THE CASAVEGAS SECTION AND ITS FUSULINID FAUNA

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ABSTRACT

The present paper deals briefly with the main geological features of the Casavegas area (Northern Palencia, Spain). Though incomplete, the sequence of Carboniferous strata in this region is regarded as a reference-section for correlation purposes within the larger N. Palencia area. A local subdivision on fusulinids of a part of the Carboniferous is proposed. Three zones are distinguished:

Protriticites Zone
Fusulinella Zone — F. ex gr. brañoserae Subzone; F. delepinei Subzone
Profusulinella Zone

Fusulinella bocki, var. *delepinei* is brought to species level as *F. delepinei* Van Ginkel, sp. nov.

CONTENTS

1. INTRODUCTION

During the summers 1954 and 1955 an area around Casavegas in Northern Palencia (Spain) has been mapped by the present author. This village is situated at about 20 km to the north of the small town of Cervera de Pisuerga. The mapped area is situated immediately south of the main watershed, which forms there the geographic boundary between Palencia and Santander. The eastern boundary of the area is formed by the road from San Salvador de Cantamundá to Piedras Luengas, which is a part of the main road from Cervera de Pisuerga to Potes. The western boundary is formed by the Sierra de Albas a NE—SW directed watershed between Casavegas and Caloca. The area covers approximately 25 km^2.

The Casavegas area apparently yielded a thick and seemingly undisturbed sequence of Carboniferous strata with a fairly rich fauna of fusulinid foraminifera. In the course of the investigation it could be shown, however, that this Carboniferous sequence is not so complete as was formerly believed by the author. The Upper Visean griotte and the lower and middle part of the Caliza de Montaña proved to be absent. Moreover, it was shown by A. Breimer (oral communication) that the lowermost strata of this Carboniferous sequence formed part of a separate structure running E—W, while the overlying strata form part of a large syncline which is at the present known as the Casavegas syncline. In the present paper the section of the Casavegas syncline proper is defined as a section which has its base at, or somewhat below, the Camasobres limestone. When in the following pages however, the Casavegas section is mentioned, it is meant to include the underlying Caloca and Piedras Luengas limestones as well.

Although the Casavegas section is not so complete as was formerly believed, it is still the most complete section in Northern Palencia and the most appropriate for correlation purposes as far as foraminifera are concerned. For this reason this paper is devoted to a description of the stratigraphy and fusulinid development in the Casavegas area. The final correlation between the limestones of Northern Palencia and those of the Casavegas section will be discussed in a forthcoming paper. In the mean time, preliminary results concerning the age relation of the Casavegas section with limestone members from the neighbouring East Pernia region are dealt with in the present paper.

2. GENERAL TECTONIC FEATURES

The stratigraphical column comprised between the Camasobres limestone (base) and the Urbaneja limestone(top) was primarily folded during the Asturian phase (post-Stephanian A and pre-Stephanian B-C (Wagner, 1955)) in a more or less symmetrical synclinal structure. It shows a north-south directed axis which bends slightly to the SE in the south and to the NW in the north, giving it a sigma-like trend, with a plunge 30—55° south. Approximately 750 m SW to the villages of Lores and El Campo, a NW—SE striking fault(?) brings the western limb of the syncline into contact with the Devonian of Lebanza. The northeastern and probably also the northwestern limitation of the syncline is formed by its basal member, resting unconformably on Westfalien A strata (Caloca limestone, Piedras Luengas limestone).

To the South, approaching the core of the syncline, its symmetrical character is gradually lost and eventually becomes overturned to isoclinal. By now the syncline moreover passes in a number of parallel secondary synclines and anticlines. This condition is clearly demonstrated along the road from Urbaneja to Lores near Urbaneja.

3. STRATIGRAPHY

For the sequence of strata in the Casavegas section we can refer to fig. 1. This figure shows five columnar sections (A to E). Section A was constructed from a section measured on the NW—SE directed watershed separating the villages of Lores and Casavegas. Here a complete sequence of strata from the Castrillo limestone up to the youngest synclinal deposits was observed. Section E was maesured along and near the road from about 750 m SW of the village of Camasobres to the cleft where the Rio Areños cuts through the Piedras Luengas limestone, near the village of Piedras Luengas. This section comprises strata ranging from the Piedras Luengas limestone up to the Camasobres coal-seam. Sections B, C and D were constructed from profiles which were situated at regular distances between the profiles A and E, measured from Casavegas to the west, north and northeast respectively.

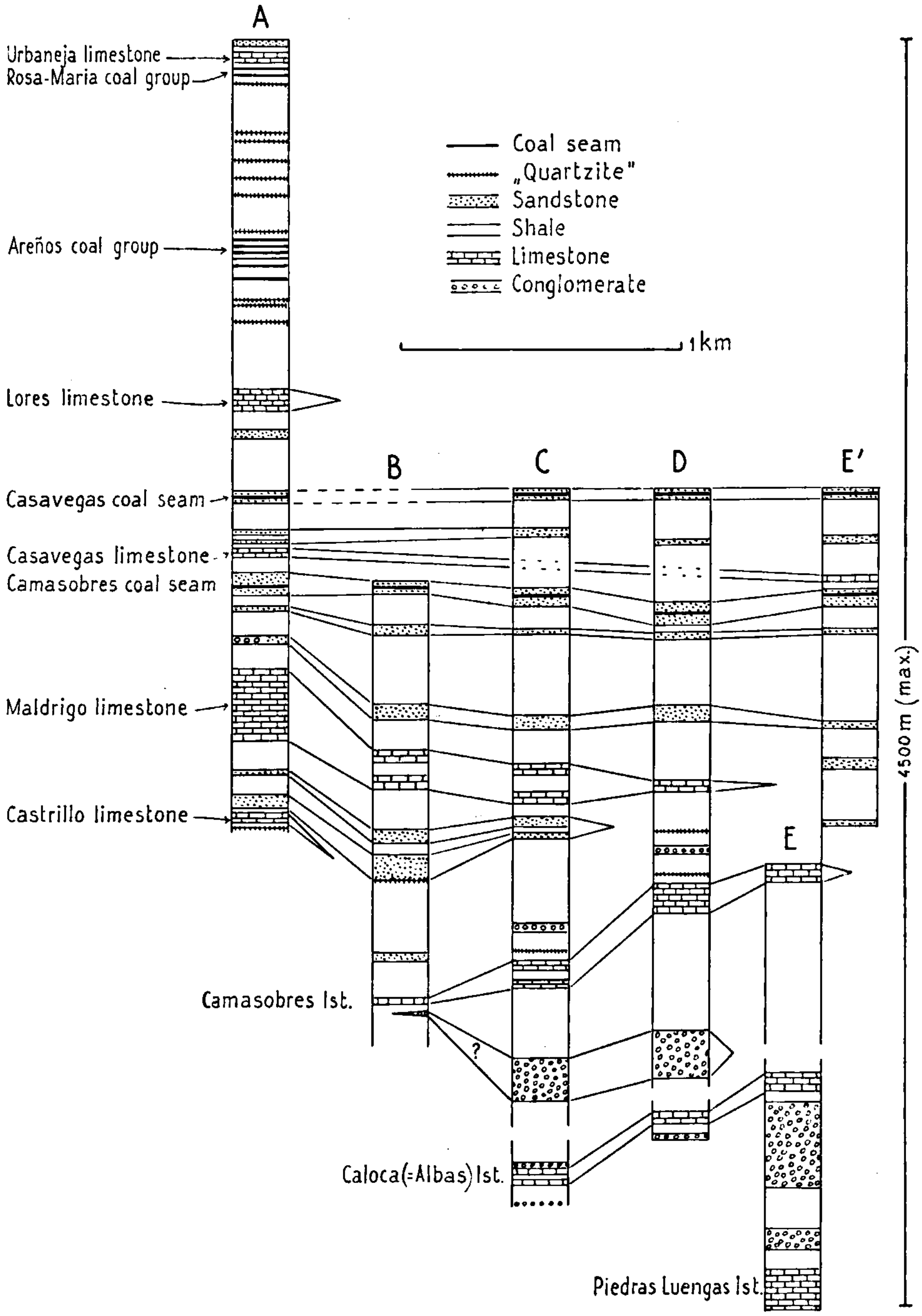

Fig. 1. Correlation chart.

The most conspicuous feature displayed by the succession of strata is the predominance of limestones and conglomerates in the lower part of the Casavegas section, while for the younger sediments the coal-seams and firmly cemented, lightgrey colored sandstones ("quartzite") (1—10 m) are more typical. The strata of the Casavegas syncline proper show a good example of deposition under paralic conditions.

Sedimentation took place in dominantly marine environments in the lower part of the Casavegas syncline (biohermal limestones, 0—300 m) as compared to the upper part of the section where a continental environment of deposition prevailed (coal-seams: Camasobres coal-seam, Casavegas coal-seam, Areños coal-group, Rosa-Maria coal-group).

The upper part of the Caliza de Montaña, or the part of the Casavegas section below the Camasobres limestone from which it is separated by an unconformity, shows a close association of conglomerates and limestones (Piedras Luengas limestone, Caloca limestone). The limestones show a biohermal aspect (thicknesses varying from 0—250 m over short distances), and at places the rather abrupt lateral and vertical contact with conglomerates could be observed (compare: Wagner, 1957). These conglomerates also vary in thickness from 0—300 m over short distances. Along the road Cervera-Potes near Piedras Luengas, we find between a thick conglomerate (300 m) and the Caloca limestone a limestone-breccia which strongly reminds one of a reef-breccia. Corals normally occur in the Caloca limestone.

The faunal content of the limestones consists of Foraminifera, Algae (Dasycladaceae, Corallinaceae), crinoid stems, echinid spines, corals, and some Bryozoa. The Foraminifera and Algae, are always associated. Some crinoid remains are usually present as well, but in typical crinoid limestones (Urbaneja limestone) Foraminifera are absent. In the Piedras Luengas limestone and the Caloca limestone the bulk volume of the rock is devoid of Foraminifera. Some enriched horizons of 2 or 3 inches, however, were crowded with forams. The occurrence of sharply defined coral and Foraminifera horizons in the Caloca limestone (along the road to Potes, Section E) was striking. From the Maldrigo limestone upward the presence of Foraminifera is a common characteristic of these limestones, and they are now more equally distributed (Foraminiferal horizons are thicker, less crowded, and more numerous).

With the exception of the limestones, the fauna is fairly scarce in sediments of the Casavegas syncline. Only somewhat above the Maldrigo limestone member (Section B, D.) and right above the Casavegas coalseam (along the road to Casavegas near the crossing with the main-road Cervera Potes), a marly shale was encountered, containing a rich fauna of brachiopods, gastropods and some trilobites.

The total thickness of strata of the Casavegas-section amounts to over 4000 m, those of the Casavegas syncline proper over 3000 m, and the upper part of the Caliza de Montaña over 1000 m.

4. FUSULINID FAUNA

A. *Position of the Casavegas section in relation to the fusulinid zones of Palencia (Fig. 2).*

We may distinguish three faunal zones in Northern Palencia based on the fusulinid fauna.

These are: Zone of *Protriticites*
Zone of *Fusulinella*
Zone of *Profusulinella*

We may subdivide the Zone of *Fusulinella* in a:
(younger) Subzone of *Fusulinella* ex gr. *brañoserae* Van Ginkel.
(older) Subzone of *Fusulinella delepinei* Van Ginkel.

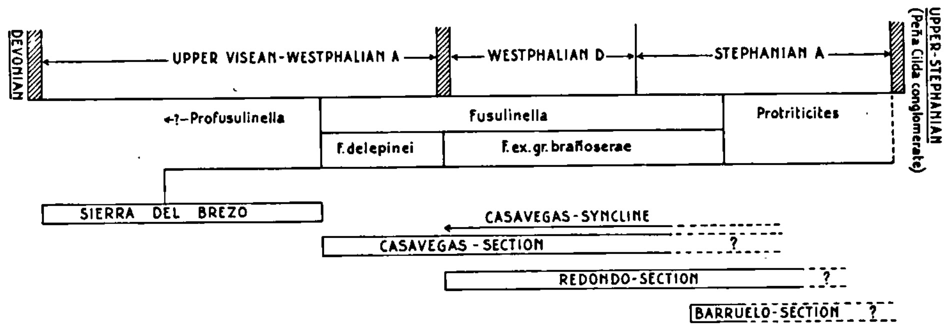

Fig. 2. The position of the Casavegas section in relation to the fusulinid zones of Palencia.

a) Zone of Profusulinella

The Caliza de Mantaña of the Sierra del Brezo at least partly falls within the Zone of *Profusulinella*. Up to the present, the Zone of *Fusulinella* has not been found to be represented in this region, and it seems probable that the very youngest deposits in this region, apart from the Curavacas conglomerate and the Rio Carrion coal-basin, are still older than the Piedras Luengas limestone of the Casavegas section.

Other Foraminifera from this zone are:

Pseudostaffella ex gr. *antiqua* (Dutkevitch)
Pseudostaffella cf. *mölleri* (Ozawa)
Ozawainella sp.
Bradyina ex gr. *cribrostomata* Rauzer-Chernoussova and Reitlinger
Plectogyra sp.

b) Zone of Fusulinella

b1) Subzone of Fusulinella delepinei Van Ginkel. — Strata characterized by *Fusulinella delepinei* Van Ginkel are present below the unconformity between the Camasobres limestone and Caloca limestone of the Casavegas section. This species occurs commonly in the Piedras Luengas limestone and Caloca limestone. The Ribadesella limestone of Asturia falls in this subzone as well. According to Delepine, this species has been found at many localities in Asturia from the upper part of the Caliza de Montaña (Delepine, 1943).

In Palencia, associated with *Fusulinella delepinei* Van Ginkel we find:

Eofusulina sp.
Nankinella sp.
Staffella sp.
Millerella sp.

Ozaweinella sp.
Eoschubertella sp.
Endothyra sp.
Plectogyra sp.
Bradyina ex gr. *cribrostomata* Rauser-Chernoussova and Reitlinger
Bradyina ex gr. *nautiliformis* Moellier

b2) Subzone of Fusulinella ex gr. brañoserae. — All strata of the Casavegas syncline from the Camasobres limestone and at least up to the Lores limestone fall within this subzone. The top of this subzone may be placed right above the Brañosera limestone (near the base of the Barruelo section, Palencia). *Fusulinella brañoserae* Van Ginkel from this limestone (type-locality) represents already a passageform to *Protriticites.* The lower part of the Redondo section belongs to this subzone as well. Here the limit with the succeeding zone of *Protricites* is to be found only a short distance above the Abismo limestone.
The fusulinids present in this subzone belong to the following genera and species:

Fusulinella brañoserae Van Ginkel
Fusulinella ex gr. *famula* Thompson
Fusulinella ex gr. *librovitchi* Dutkevitch
Speudostaffella cf. *quadrata* (Deprat)
Pseudostaffella sp.
Schubertella cf. *kingi* Dunbar and Skinner
Fusulina spp.
Fusulina (cf. *Pseudotriticites*)
Dagmarella sp.
Dagmarella?
Fusiella sp.
Staffella sp.
Nankinella?sp.
Ozawainella sp.
Eoschubertella spp.
Millerella sp.
Paramillerella sp.

c) Zone of Protriticites

The limit between this zone and the foregoing subzone is not an abrupt one, since *Fusulinella brañoserae* gradually grades into *Protriticites.* The small limestone outcrop (loc. LII) approximately 100 m above the Abismo limestone (Nederlof, oral communication), and just below the Lomba coal-seam, falls definitely within this zone.
Associated with *Protriticites* is *Pseudotriticites.*

B. Development of the fusulinid fauna from the Piedras Luengas limestone up to the Lores limestone.

Most attention has been devoted to the genus *Fusulinella,* since in Palencia, and probably in Asturia as well, this genus is very common and has a wide geographical distribution. Moreover its development goes at a quick rate which makes it particularly useful for correlation purposes.

Gübler described from Ribadesella (Asturia) a species of this genus which he considered to be only a variety of the *F. bocki*. It was named: *Fusulinella bocki* var. *delepinei* Gübler (Gübler, in Delepine, 1943). The present author has topotypes of this variety at his disposal, which he compared with a description of *Fusulinella bocki* Moeller (emend. Thompson) (Thompson, 1945).

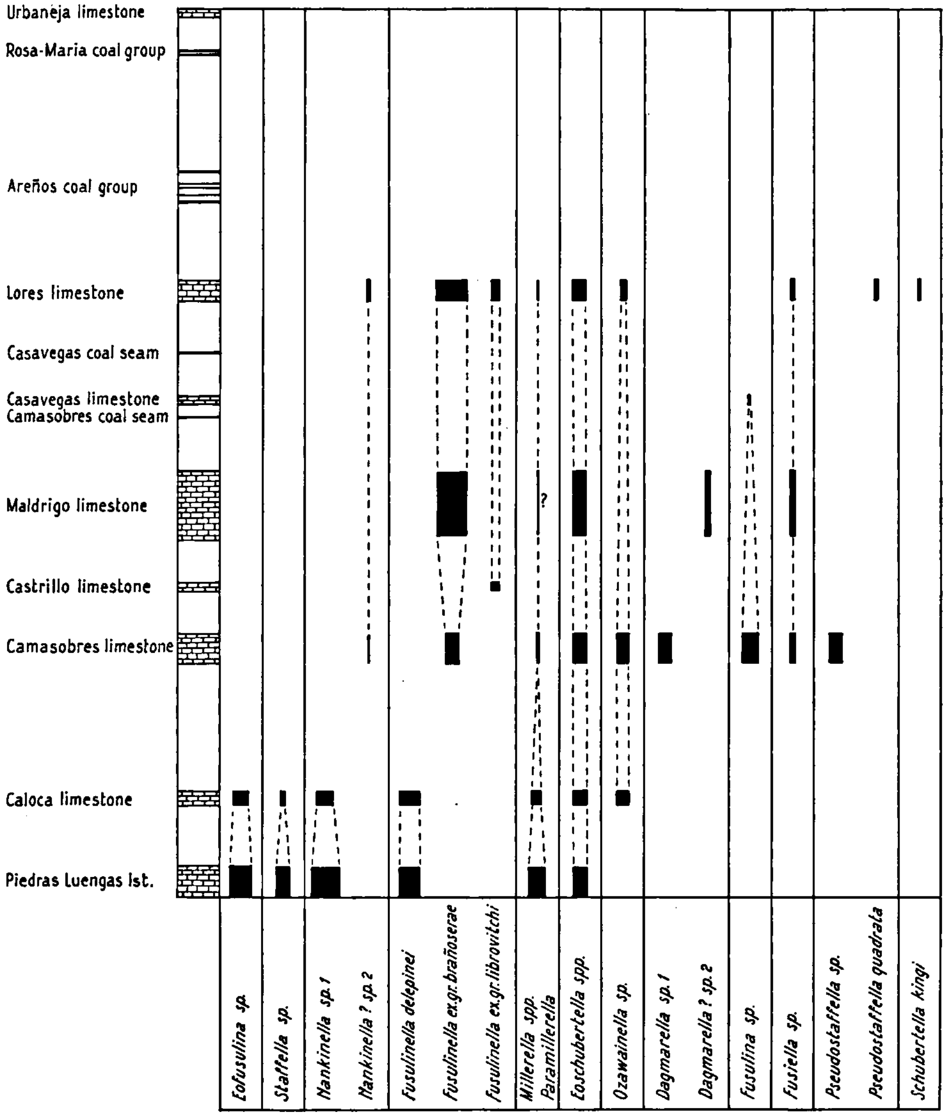

Fig. 3. Range chart.

It became apparent that Gübler's form was actually more primitive than *Fusulinella bocki* Moeller. This could be expected since *F. bocki* seems to be present in the upper part of the Moscovian only, whereas Gübler's form is said to be from the Westphalian A. The primitive character is especially shown in the nature of the juvenarium which is mostly plectogyroid, the small dimensions as compared with *F. bocki,* and the wall with a very thin diaphanotheca which sometimes is absent altogether. Actually, the form-ratio and the well developed chomata are the only points of resemblance between these two forms. For these reasons a reassignment to species level of Gübler's variaty seems justified, especially if we take into account the small differences with existing species on which new species of the Fusulinidae are normally established. In the following pages Gübler's form is referred to as *Fusulinella delipinei* Van Ginkel 1959, and we may consider it as a species intermediate between *Fusulinella* and *Profusulinella.* In the Casavegas section this species was encountered in the Piedras Luengas limestone and the Caloca limestone. It is absent from strata above the unconformity between the Westfalian A and D. Above the mentioned unconformity, in the Camasobres limestone, we find a *Fusulinella* which is considered to be the fore-runner of *Fusulinella brañoserae* from the Brañosera limestone. Observations and measurements on specimens of *Fusulinella* from the Camasobres, Maldrigo and Lores limestone respectively demonstrate that some characters show a clear evolutionary trend. Extrapolation of these trends seemingly leads to *Fusulinella brañoserae* from the Brañosera limestone. From the Camasobres limestone up to the Lores limestone these trends are:

1 an increase in the number of specimens;
2 a clear increase of the form-ratio leading from fusiform to sub-cylindrical forms (diagram 1);
3 an essential equal form-ratio throughout growth evolving to an increasing form-ratio during growth (diagram 2);
4 probably a slight decrease of the average diameter for each whorl (diagram 2);
5 probably an increase in the variation of the diameter for each whorl (diagram 2);
6 a clear intensification of septal-fluting from folds at a narrow zone along the axis to a typical "cauliflower" structure at the poles; simultaneously, septal fluting progresses along the lateral slopes;
7 a decrease in height and breadth of the chomata;
8 a clear development of pores in the wall which are not yet observed in the Camasobres limestone, but clearly visible in some specimens of the Lores limestone;
9 a slight increase in thickness of the diaphanotheca, absolute as well as relative with regard to the tectoria.

Diagrams 1 and 2 show respectively the trend of the form-ratio and the probable trend of the diameter, from the Caloca, Camasobres, Maldrigo, Lores up to the Brañosera limestone. To save time, only the last whorl of good centered specimens was measured. By this procedure the graphs give also an idea of the average number of whorls. It is realized that this is a rather inexact procedure which can only be applied if evolution goes at a high rate.

With a few exceptions, extrapolation of mentioned trends leads to *Fusulinella brañoserae.* Diagram 2 shows the marked increase in diameter from *Fusulinella delepinei* (Caloca limestone) to *Fusulinella* ex gr. *brañoserae* (Camasobres limestone). It shows the reserve trend equally well from *Fusulinella* ex gr. *brañoserae* (Camasobres limestone) to *Fusulinella brañoserae* (Brañosera limestone). A second reversion of this trend (i. e. a second increase

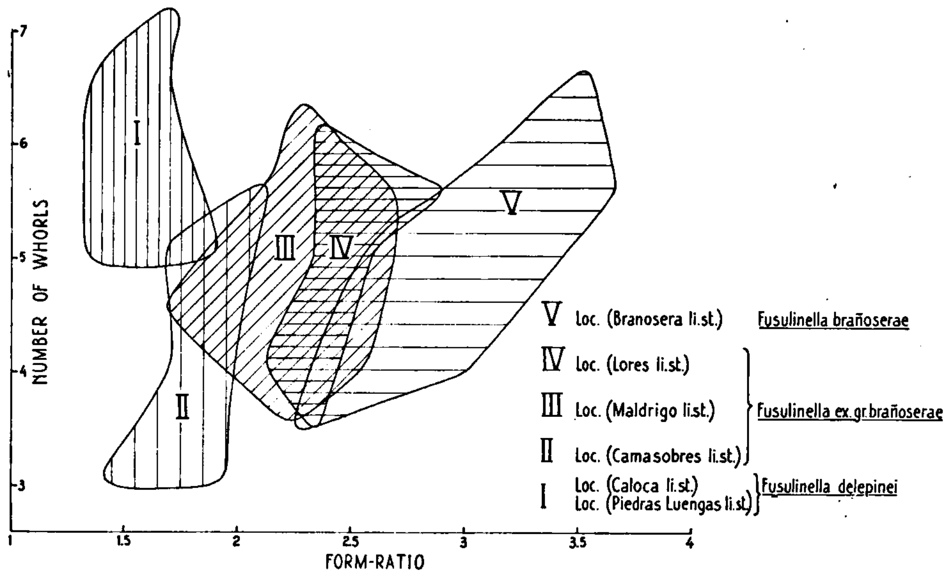

Diagram 1

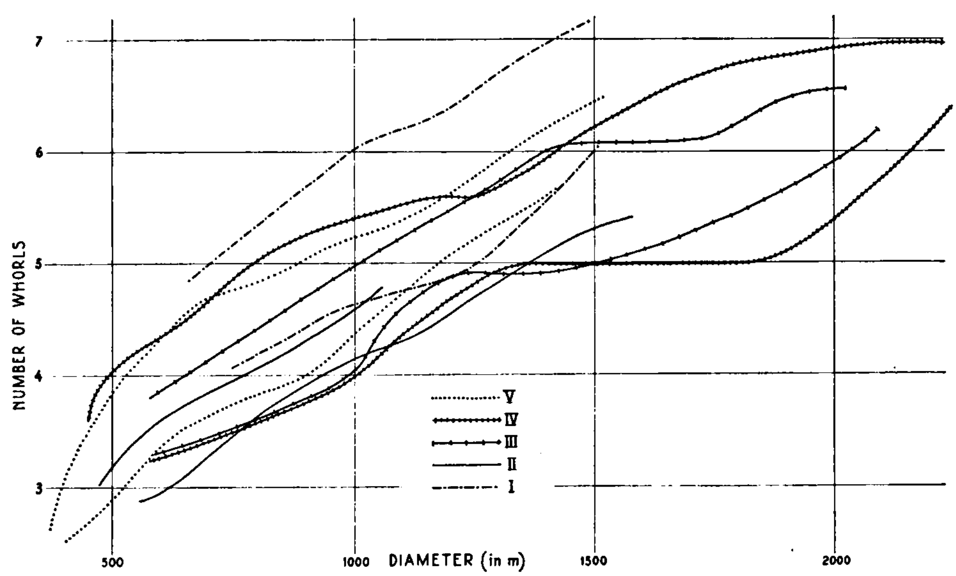

Diagram 2

in diameter) takes place as *Fusulinella brañoserae* gradually develops into *Protriticites.*

From the Castrillo limestone to the Lores limestone, a third species of this genus was encountered belonging to the group of *librovitchi* Dutkevitch. To the same group seems to belong *Fusulinella pulchra* Rauser-Chernoussova. Probably in concordance with *Fusulinella librovitchi,* in our specimens also, the diaphanotheca is not clearly shown, and as a rule is only discernable in the last two whorls.

A fourth species *Fusulinella* ex gr. *famula* Thompson was not encountered in the Casavegas syncline but in the region immediately south of the Redondo syncline (Cotaraso limestone, loc. LVIII) (Syncline of Celada, loc. XLV) (Verdiana limestone, loc. L). Our specimens differ from *Fusulinella famula* Thompson, by their larger size (max. observed diam. 2,95 mm), more elongate shell (max. observed form-ratio 2,3) and less whorls at maturity (max. observed number of whorls 8). The diaphanotheca is well developed but thin in relation to the tectoria. Other genera were not studied in detail as yet, and for the repartition of the various species and genera is referred to fig. 3.

The marked change of the fusulinid assemblage from the Caloca limestone to the Camasobres limestone is self-evident. This change will be better realized if we consider the abrupt replacement of such a primitive form as *Eofusulina,* having a thin and sometimes hardly discernable diaphanotheca, by a highly evolved *Fusulina* with a thick diaphanotheca not seldom showing pores protruding from the wall. We may note, moreover, the rather abrupt fall of *Millerella* and *Nankinella* above the Caloca limestone. The last genus is represented above the unconfirmity by a totally different species which is only tentatively referred to this genus and which is possibly more akin to *Nummulostegina.* Noteworthy is also the absence of *Fusiella* below the unconformity. *Staffella* is absent above this unconformity, but this holds only for the Casavegas-syncline as we meet it again in the Stephanian A (Brañosera limestone). *Schubertella* appears in the youngest foraminiferous limestone (Lores limestone). The same species was found in the Sierra Corisa limestone.

It belongs to the group *kingi* Dunbar and Skinner. It has a slightly larger diameter, but except for this it corresponds to all the characters of this species, especially with the specimen illustrated as fig. 12 (see Dunbar & Skinner, 1937). This species from the Hueco formation (Lower Permian) of Texas seems to have had its precursors already in basal Upper Carboniferous strata.

The genus *Pseudostaffella,* although not observed in the Caloca limestone and Piedras Luengas limestone, was represented in the Sierra del Brezo with *Pseudostaffella* cf. *mölleri* (Ozawa) and such a primitive group of forms as *Pseudostaffella* ex gr. *antiqua* Dutkevitch. Above the unconformity in the Casavegas section this genus again is represented with two species. The lower occuring species Camasobres limestone) has even a slightly larger than *Peudostaffella quadrata* (Deprat) from the Lores limestone, but its form-ratio is smaller (0,78—0,87) as against 1,00 in *Ps. quadrata.* Its perifery, moreover, is more rounded which gives it an oval outline. The same evolutionary trend seems to exist in the Huanglung limestone of China (compare *Ps. ozawai* Lee and Chen, Huanglung M_a and *Ps. parasphaeroidea* Lee and Chen, Huanglung M_b).

A sudden fall of the genus *Fusulina* is observed from the Camasobres limestone upwards. Actually this genus was only met with in the Casavegas

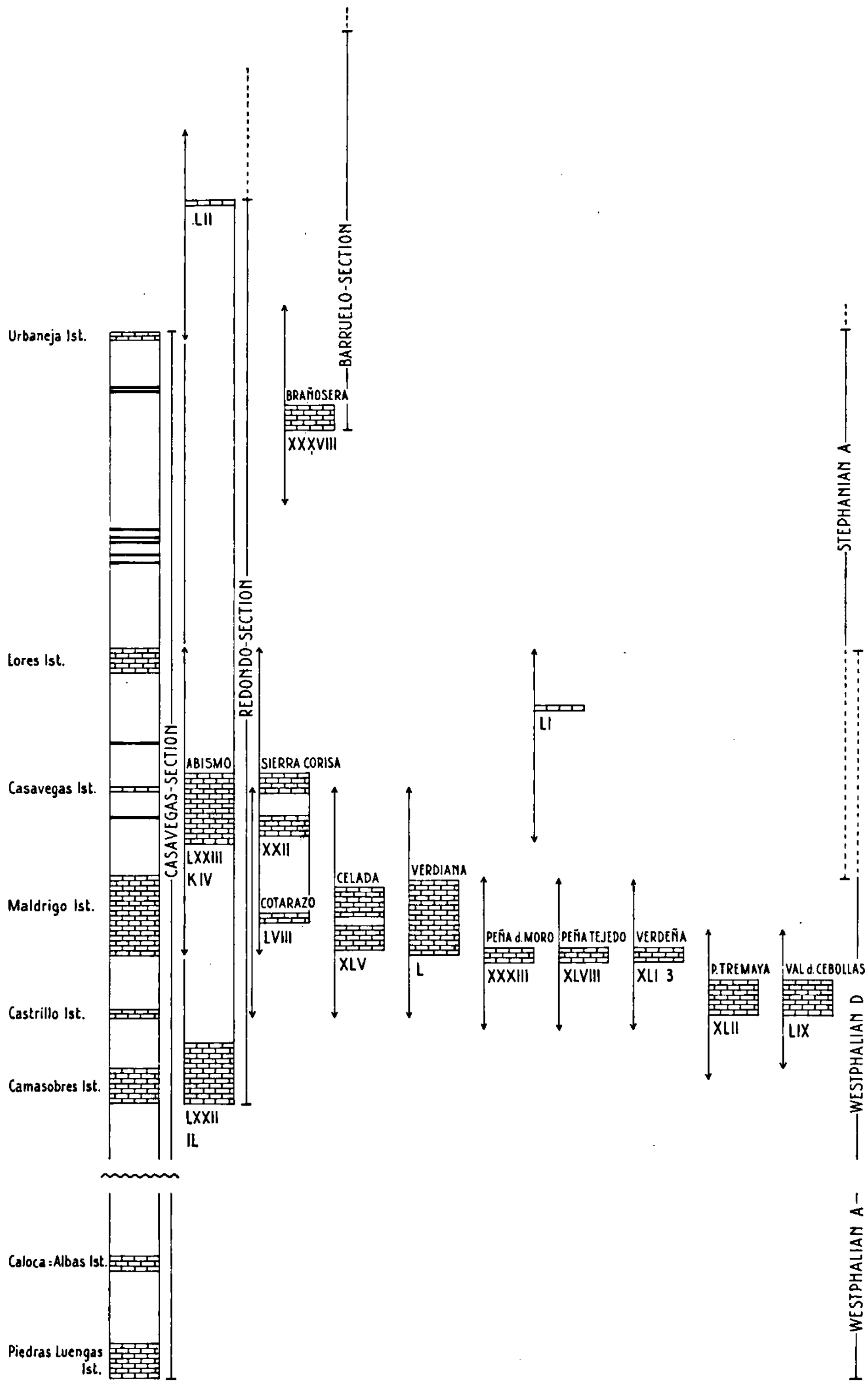

Fig. 4. Carboniferous sections in northern Palencia.

limestone (section E). This decrease in number has most probably no stratigraphic significance, since this genus south of the Redondo syncline was represented by numerous specimens in strata which are supposed to be younger than the Camasobres limestone (Cotaraso, loc. LVIII; Celada, loc. XLV; Verdiana, loc. L). It seems that the favouring facies of *Fusulina* in Palencia has been a rather impure and somewhat clastical, brown colored, limestone and that it could easier withstand terrigenic influences than *Fusulinella brañoserae*. *Fusulina* is rarely found to be associated with *Fusulinella brañoserae*. This might explain the absence of *Fusulina* in the pure, grey colored, and perhaps in somewhat deeper water originated Maldrigo- and Lores limestone.

Typical representatives of the genus *Dagmarella* were found in the Camasobres limestone and in the Tremaya limestone. In the Maldrigo limestone a species has been encountered which undoubterly developed from the Camasobres type, but which shows a clear diaphanotheca, somewhat reduced chomata and a greater form-ratio, thus becoming intermediate between *Fusulina* and *Fusulinella.*

C. *Age relation between the Casavegas section and East-Pernia (Redondo syncline and the region immediately south of it).*

Conclusions concerning correlation were based mainly on the evolutionary level of populations in the lineage: *Profusulinella-Fusulinella-Protriticites.* Fig. 4 gives the time-relation of the Casavegas-section with several localities from the Redondo syncline and the region immediately south to this syncline (syncline of Celada, loc. XLV; Sierra-Corisa, loc. XXII; Cotaraso, loc. LVIII, etc.). In this figure the degree of uncertainty of correlation is expressed by arrows indicating the upper- and lowermost possible position as compared with the Casavegas section. The roman numerals indicate the localities, the situation of which is shown on fig. 5.

One of the most surprising results of this investigation was that the supposed correlation between the Abismo limestone (Redondo syncline) and the Camasobres limestone (Casavegas syncline), which was based on field-evidence, had to be abandoned. The several limestone outcrops, stratigraphically below the Abismo limestone, situated near and striking parallel to the Carboniferous-Triassic contact (loc. LXXII, loc. IL), moreover could not be correlated with the Piedras Luengas limestone or Caloca-limestone as was formerly believed. It was possible to prove that the eastern Redondo section from the Trias-Carboniferous contact up to the youngest synclinal deposits, occupies a considerably higher stratigraphical position with regard to the Casavegas section. Its basal limestone-member (loc. LXXII, loc. IL) proved to be the equivalent of the Camasobres limestone; the Abismo limestone had to be correlated with the Sierra Corisa limestone (= Maldrigo limestone or Lores limestone in the Casavegas section); the uppermost fusulinid containing limestone-outcrop in the Redondo section has probably no time-equivalent in the Casavegas section, and contained a definite "triticitid" fauna not yet encountered in any other locality in Palencia or Asturia. The establishment of the relation of Verdiana (loc. L), Cotarasso (loc. LVIII) and Celada (loc. L) with the Casavegas section is not yet satisfactory solved. A fusulinid assemblage is present here which differs in notable degree from those met with in the Casavegas section. These limestones are characterized by the association *Fusulinella* ex gr. *famula* Thompson — *Fusulina* cf. *Pseudotriticites.* The presence of *Fusulina* in abundancy would point rather to a Camasobres limestone

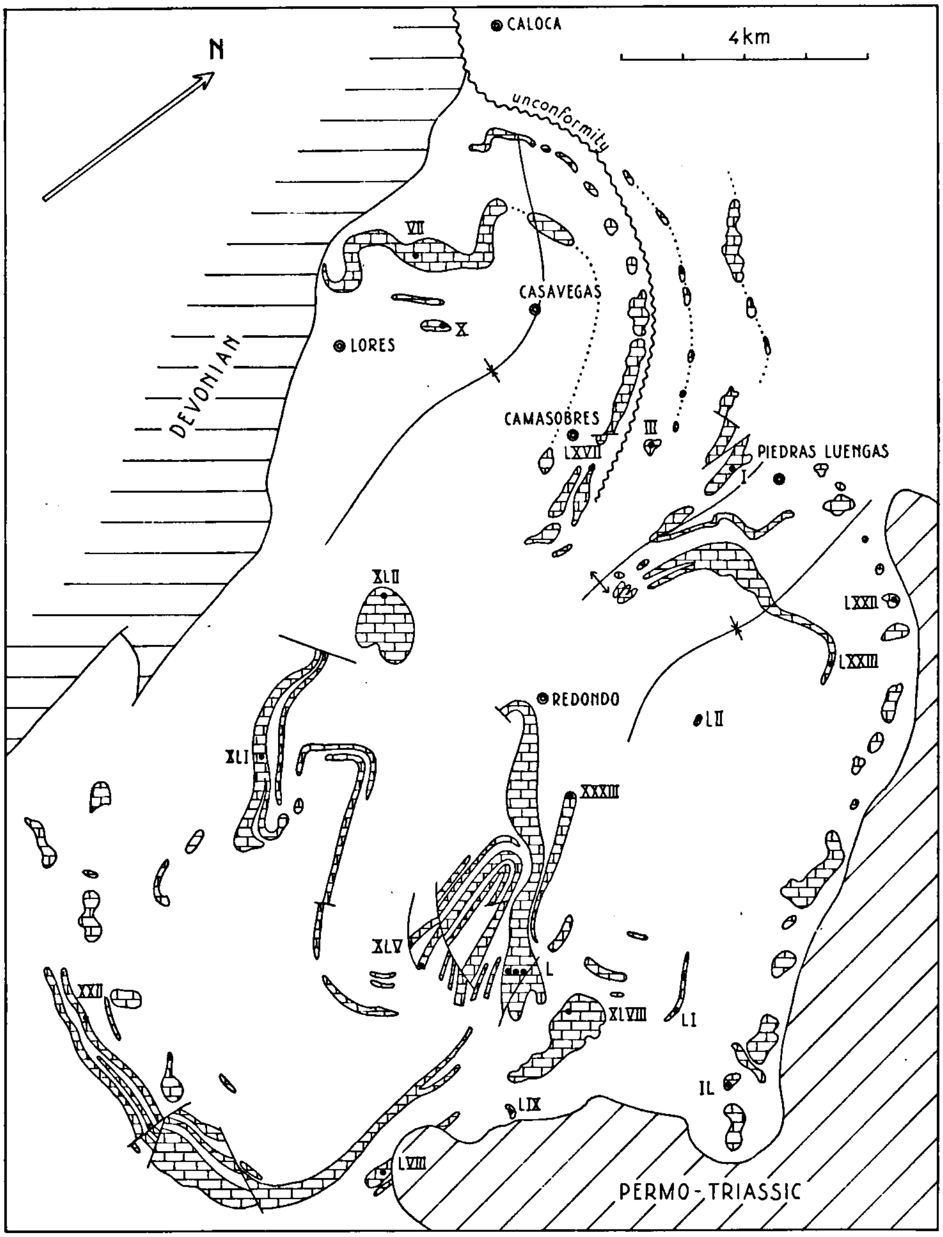

Fig. 5. Index map of the limestone outcrops and fossil localities.

equivalent. As has already been set forth, however, this is believed to be a mere reflection of a different environment. Also, the *Fusulina* from the Camasobres limestone is somewhat smaller and shows a less developed wall-structure [1]). Since we know that the Cotaraso limestone is older than the Sierra Corisa limestone (field-evidence), and know also that the Sierra Corisa limestone is definitely not younger than the Lores limestone [2]), we may conclude that the three localities under consideration might take any position between the Camasobres and the Lores limestone. They are tentatively correlated with the Maldrigo limestone.

5. AGE (WITH A SPECIAL REFERENCE TO THE POSITION OF THE LIMIT BETWEEN WESTFALIAN D AND STEPHANIAN A)

It is shown in the present paper that the Caloca (= Albas) limestone, which is the highest limestone member below the unconformity in the Casavegas section, is of upper Caliza de Montaña age and through its fauna directly can be compared with the Ribadesella limestone in Asturia (see Gübler, in Delepine, 1943). The Ribadesella limestone is the type locality of *Fusulinella bocki*, var. *delepinei* Gübler, which species is also present in the Caloca limestone. A comparison with the Russian and West European fauna led Delepine to assign a Westfalian A age to the Ribadesella limestone (Delepine, 1943). The Piedras Luengas limestone, 750 m below the Caloca limestone might be of Westfalian A age as well.

The Casavegas syncline proper is of Westfalian D and Stephanian A age (Wagner, oral communication; De Sitter, 1957; Wagner & Breimer, 1958). This would mean that a time aequivalent of the Curavacas conglomerate, which is of Westfalian B or C age (Wagner, in Kanis, 1955) is absent in the Casavegas syncline. In this connection it might be interesting to know if a thick conglomerate stratigraphically above the Caloca limestone forms here the uppermost horizon of the Westfalian A or rather the basal conglomerate of the Casavegas syncline. If the last possibility would prove to be true and the Curavacas conglomerate would be of Westfalian C rather than of Westfalian B age, then the relation of both conglomerates to the tectonic history could be analogue. For this reason we cannot definitely exclude an Upper Westfalian C age for what might be the basal conglomerate of the Casavegas syncline.

It is also doubtfull whether the uppermost strata of the Casavegas syncline reach, as high in the Stephanian A as is the case in the Barruelo section (see Wagner, 1955), because the youngest limestone containing an abundant fusulinid fauna (Lores limestone in the Casavegas section) is still older than the Brañosera limestone at the base of the Barruelo section. The gradual development of a continental environment in both sections made it impossible to give a conclusive answer to this problem by means of foraminifera.

A paper dealing with the boundary between the Westfalian D and the Stephanian A in Northern Palencia has been recently published by Wagner & Breimer (1958). The first author described some plant fossils from the San Cristobal coal seam which he considered to be of lowermost Staphanian A age. As a consequence the boundary between the Westfalian D and the Stephanian A

[1]) The *Fusulina* from Celada is actually intermediate between *Fusulina* and *Pseudotriticites,* since a large number of specimens show small pores protruding all wall-layers. These pores are especially well visible in the lower tectorium.

[2]) By comparison of *Fusulinella ex gr. brañoserae.*

had to be lowered from the stratigraphically higher situated San Felices coal group, whose Stephanian A age was already established (Wagner, 1955), to the base of the San Cristóbal coal seam. This shifting must affect the limit under consideration in other regions as well. Since we find the Sierra Corisa limestone member stratigraphically immediately below the San Cristóbal coal seam, we might consider this limestone to have an uppermost Westfalian D age. This implicates that for the Casavegas section, the limit under consideration has to be placed somewhere between the top of the Maldrigo limestone and the top of the Lores limestone. As a consequence the Areños coal group and the Rosa Maria coal group would be of Stephanian A age. The Casavegas and Camasobres coal seam might be uppermost Westfalian D or lowermost Stephanian A. In the Redondo section we might place this limit immediately above the Abismo limestone. The Barruelo sequence of strata, the basal Brañosera limestone inclusive, would be entirely deposited in Staphanian A time [3]).

[3]) The last conclusion does not agree with the results obtained by Mrs. Wagner-Gentis who after examination of Brachiopod assemblages from the lower part of this section concluded upon a Westfalian age (Wagner-Gentis, in Wagner, 1955, p. 195).

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