B R E V I O R A

GEOLOGICA ASTURICA

AÑO XVIII (1974) OVIEDO Núm. 4

INSTITUTO DE GEOLOGIA APLICADA DE LA FACULTAD DE CIENCIAS, UNIVERSIDAD.
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS

T. Ambrose (*).—THE LOWER PALAEOZOIC ROCKS OF NORTHERN PALENCIA.

The first published information to indicate the presence of Lower Palaeozoic rocks in Palencia was given in a 1 : 100,000 map of the Southern Cantabrian Mountains compiled by DE SITTER (1962). The unpublished evidence for this was obtained by CRAMER (pers. comm.) who had obtained upper Silurian microfossils from a sample of green shales collected on Peña Polentinos. A further extension of these shales is shown on the maps of VAN VEEN (1965) and DE SITTER & BOSCHMA (1966), where they are named as the member «a» of the Carazo Formation. The area, which is north of Cervera de Pisuerga and extends to the border with the province of Santander, is shown on Fig. 1. Its geological limits are, to the south, the Los Cintos Syncline in upper Westphalian B conglomerates, to the west the Curavacas Fault and similar conglomerates, to the north and east faulted contacts with Upper Carboniferous strata of various ages.

The structure of this area is controlled by low angle gravity thrusting towards the south, in which the competent quartz-arenitic and calcareous units have slipped over shales and mudstones. As a result, much of the area appears to be gently folded and shows only a shallow northward dip, except for the immediate vicinity of thrusts where overturned strata are seen. Most of the sequence involved is Devonian, but Lower Palaeozoic strata are also present.

Three formations are described here, the oldest being the Robledo Formation of sandstones and quartzites; it is followed, possibly disconformably, by the Arroyas Shale Formation which includes the upper Silurian green shales dated by Cramer, and the Carazo Formation of quartzites, ferruginous sandstones and shales. Type sections for these formations are shown by arrows pointing towards the youngest part of each sequence. Although the Robledo and Arroyacas formations can be compared to the

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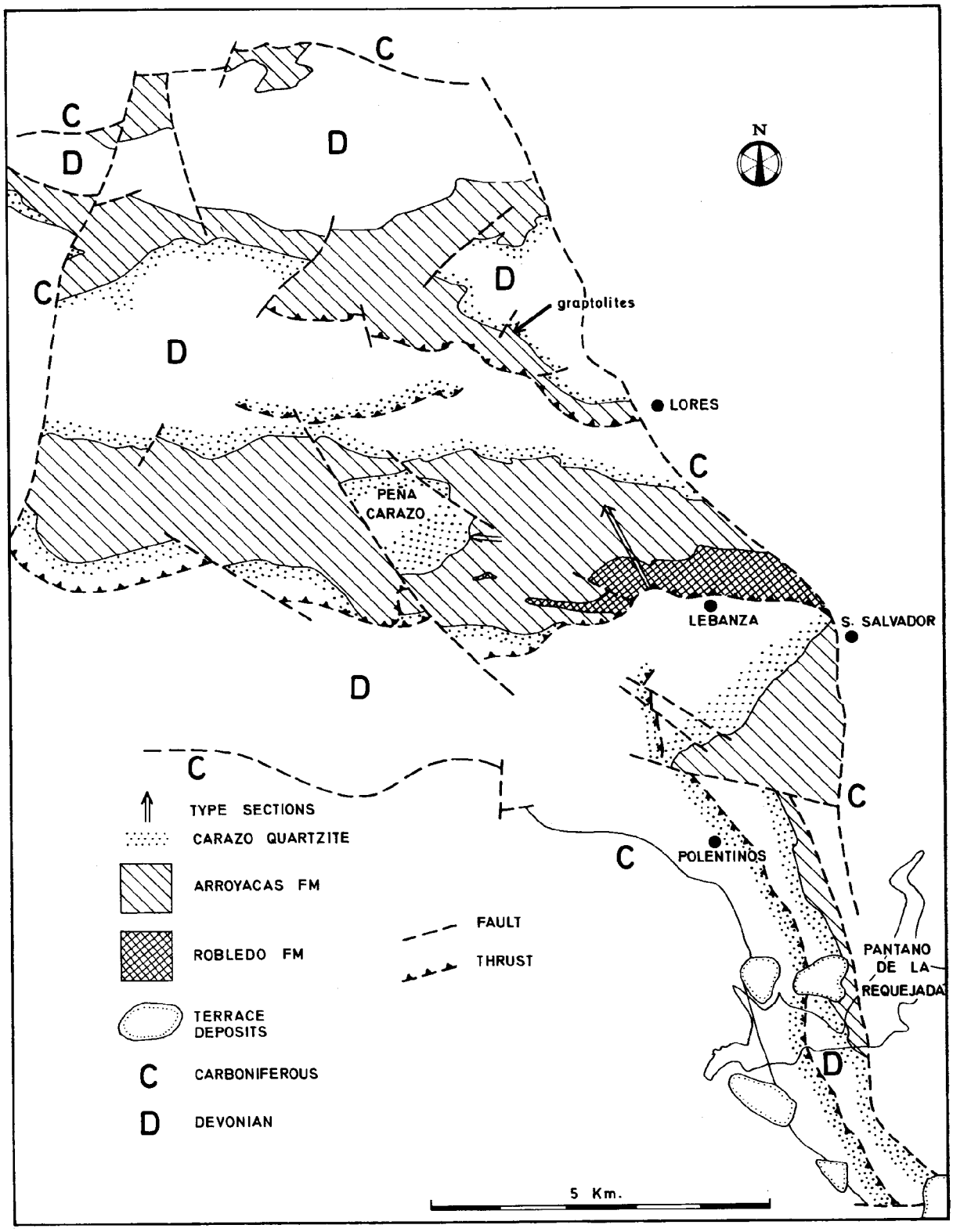

Fig. 1.—Outcrops of Lower Palaeozoic strata north of Cervera de Pisuerga (prov. Palencia) (based on an unpublished map by the author).

Barrios and Formigoso formations in northern León, new names are proposed here for the formations in Palencia, since important differences do occur.

Robledo Formation.—The oldest rocks exposed consist of 160 m of quartzites and sandstones with shale partings, the latter comprising 30 % of the total thickness. The formation has not previously been described, since its rocks were

confused with those of the later Carazo Formation on the maps published by VAN VEEN and DE SITTER & BOSCHMA. It is named after a hill west of the measured section near the village of Lebanza (see Fig. 1). The shales are extensively bioturbated, but no micro— or macrofossils have been discovered. The beds are correlated on lithological grounds and by their stratigraphic position with the Barrios Formation of Arenig age in León. They consist of very pure white, medium and fine-grained quartzitic sandstones. Grain size and the sorting of the grains increase throughout the formation. Ripplemarks and cross bedding are found throughout, and even the thickest beds show an internal fine lamination. They appear to have been deposited in shallow water.

At the top of the formation there is an abrupt transition from a hard, ferruginous medium-grained quartzite to a soft, calcareous mudstone. This boundary is taken to represent the base of the Arroyacas Formation, and it may mark a break in deposition. However, there are no signs of erosion of the quartzite.

Arroyacas Formation.—VAN VEEN (1965) described 75 m of shales as the oldest beds exposed in this area, and named them as member «a» of the Carazo Formation. In fact, the shales total some 350 m and are sufficiently distinctive to merit a separate formational name. The formation is named after the hill and stream of Las Arroyacas near Peña Carazo, 2 km NW of Lebanza (see Fig. 1).

Within the bioturbated, thinly bedded shales and fine sandstones, there is only one important marker horizon of well washed cross bedded sandstone, about 2 m thick. Immediately above this is the green shale, mentioned above. The uppermost beds of the formation have yielded graptolites identified by Dr. R. B. Rickards (*in litt.* Dec. 1971) as *Monograptus incipiens* WOOD, indicating a Ludlow age. These specimens are in the Sedgwick Museum, Cambridge (Cat. nos. A 80967-91). A number of poorly preserved spiriferids and a *Protochonetes* sp. were found at one horizon near the base of the formation, and straight nautiloids and an unidentifiable trilobite were also collected.

The thickness and relative incompetence of the shales, caught between two arenaceous units, have resulted in widespread cascade folding and small scale faulting. Thus complete sections of exposed strata are difficult to find and only the type section can be relied upon. The beds are correlated both lithologically and faunally with the Formigoso Shales in northern León.

Carazo Formation.—This formation, already described by VAN VEEN (1965) and DE SITTER & BOSCHMA (1966), is briefly outlined because it is partly of Silurian age and thus belongs with the other Lower Palaeozoic formations, and also because it requires redefinition. With the removal of the lower shales to a new formation, the base is now the very prominent horizon marked by sandstone and ironstone deposition. These beds, frequently referred to as the Carazo Quartzite, range from 190 m in thickness on Peña Carazo, to *ca.* 50 m in the Peñas Negras near Cervera de Pisuerga, and 20 m near the northern boundary of the area studied. The beds contain a brachiopod fauna identical to that recorded by COMTE (1959) from the San Pedro Formation in northern León. They are also similar in lithology, containing ironstones at several horizons and phosphatic pellets (erroneously described by several authors as volcanic pellets).

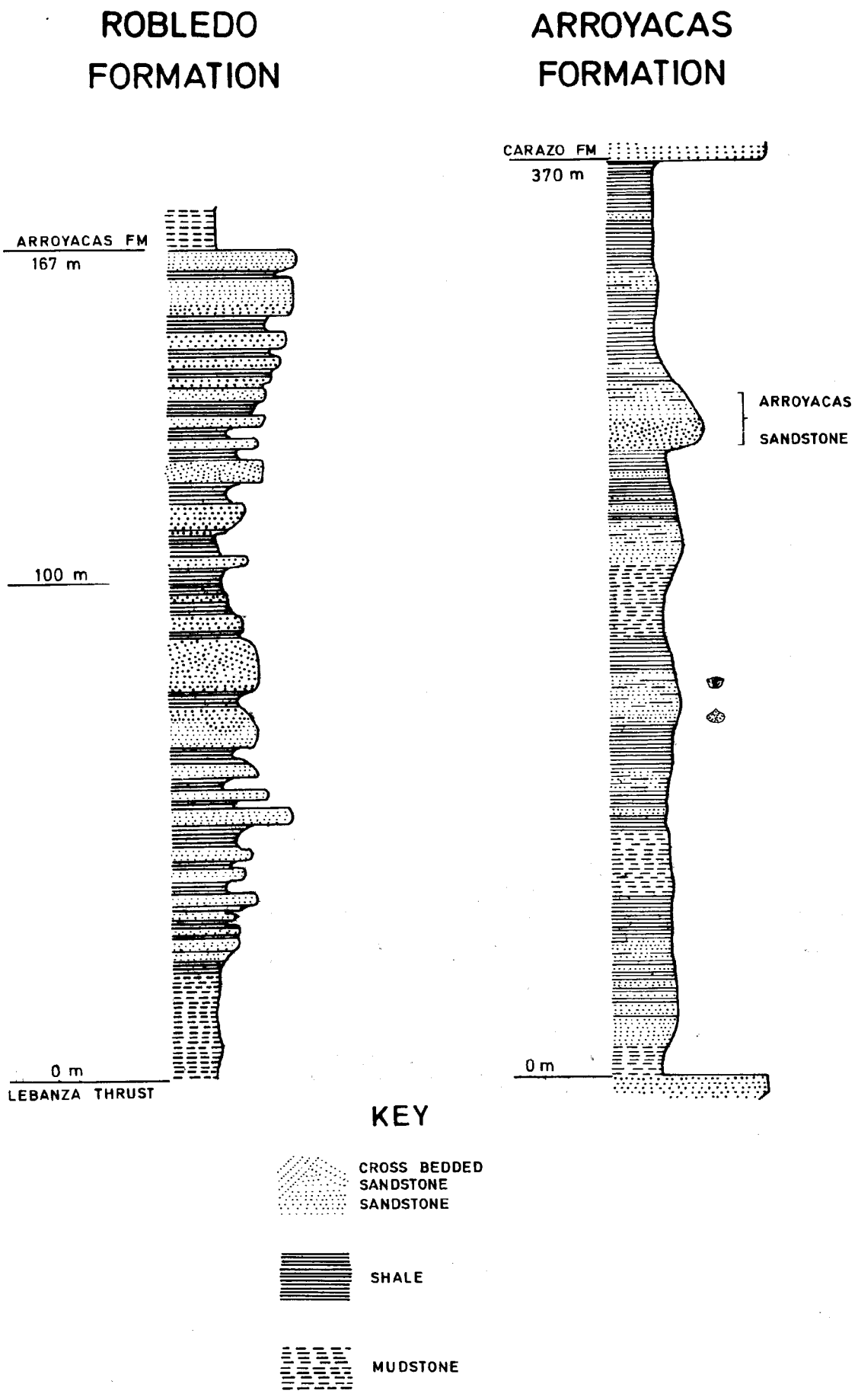

Fig. 2.—Type sections of the Robledo and Arroyacas Formations.

The upper part of the Carazo Formation, consisting of 210 m of shales, sandstones, ironstones and some brachiopod limestones, is of Lower Devonian age and is therefore outside the scope of the present paper.

Other outcrops.—Lower Palaeozoic strata are also exposed in the San Julián area, well east of Cervera de Pisuerga, where they figure on a map published by WAGNER (1971). The Arroyacas Shales are overlain here by Carazo Quartzites and ironstones, and the facies of these beds suggests a similar environment to that of the Carazo Formation around Peña Carazo.

Acknowledgements.—The writer is indebted to Dr. R. H. Wagner for general advice and supervision, to Dr. R. B. Rickards for the identification of graptolites, and to Mr. P. Wilkinson for assistance with certain sedimentological problems. The work was carried out with the financial assistance of a research studentship from the Natural Environment Research Council.

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Andrés Pérez-Estaún (*).—LA SUCESION ORDOVICICA EN EL DOMINIO DEL ALTO SIL (ZONA ASTUROCCIDENTAL-LEONESA, NW DE ESPAÑA).

Dentro de la Zona asturoccidental-leonesa y en el dominio del alto Sil (fig. 1), el Ordovícico se presenta de forma completa. La sucesión ordovícica de esta región fue previamente establecida por MATTE (1968) y NOLLAU (1968) y posteriormente MARCOS (1973) y CRIMES, MARCOS & PÉREZ-ESTAÚN (1974) establecieron algunas precisiones en cuanto a ella. En esta nota se presentan los datos obtenidos más recientemente sobre la sucesión estratigráfica y las faunas.

Sobre los materiales Cámbricos, la sucesión ordovícica es la siguiente:

1) Serie de los Cabos.—Se trata de una sucesión detrítica, predominantemente cuarcítica, en la que tanto las estructuras sedimentarias inorgánicas como los icnofósiles (*Skolithos*, *Cruziana* y otros) indican una sedimentación en un medio marino de poco fondo. Un corte completo de esta formación puede obtenerse a lo largo del río Sil, en la carretera de Villablino a Ponferrada (Km 41 a 53), donde ha sido anteriormente descrita por LOTZE (*in* LOTZE & SDZUY 1961) y MATTE (1968). En este corte el espesor aparente de la Serie de los Cabos se aproxima a los 10.000 m (MATTE 1968); este espesor contrasta con el estimado más al N, en el occidente de Asturias,

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