		25		35		29								
	4	34		42	24			24	38				33			20–42	30
				29			27						35	26			
	5			35					27							26–35	30
T.h/T.w	0.5	36	33		32				29	13		75	42				
	1	33						38			35	35	43	69		13–75	39
		34			22	23	42	26					25	53			
	2	36	21	21	23	42	35	48			23		23	42		21–53	32
		25	20			28		17		10							
	3	13	17	32	13		17	30	18	18			26	33		10–33	21
		6	12		11		21		13								
	4	10		20	9			8	16				15			6–21	13
				12			10						11	11			
	5			12					6							6–12	10

	Specimen: Wh.n.	15	5	8	13	10	2	6	11	14(2)	1	7	3	4	14(1)	Range	Average
	0.5	12	12		12				14		12	7	9				
	1	11						10	7	12	10	10	8	10		7–14	10
		9	12	9	11	8	8	9	9	9	10	7	8	6			
	2	10	12	11	10	9	10	8	8	9	10	7	9	7		6–12	9
		8	10	9	9	8		10	7	10	10	9	10	8			
T.w/L	3	11	12		10		11	9	10	9	10	10	11	8		7–12	10
		12	13		7		11	10	10	9	11			9	10		
	4	12		11	10		12	11	11	10	12		9	10		7–13	10.5
				15			13		12					11			
	5		14	11			21	14	19	17			13	11	15	11–21	14
				12			19	15						13			
	6		19	15	10			18		13				16		10–19	15

	Specimen: Chomata Wh.n.	15	5	9	12	8	13	10	2	6	11	14(2)	1	7	3	4	14(1)	Range	Average
	0.5	31	37				29	43	29	34	40	36	42	34				29–43	35.5
	1	30		39		46	27		21	28	49	29			45		40	21–49	35.5
		44		30		41	33	43		28	30	41	41	50	40			28–50	38
	2	39		36			24	29		26	31	40			38		38	24–40	33
Ch.h/H		40		25		28	27	35	31	33	29		39	38	20	35	42	29–42	32
	3	35		26		28		34		30	46	37	30		32		37	26–46	33.5
				34	37	27	41			38		26	28		20	24		20–41	31
	4			31		32			17		23				34	37	40	17–40	31
		21	15	18		18	20		24	16	18	27	14				20	14–27	19
	5	24	33	17		35	14	25	10	10	18	10			17	23		10–35	20
				28			24		17	24						23		17–28	23
	6					33	23					12				17		12–33	21

	Specimen: Wh.n.	15	5	9	8	13	10	2	6	11	14(2)	1	7	3	4	14(1)	Range	Average
	0.5	26	63			38	45	80	69	78	100		61	63	55			
	1	30	32	32	38	31	32	30	18	28	39	25	44	28	38	42	18–100	45
		24		29	27	21	27	26	26	31	43	32	35	37	30			
	2	18		16	25	26	16	18	34	27	40	18		29	21	16	16– 43	27
		19	20	19	16	31	21	23	39	18	37	26		20	23	24		
Ch.w/lw	3	16	12	28	18	10		18	23	19	26	26		13	18	18	10– 39	22
				26	16	26		26	14	19	16	14		20	20	23		
	4	20	9	18	18	16		16	20		15			14	18	16	9– 26	18
		33	12	21	13	11		21			15	9			16	14		
	5	22	15	9	28	9	13	14	6	11	17				19	12	6– 33	15
		0	14	7	14	24		13	7						7	9		
	6	–	13	12	17	4			–		7				–	–	0– 24	11

Sagittal sections:

	Specimen: Wh.n.	18	21	19	20	23	24	Range	Average
	0	118	112	93	82	63	60	60–118	88
	1	216	206	195	153	134	128	128–216	172
R.v.	2	318	310	335	264	235	230	230–335	282
	3	431	427	498	402	369	385	369–498	419
	4	599	557	687	561	532	553	532–687	581
	5	804	787	871	712	628•	712	712–871	777
	6	971			888•		838		
	1								
	2	47	50	72	73	75	80	47–80	66
G.r.	3	36	38	49	52	57	67	36–67	50
	4	39	30	38	40	44	43	30–44	39
	5	34	41	27	27		29	27–41	32
	6	21					18		

	Wh.n.	18	21	19	20	23	24	Range	Average
	1	9	10	9	9	—	7	7–10	9
	2	16	16	14	15	—	12	12–16	15
S.c.	3	17	16	15	15	16	17	15–17	16
	4	18	18	19	18	19	19	18–19	18.5
	5	17	17	18	22		18	17–22	18
	6	19					18		
	1	19	17	21	16	—	17	16–21	18
	2	27	25	34	23	23	19	19–34	25
W.th.	3	27	34	40	30	30	29	27–40	32
	4	44	43	48	45	40	38	38–48	43
	5	59	55	50•	55	55•	55	50–59	56
	6	61			63•		59•		

Specimen:	1	2	3	9	11	13	14(2)	15	24
Number of mural pores per 100 micron length of wall (measured at lower side of wall)									
Wh.n.									
4	5–6			6–8	5–6	8	7		
5		7	6–8	6–8	6–7			8	
6			6–7	6		6			6–7.5
Width of mural pores									
Wh.n.									
4	4–10.5			4–8.5		2–8.5	4–8.5		
5		4–8.5	4–10.5					4–8.5	
6			6–13	6–8.5		6–13			

PLATES

Plate explanation

The scale of the microphotographs in the plates is indicated by a bar representing 500 μ. Different enlargements in a single plate are indicated by insertion of extra bars. The specimen numbers quoted correspond to those of the slides in which the specimens have been found. Where more than one specimen of the same species or genus has been measured in the same slide, these have been distinguished by affixing a subsidiary number e.g. 12(1) and 12(2).

t.sp. = type specimen
a.s. = axial section
s.s. = sagittal section
c.obl. = central oblique

PLATE I

Figs. 1–7, 14
Fusulinids from the Urbaneja Limestone Member (Loc. P 5) which is the uppermost limestone member of the Casavegas syncline; Río Lores; Urbaneja; Cervera de Pisuerga; Palencia.

Figs. 1–3		
Staffellinae	1, specimen 6, a.s.,	× 35
	2, 7	× 35
	3, 5	× 35
Figs. 4,5		
Fusulinella sp.	4, specimen 1, a.s.,	× 16
	5, 2, s.s.,	× 24
Figs. 6, 7, 14		
Fusulina cf. *pakhrensis* Rauser-Chernoussova		
	6, specimen 3, a.s.,	× 16
	7, 4, s.s.,	× 24
	14, 5,	× 24

Figs. 8–13
Fusulinids from a limestone outcrop about 1300 m E of the village Vañes in the valley of the Río Castillería (Loc. P 99), stratigraphically above the Sierra Corisa Limestone Member; Río Castillería; Cervera de Pisuerga; Palencia. (See also Pl. II, Figs. 1–3)

Figs. 8–13		
Staffellinae		
Figs. 9, 10		
Staffella sp.	9, specimen 13, a.s.,	× 35
	10, 26(2)	× 35
Figs. 11–13		
Parastaffella?	11, specimen 24, a.s.,	× 35
	12, 12	× 35
	13, 26	× 35
Fig. 8		
Staffella mochaensis van Ginkel	8, specimen 11, a.s.,	× 35

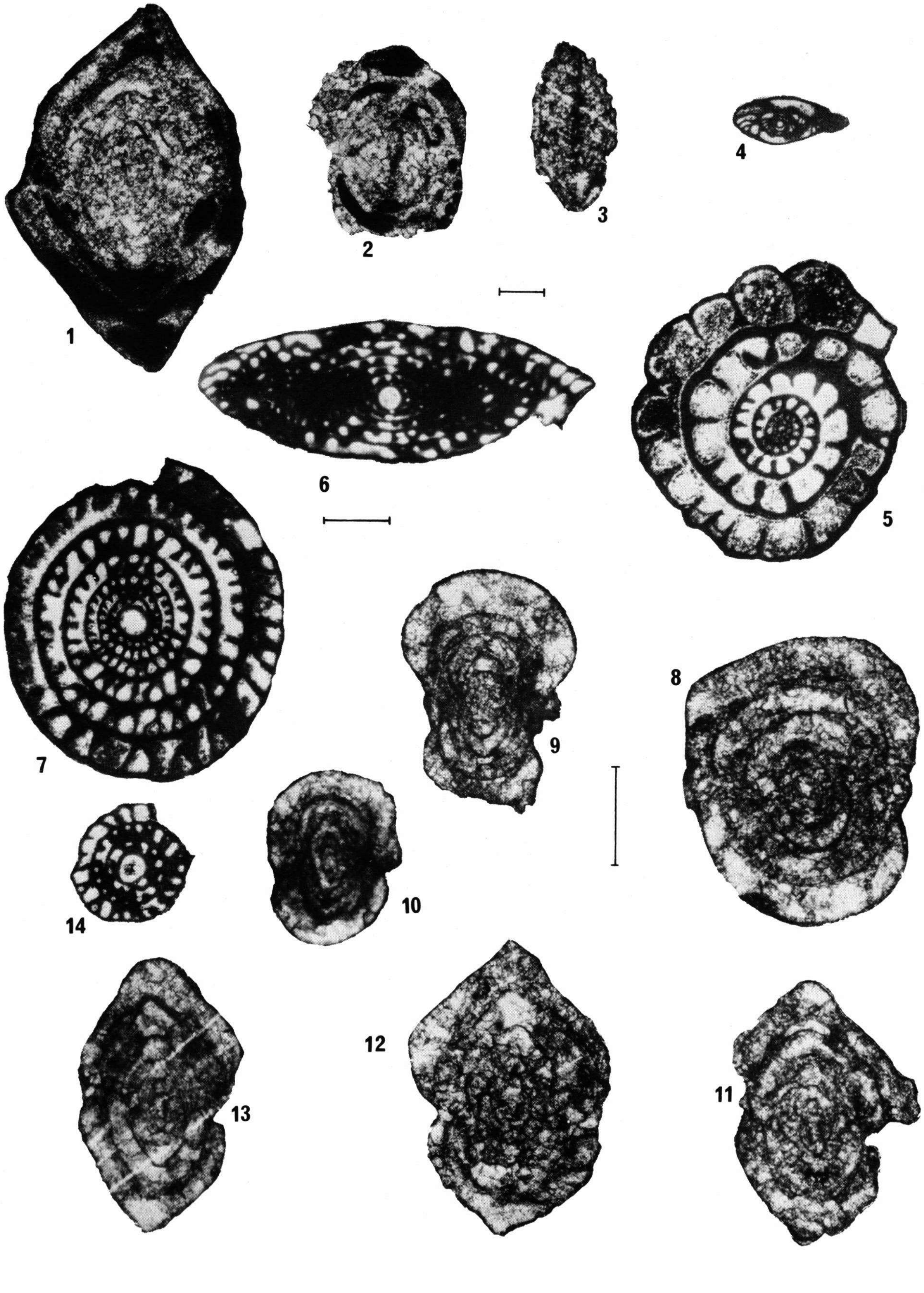

1
2
3
4
5
6
7
8
9
10
11
12
13
14

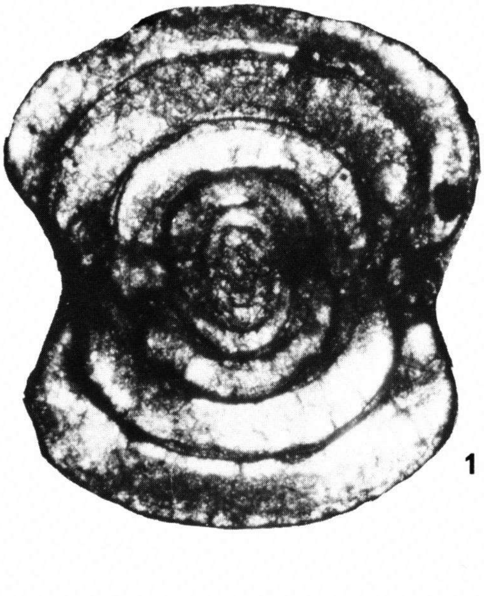
PLATE II

Figs. 1, 2				
Staffella mochaensis? van Ginkel	1, specimen	15,	a.s.,	× 35
	2,	21,	s.s.,	× 35
Fig. 3				
Fusulinella sp.	3, specimen	7,	s.s.,	× 24

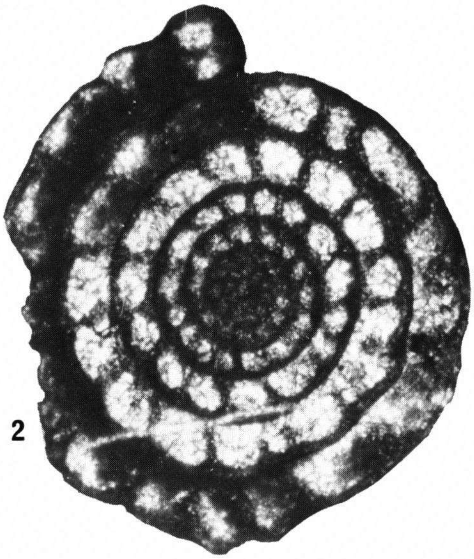
Figs. 4–7

Fusulinids from a limestone outcrop near Estalaya (Loc. P 36), stratigraphically above the Sierra Corisa Limestone Member and above locality P 99; Río Castillería; Cervera de Pisuerga; Palencia. (See also Pl. III, Figs. 1–5)

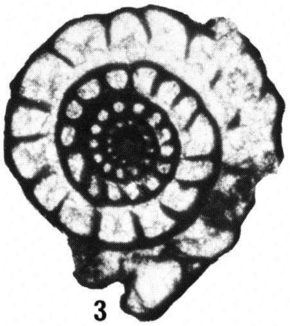
Figs. 4, 5				
Pseudostaffella sp.	4, specimen	4(2),	a.s.,	× 35
	5,	4(1),	a.s.,	× 35
Figs. 6, 7				
Protriticites	6, specimen	9,	a.s.,	× 16
	7, specimen	3,	a.s.,	× 16



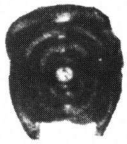
1



2

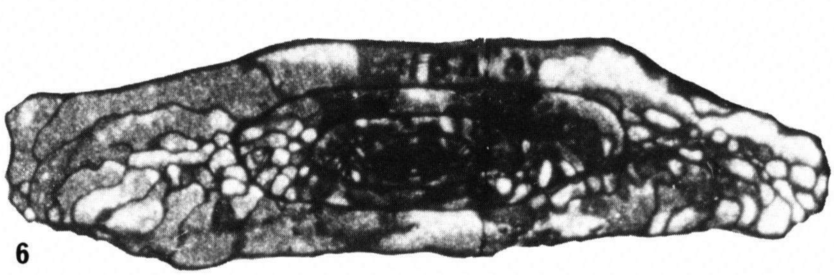


3

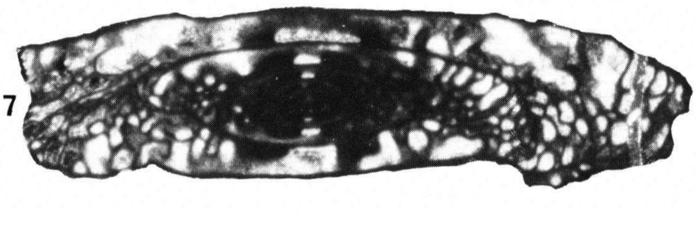


4

5



6



7

PLATE III

Figs. 1–4

Fusulina cf. *bella* Semikhatova *et* Melnikova

1, specimen 10,	a.s.,		× 16
2,	12		× 16
3,	11		× 16
4,	1,	s.s.,	× 24

Fig. 5

Fusiella cf. *lancetiformis* Putrya — 5, specimen 13, a.s., × 35

Figs. 6, 7

Fusulinids from about 100 m below the Peñacorba Coal Member (Loc. P 6); Río Rubagón; Barruelo; Palencia. (See also Pl. IV, Figs. 1–13)

Figs. 6, 7

? Immature specimens of *Protriticites*

6, specimen 14,	s.s.,		× 24
7,	12,	c.obl.,	× 16

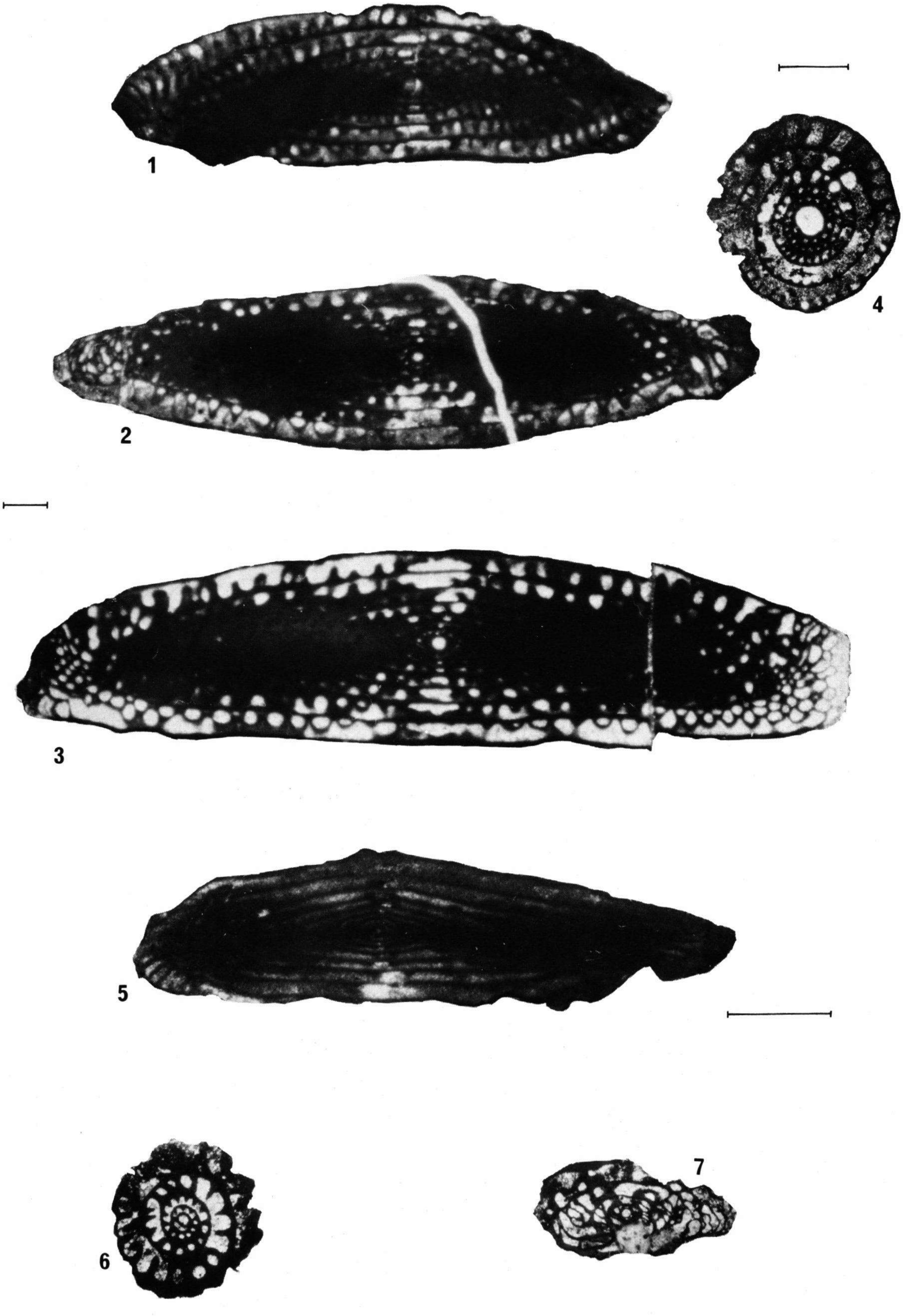

1
2
3
4
5
6
7

PLATE IV

All × 35

Figs. 1–13
Staffella sp.

1,	specimen	8,	a.s.
2,		9	
3,		11	
4,		15	
5,		10	
6,		7	
7,		18	
8,		2,	s.s.
9,		3	
10,		17	
11,		16	
12,		6	
13,		4	

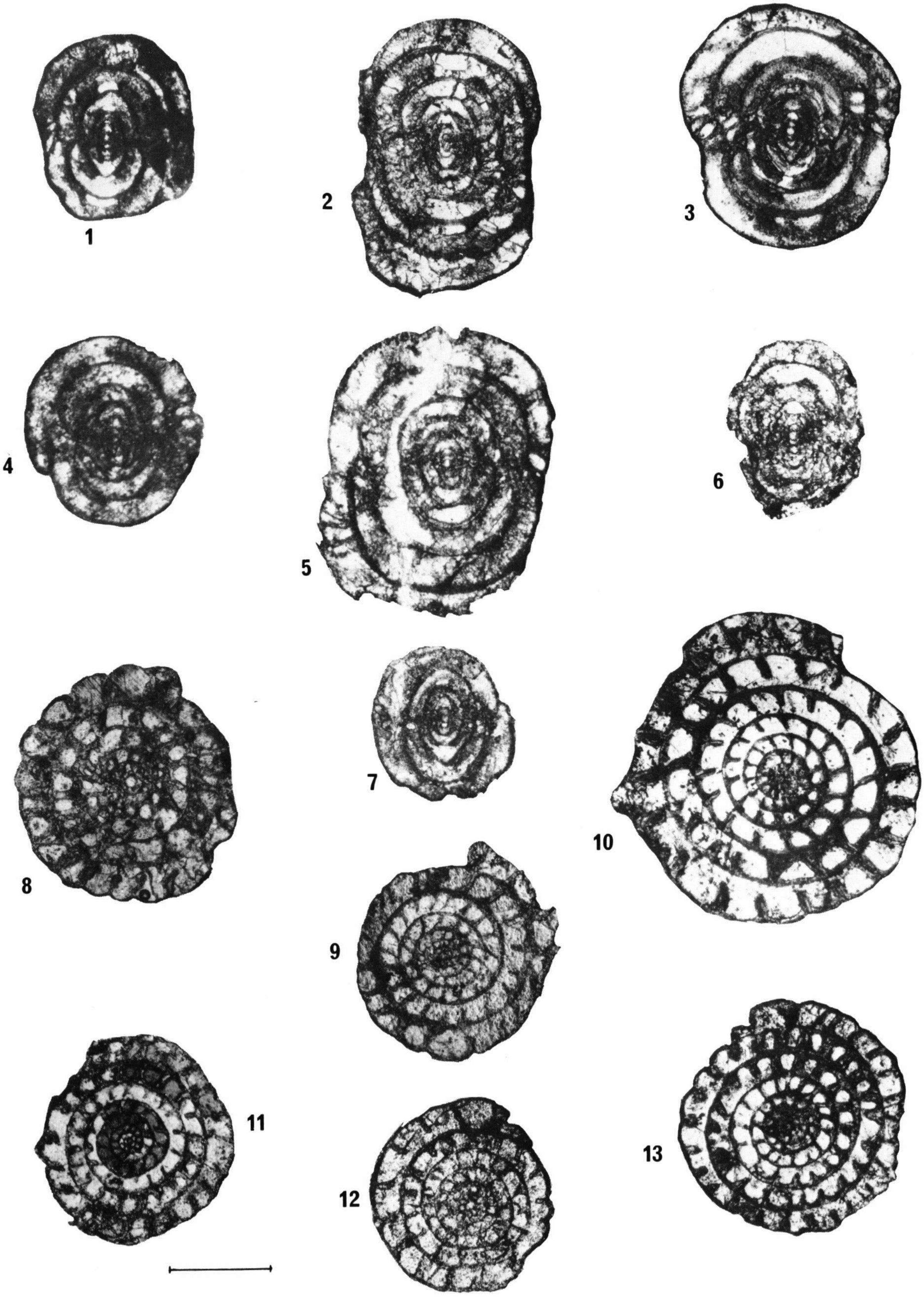

1
2
3
4
5
6
7
8
9
10
11
12
13

PLATE V

Sagittal sections × 24
Axial sections × 16

Figs. 1–12
Fusulinids from the Corros Limestone Member (Loc. P 52); Arroyo de la Varga, a tributary of the Río Pisuerga; Redondo syncline; Cervera de Pisuerga; Palencia.

Figs. 1–4
Pseudotriticites cf. *lebedevi* (Putrya)

1, specimen	19,	s.s.
2,	16,	a.s.
3,	15	
4,	22	

Figs. 5–12
Protriticites sp.

5, specimen	21,	a.s.
6,	20	
7,	23(1)	
8,	6	
9,	11,	s.s.
10,	23(2)	
11,	18	
12,	14(1)	

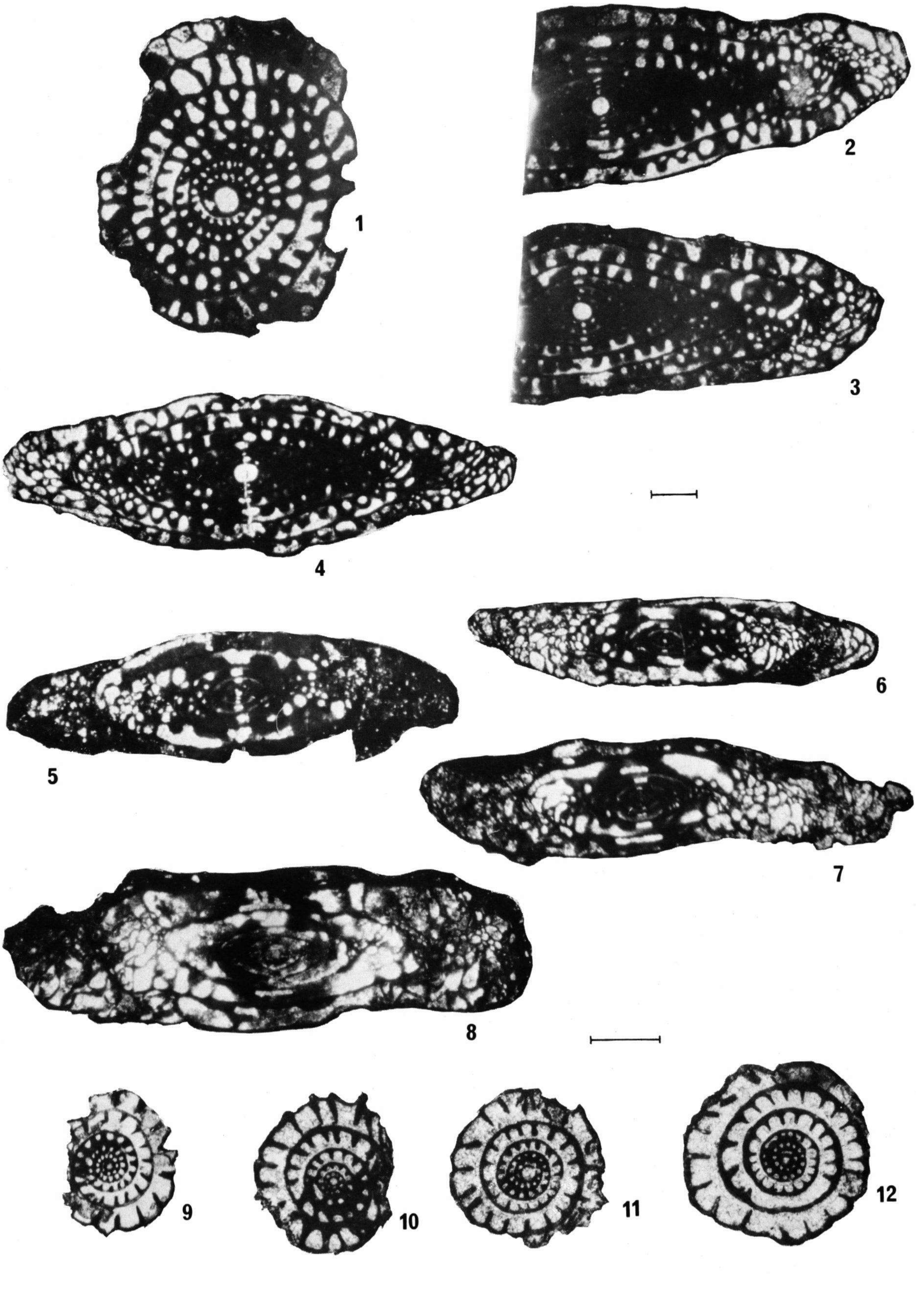

1
2
3
4
5
6
7
8
9
10
11
12

PLATE VI

All × 16

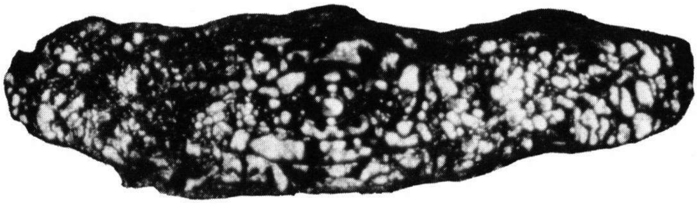
Figs. 1–9

Fusulinids from a muddy limestone in a road section just out of the village Arenas de Cabrales on the road to Camarmeña (Loc. A 4); Río Cares; Oviedo (Asturia). (See also Pl. VII, Figs. 1–7)

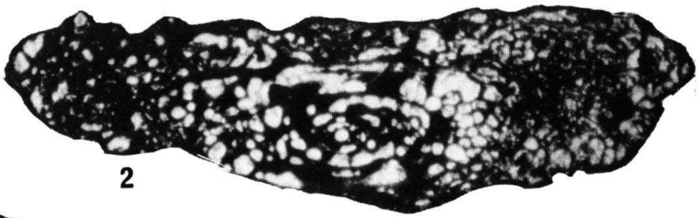
Figs. 1–9

Triticites (*Montiparus*) *fischeri* sp. nov.

	1, specimen	6(2), a.s.
	2,	6(1)
	3,	4(2)
t.sp.	4,	5
	5,	7
	6,	1
	7,	3
	8,	4(1)
	9,	2

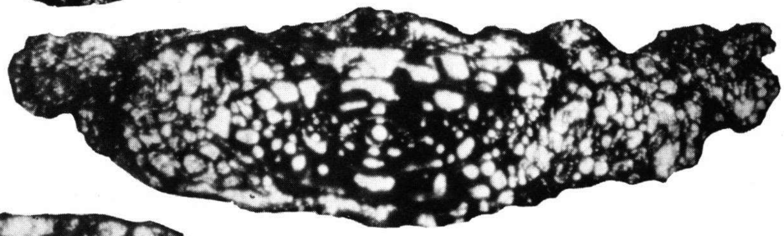


1



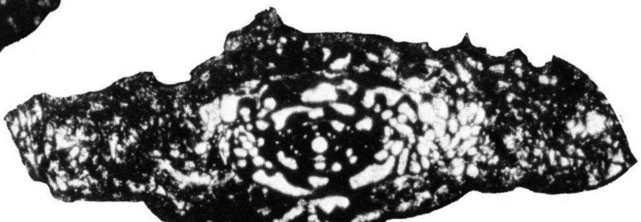
2

3

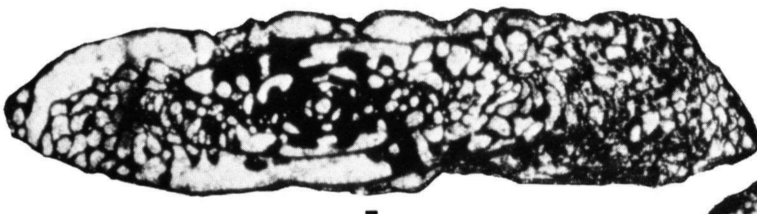


4

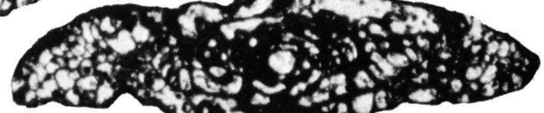
5



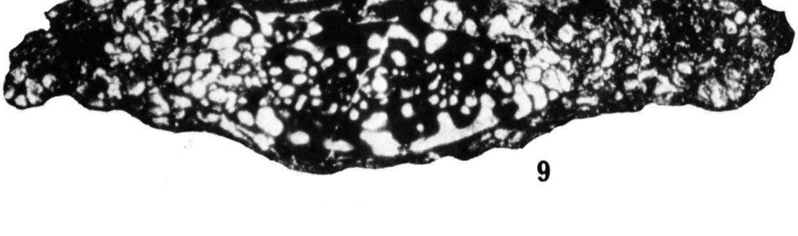
6



7



8



9

PLATE VII

Figs. 1–7 × 24
Figs. 8–13 × 35

Figs. 1–7
Triticites (*Montiparus*) *fischeri* sp. nov.

1, specimen	17,	s.s.
2,	18	
3,	12	
4,	19	
5,	16	
6,	15	
7,	14	

Figs. 8–13
Fusulinids from a limestone which crops out immediately W of the road Panes-Potes in the village Puentellés (Loc. A 2); near confluence of Río Deva and Río Cares; Oviedo (Asturia). (See also Pl. VIII, IX, and X)

8, specimen	17,	a.s.
9,	16	
10,	14,	s.s.
11,	15	
12,	19,	a.s.
13,	18	

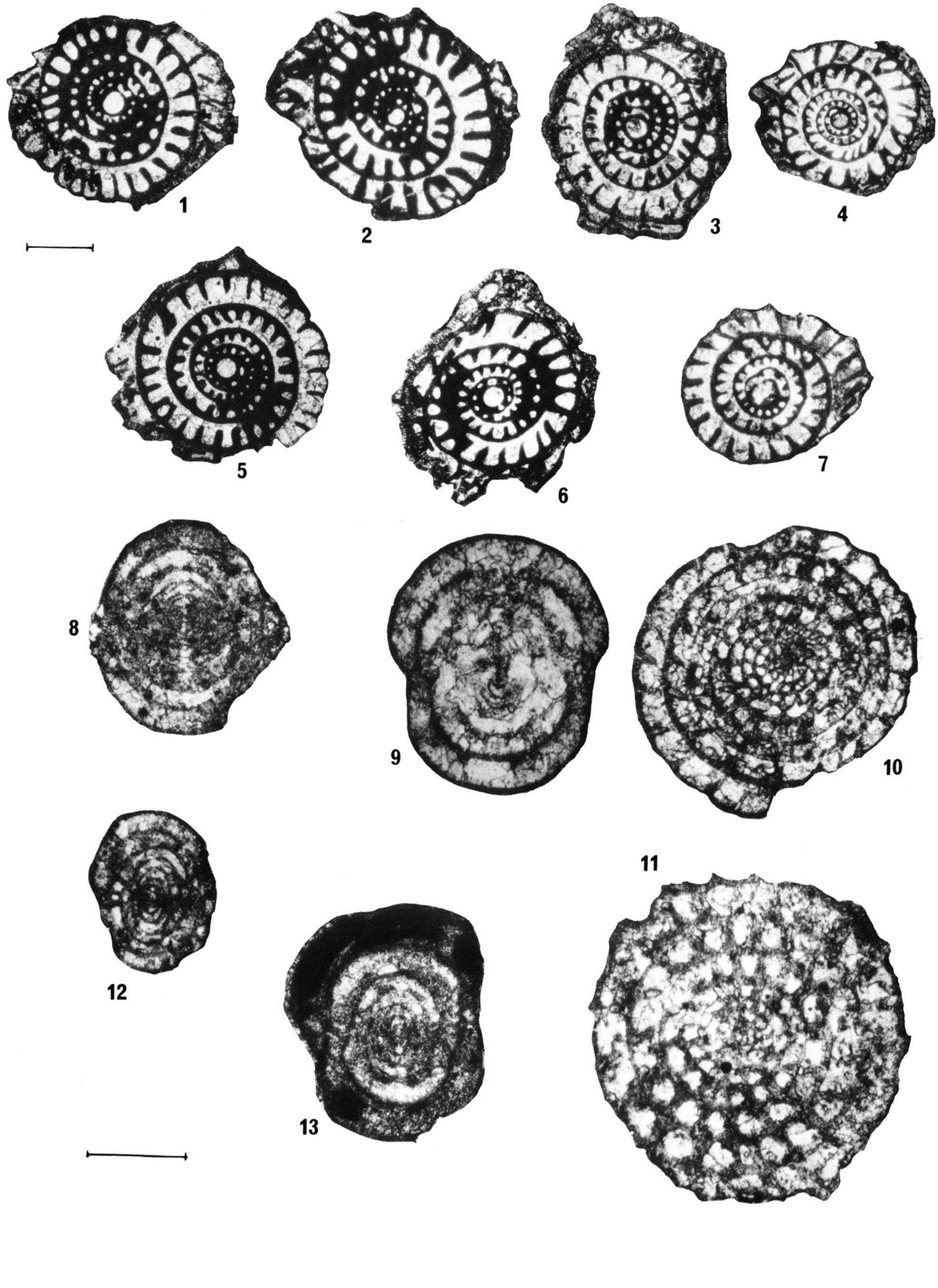

1
2
3
4
5
6
7
8
9
10
11
12
13

PLATE VIII

Sagittal sections × 24
Axial sections × 16

Figs. 1–8
Triticites (*Triticites*) *ohioensis* Thompson subsp. *benshi* subsp. nov.

1,	specimen	8,	a.s.
2,		11	
3,		20,	s.s.
4,		18	
5,		9,	a.s.
6,		14(2)	
7,		21,	s.s.
8,		5,	a.s.

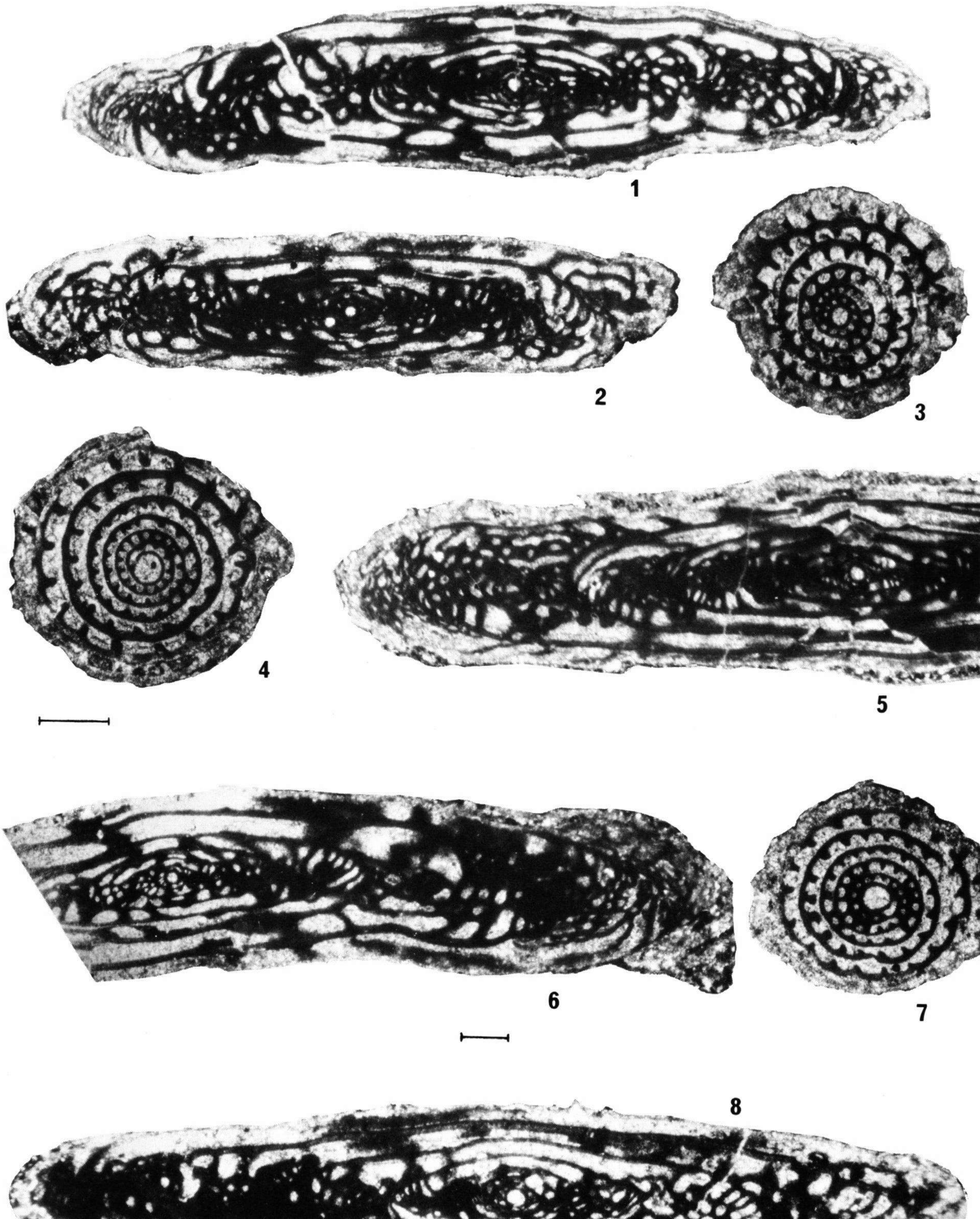

1
2
3
4
5
6
7
8

PLATE IX

Sagittal sections $\times$ 24
Axial sections $\times$ 16

Figs. 1–8
Triticites (*Triticites*) *ohioensis* Thompson subsp. *benshi* subsp. nov.

1, specimen	10,	a.s.
2,	19,	s.s.
3,	14(1),	a.s.
4,	1	
5,	4	
6,	15	
7,	24	
8,	2	

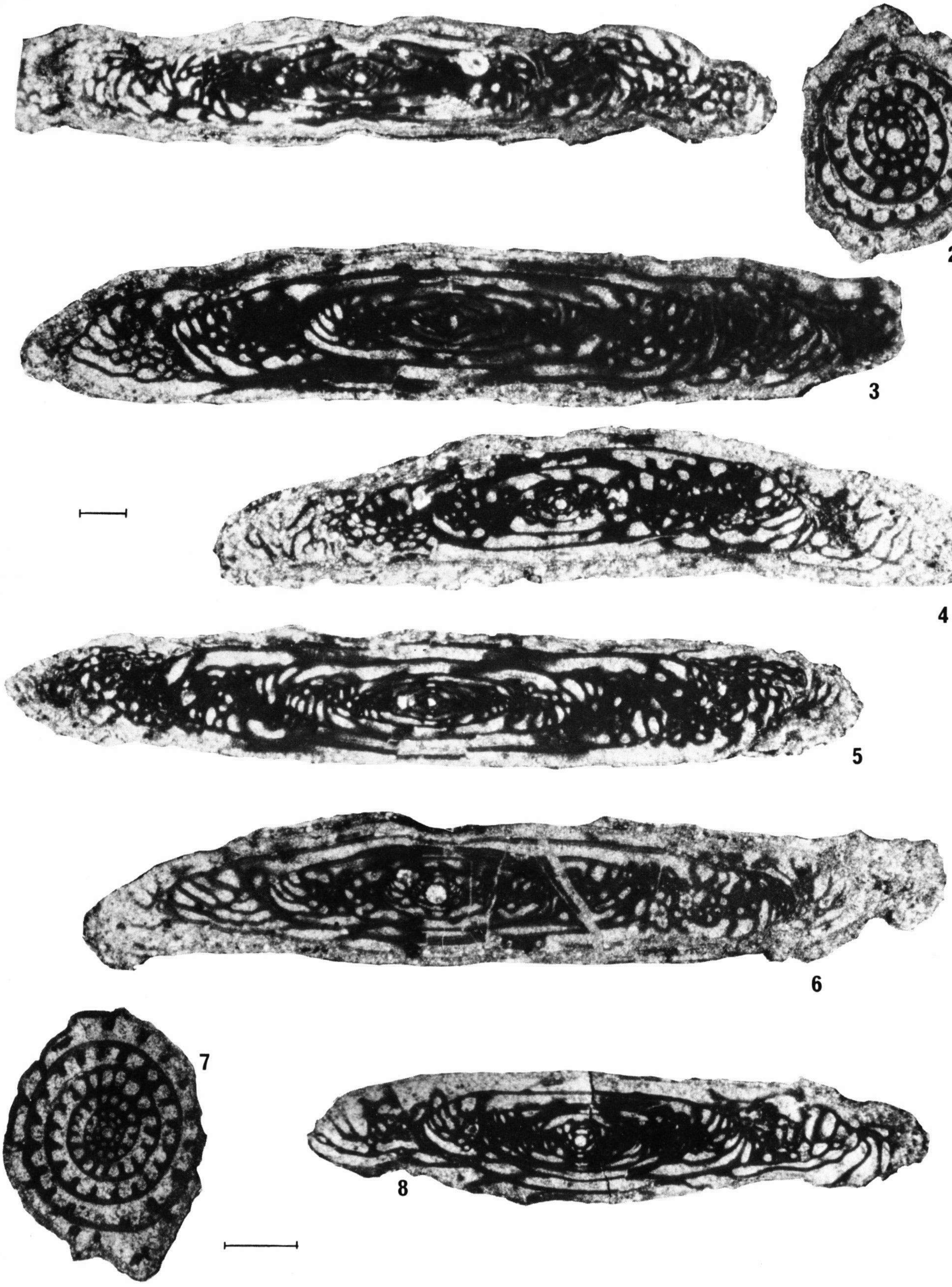

2
3
4
5
6
7
8

PLATE X

All $\times$ 16

Figs. 1–5

Triticites (*Triticites*) *ohioensis* Thompson subsp. *benshi* subsp. nov.

t.sp.	1,	specimen 13,	a.s.
	2,	3	
	3,	6	
	4,	9	
	5,	7	

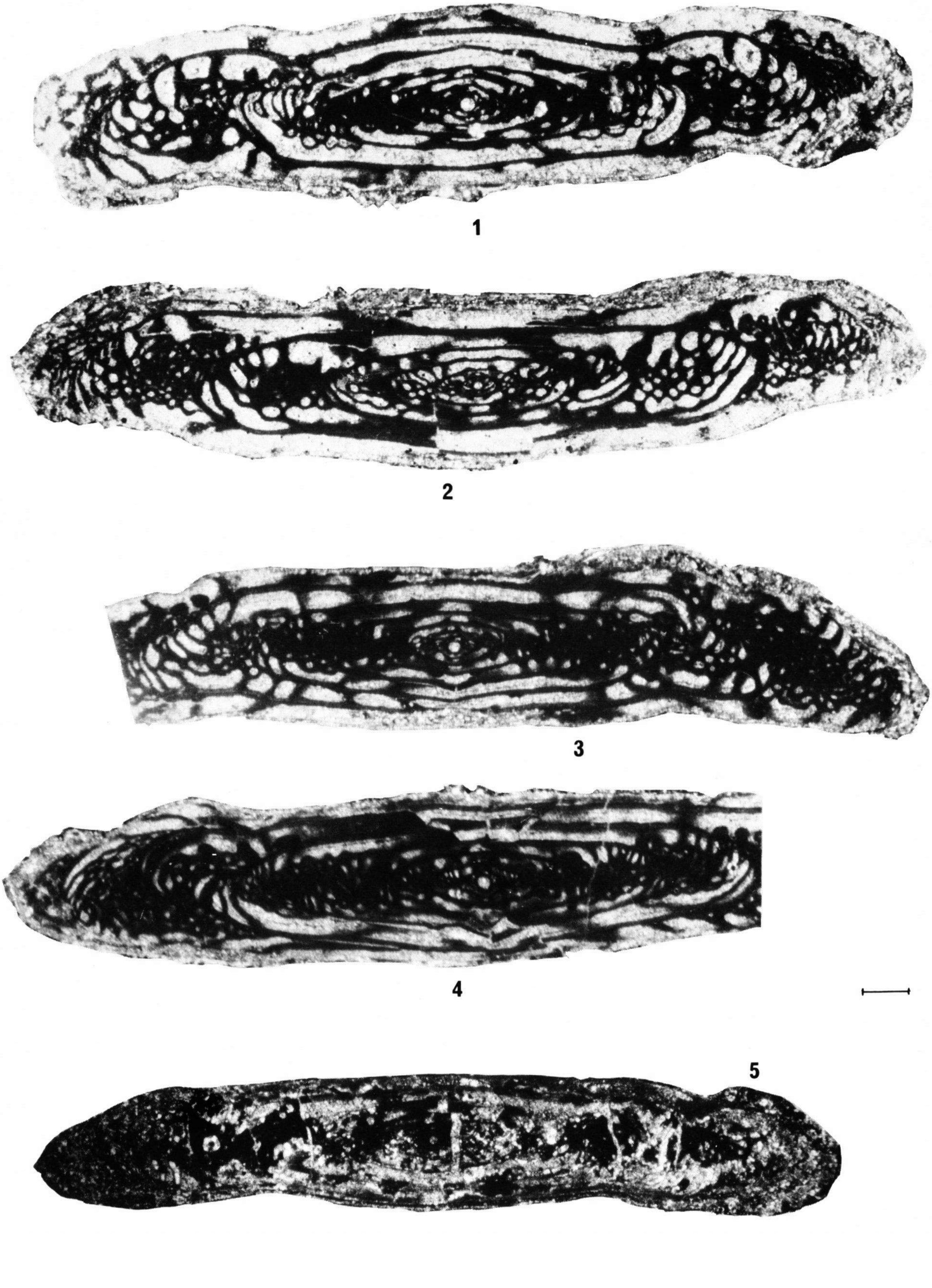

1
2
3
4
5

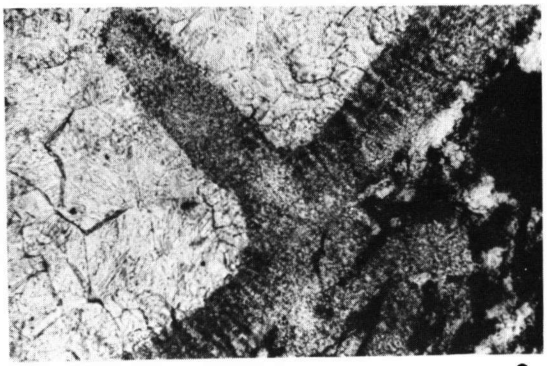
PLATE XI

Figs. 1–6
Protriticites sp. from the Corros Limestone Member (Loc. P 52); Palencia.

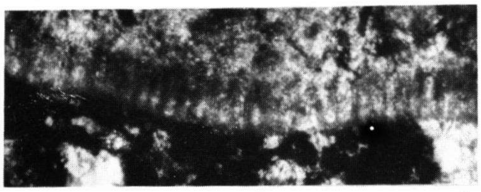
1, specimen	14,	× 100.
2,	14,	5th whorl, × 200.
3,	14,	inner three whorls, × 200.
4,	6(2),	4.5 whorl of an exc. axial section, × 200.
5,	13,	2.5 and 3.5 whorl showing "double wall"; the upper layer is the upper tectorium, × 200.
6,	6,	4.5 whorl; layering in the porous chomata, × 200.

Figs. 7, 8
Triticites (*Montiparus*) *fischeri* sp. nov. (Loc. A 4); Oviedo (Asturia). (See also Pl. XII)

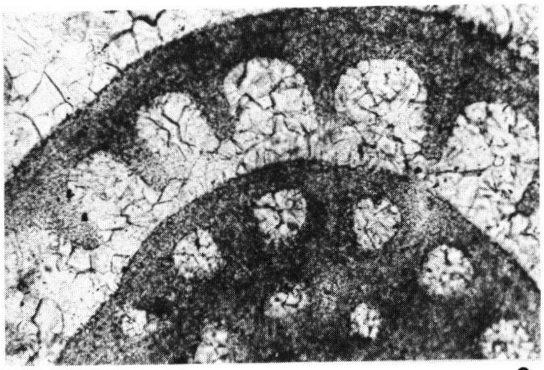
7, specimen	10,	4.5 whorl; shows keriotheca, × 200.
8,	1,	4.5 whorl; shows keriotheca, × 200.



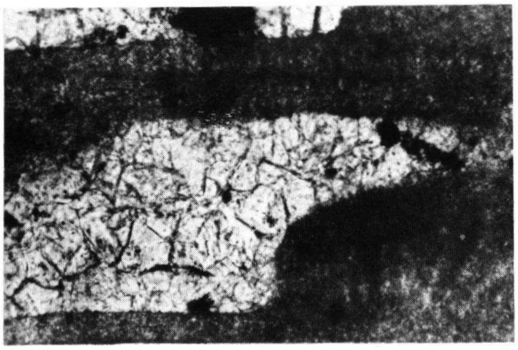
2



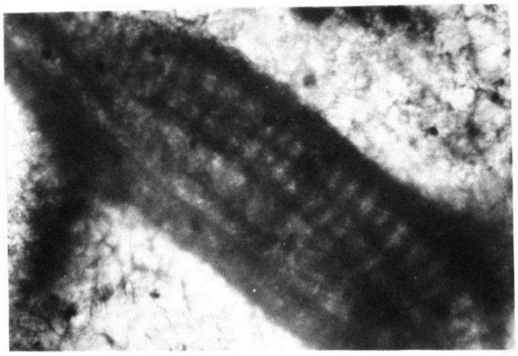
4



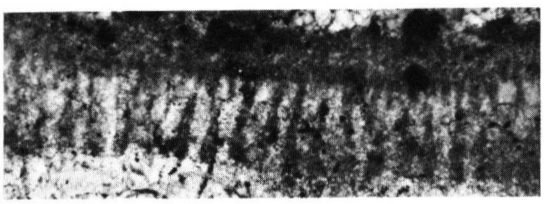
3



5



6



7

8

PLATE XII

Figs. 1–8

Triticites (*Montiparus*) *fischeri* sp. nov. (Loc. A 4); Oviedo (Asturia).

1, specimen	16,	inner five whorls, × 100.
2,	16,	proloculum and first two whorls, × 200.
3,	16,	inner three whorls, × 200.
4,	16,	3.5 and 4.5 whorl, × 200.
5,	4,	3rd whorl; layering in the porous chomata, × 200.
6,	2,	3rd whorl; layering in the porous chomata, × 200.
7,	12,	4th whorl; septum and keriotheca in sagittal section, × 200.
8,	11,	4.5 whorl; shows keriotheca (the figure is upside down), × 200.

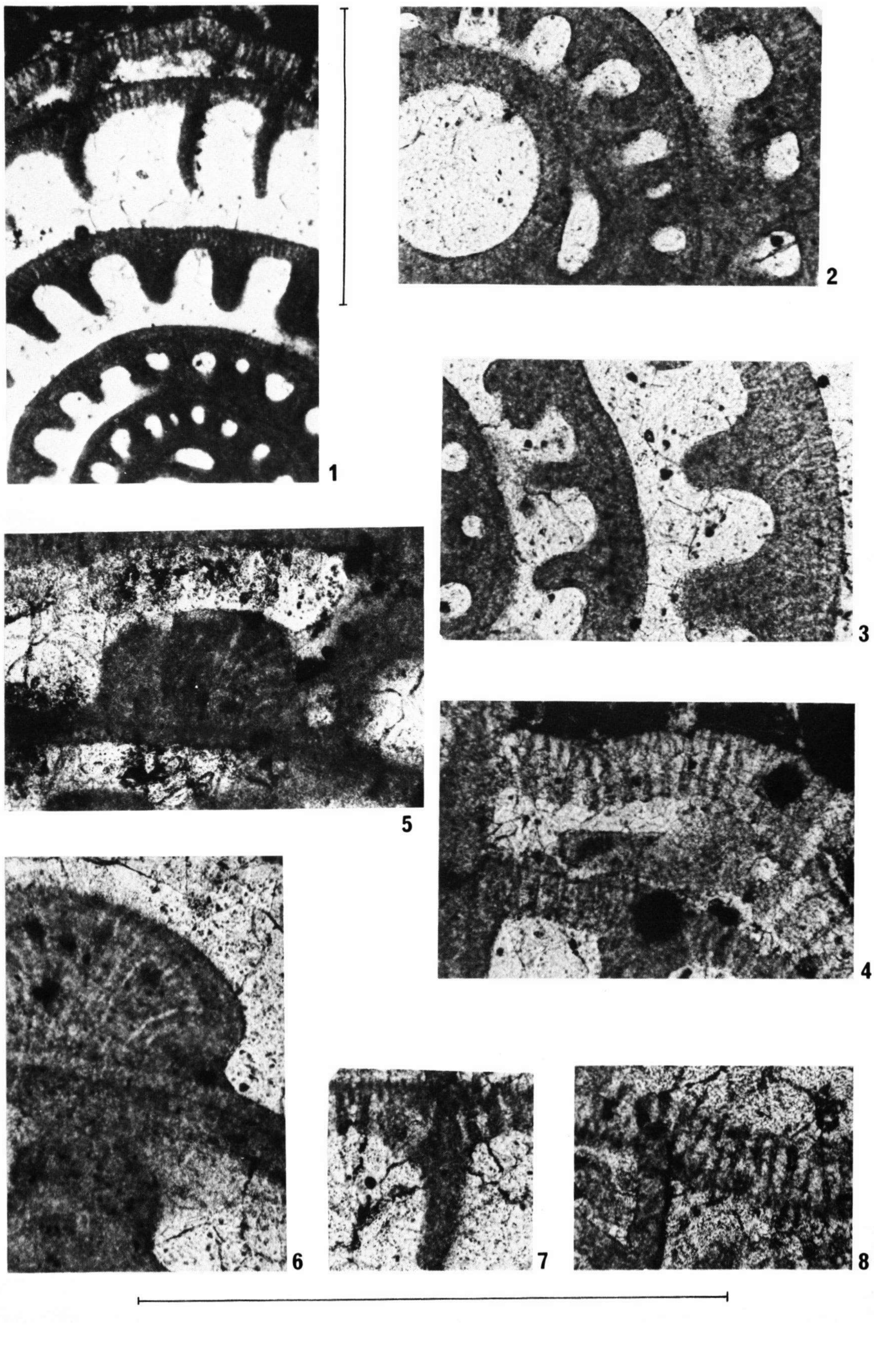

1
2
3
4
5
6
7
8

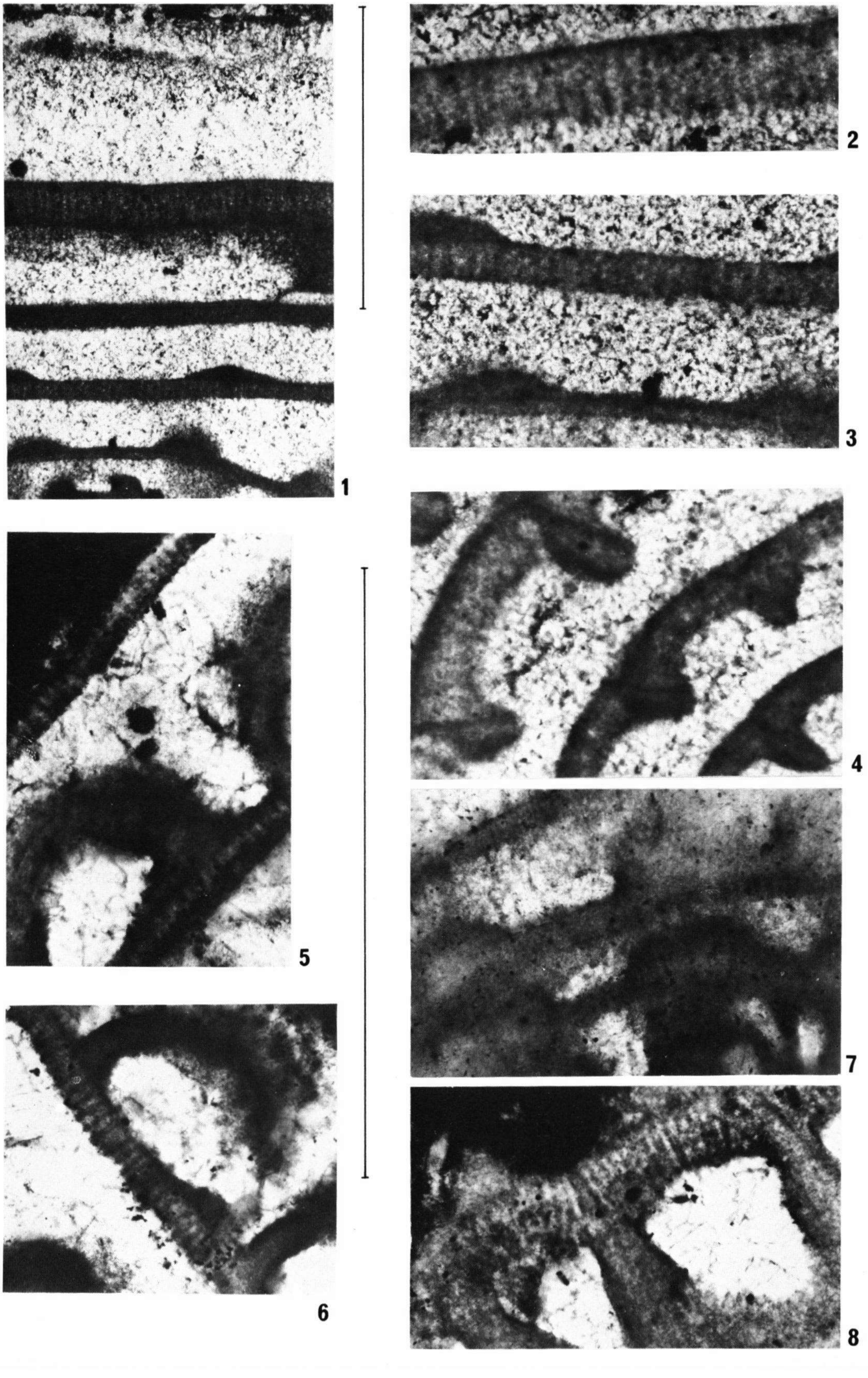
PLATE XIII

Figs. 1–4
Triticites ohioensis Thompson subsp. *benshi* subsp. nov. (Loc. A 2); Oviedo (Asturia).

1, specimen	3,	inner 5.5 whorls of axial section, × 100.
2,	3,	5.5 whorl, × 200.
3,	3,	1.5 and 2.5 whorl, × 200.
4,	18,	2nd, 3rd and 4th whorl of a sagittal section, × 200.

Figs. 5–8
Pseudotriticites cf. *lebedevi* (Putrya) from the Corros Limestone Member (Loc. P 52); Palencia.

5, specimen	22,	4.5 and 5.5 whorl of axial section, × 200.
6,	22,	5th whorl of the same axial section; simple straight mural pores, × 200.
7,	16,	inner three whorls of axial section showing fine mural pores, × 200.
8,	19,	5.5 whorl; wall with simple mural pores and insertion of septa in a sagittal section, × 200.


1
2
3
4
5
6
7
8