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E. Iwaniw (*) and J. A. Knight (**).–EVIDENCE FOR THE ASTURIAN UNCONFORMITY NEAR SANTA OLAJA DE LA VARGA, NE LEON, SPAIN

The present note summarises recent work in the area of Santa Olaja de la Varga, where post-Asturian Stephanian A is in contact with post-Leonian lower Cantabrian. The stratigraphy of the Sabero Coalfield west of the River Esla has been described by KNIGHT (1971, 1974, 1975) and its sedimentary environment has also been further discussed by HEWARD (1978). The Sabero succession is largely of Stephanian B age, with late Stephanian A being recognised in the lower part; it is post-Asturian folding phase and unconformable on lower palaeozoic strata. Recent work has extended the mapping of this post-Asturian succession eastwards across the River Esla into the area near to the villages of Santa Olaja de la Varga and Fuentes de Peñacorada (Fig. 1). This has resolved the contentious problem (cf. HELMIG 1965) of the relationship between the post-Asturian Sabero succession and the post-Leonian folding phase succession of largely Cantabrian strata known in the area of Ocejo de la Peña and in the Valderrueda Coalfield (WAGNER & WINKLER PRINS 1979, WAGNER and FERNÁNDEZ-GARCÍA, in press). A clearly unconformable relationship occurs between the pre-Asturian and post-Asturian successions, which is confirmed by sedimentary differences and by fossil floras.

Mapping in conjunction with detailed stratigraphic sections has revealed a larger lateral extent for the Sabero Marine Horizon (see EAGAR & WEIR 1971, KNIGHT 1971), which was previously known only from a limited area north-west of Sabero. The marine horizon has proved to be a significant stratigraphic marker in the poorly exposed area east of the River Esla. This is in addition to its palaeogeographical significance as the singular indication of direct marine influence in the post-Asturian succession of northern León.

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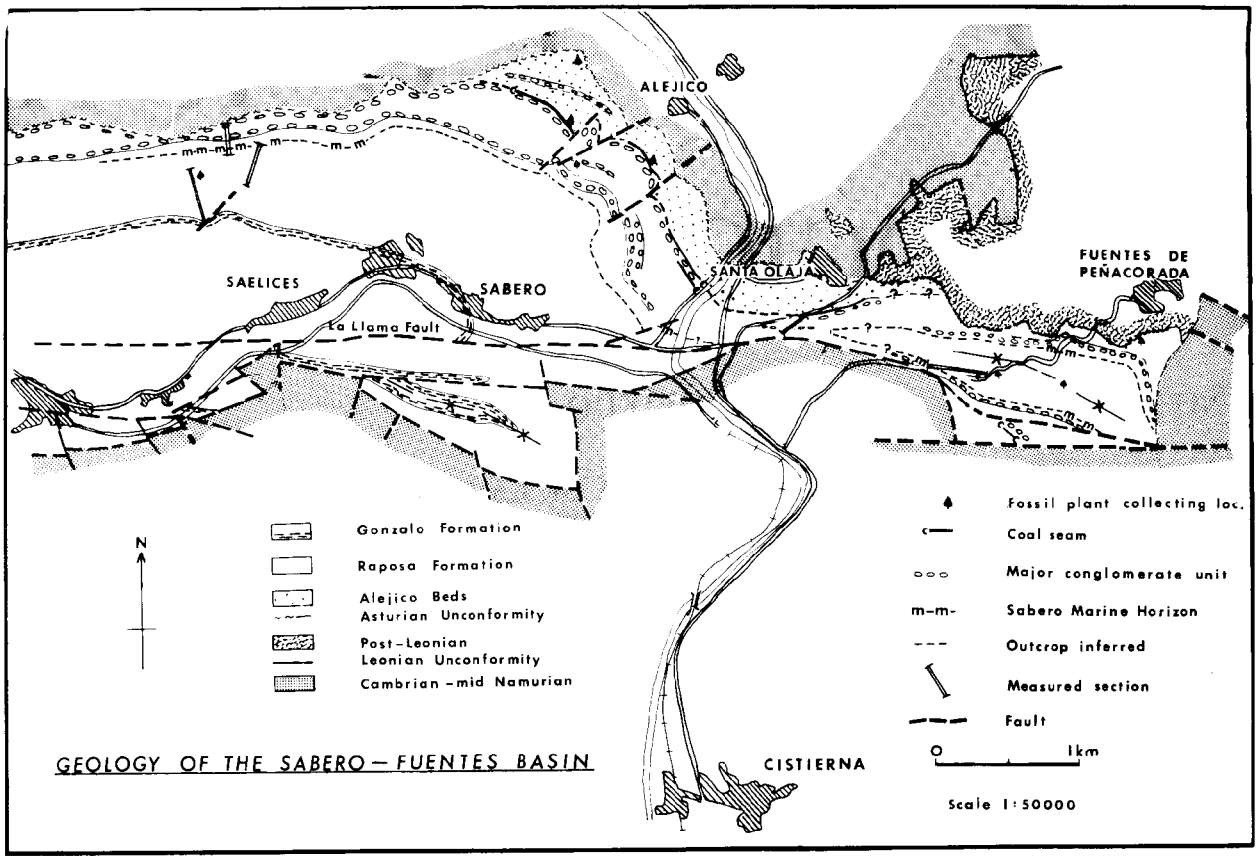

Fig. 1.–Geological map of the eastern end of the Sabero Coalfield.

THE POST-LEONIAN SUCCESSION (PRE-ASTURIAN)

The post-Leonian strata in the area of Santa Olaja de la Varga commence with deposits infilling a deeply incised fossil topography on previously folded Palaeozoic rocks ranging in age from Cambrian to mid-Namurian. Three, as yet informal divisions of the post-Leonian succession are distinguished.

(1) Red bed succession – These basal valley-fill deposits are at least 150 m thick along the road to Ocejo de la Peña. They consist of a number of fining upwards sequences of conglomerates, sandstones and siltstones with occasional silty mudstones. No rootlet beds are present and neither are coals. These sediments are similar to those described by HEWARD (1978) and may be regarded as a proximal fanhead canyon fill association generated along a fault controlled mountain front. The top of each fining upward sequence probably corresponds to a period of tectonic quiescence, without fault movement. The presence of a fossil scree found by WAGNER (1957) along the sides of the largest fossil valley indicates proximity to source and rapidity of infilling/subsidence.

(2) Grey bed succession – The red beds are overlain conformably by a finer grained sequence of grey beds consisting of sandstones, siltstones and shales. Rootlet beds and coals are often present. Occasionally, mid fan conglomerate lobes occur interfingered. Many of the coals are overlain by overbank deposits, including the one with plant remains which enabled WAGNER, (in WAGNER & WINKLER PRINS, 1979) to identify lower Cantabrian. At the top of the grey beds there is a laterally extensive lacustrine horizon with the non-marine bivalve

Anthraconaia and the serpulid worm *Spirorbis*. HEWARD (1978) interprets a similar association as a distal fan valley-fill sequence.

(3) Thick conglomerate succession – Immediately above the lacustrine horizon a thick limestone conglomerate is found. This succession includes the first deposits laid down more extensively than the local valley-fills. This 600 m thick unit has few interlobe sediments near its base, becoming more common upwards. The subsequent marine band recorded at Tejerina (WAGNER *et al.* 1969), has not been reached in the succession near Santa Olaja and Ocejo de la Peña. Marine transgression has been ascribed to downfaulting (op. cit.).

THE POST-ASTURIAN SUCCESSION

The complete succession at Sabero has been described by KNIGHT (1975 and in press). The present work deals with the lowest two stratigraphical units, i.e. the Alejico Beds and the overlying Raposa Formation.

Alejico Beds

Lack of exposure has prevented the measurement of continuous sections; short sections have been made available by recent open-casting. The limited area of outcrop below the Raposa Formation reflects initial sedimentation within the confines of a fossil valley.

The thickest development (*c* 300 m) is near Alejico, reflecting the infilling of a progressively subsiding, probably fault-bounded small trough. The north-western basin margin was a permanent feature during the deposition of the Alejico Beds, being formed by a major upstanding ridge of Ordovician quartzite. South-eastwards the Alejico Beds progressively onlapped across the depositional trough. The top of the Alejico Beds is defined at the roof of a well-developed and locally worked coal seam of wide mappable extent across almost the entire width of outcrop of these beds. The roof of this seam is the flat, non-erosive base of a major thick conglomerate band of predominantly limestone clasts which is the basal unit of the Raposa Formation. This conglomerate overlaps to a wide extent beyond the area of the Alejico Beds, both eastwards and westwards and represents an extensive widening of the depositional area beyond that of the Alejico Beds. Its base forms the natural upper boundary to the latter. In the area near Santa Olaja, the coal seam at the top of the Alejico Beds can be followed eastwards to become progressively closer to the Asturian Unconformity, thus defining a marked attenuation of this unit (Fig. 1). Beyond this point the Raposa Formation overlaps to rest directly on the pre-Asturian (and post-Leonian) succession. The Alejico Beds were thus deposited within the fairly narrow confines of a fossil valley of 3 km maximum width. In this and adjacent areas there appears to be no prospect of encountering older post-Asturian strata than the Alejico Beds, which are the oldest known above the Asturian Unconformity.

The Alejico Beds are extremely variable. At the north-western basin margin the basal deposits are a scree of locally derived Ordovician quartzite; these rapidly wedge out. Eastwards along the apparently overlapping base, the

basal deposits vary from carbonaceous pebbly grit to limestone conglomerate or to rather angular, predominantly sandstone conglomerate, depending on local substrate. Apart from the top coal which is more extensive, substantial coal development only occured near the village of Alejico, associated with the area of maximum thickness of strata deposited. In this area numerous carbonaceous and seat-earth horizons occur in the lower part of the sequence. Floral remains have been collected mainly from this part of the sequence and have been recorded and discussed by KNIGHT (1974, 1975). The composition of the flora suggests the presence of a nearby upland relief and the assemblage clearly indicates a probable late Stephanian A age. Above the principal coal horizons, conglomerates, pebbly sandstones or grits contain a predominance of rounded limestone clasts. The major conglomerate bands are flat-based, commonly matrix supported and frequently show inverse grading; they suggest deposition by a sheetflow mechanism. The suggested environment was of pronounced local relief adjacent to the actively subsiding valley floor, in which initial coal-forming conditions were eventually overcome by successive and widening flows of coarse material of relatively local derivation.

Raposa Formation

This sequence was first described on the basis of the measured sections North of Saelices (KNIGHT 1971), and these constitute the formational stratotype (KNIGHT 1975). On this section the basal conglomerate attains a thickness of over 100 m and rests directly upon the incised palaeotopography of the Asturian Unconformity, after overlapping the Alejico Beds. Immediately above the conglomerate, the Sabero Marine Horizon constitutes a characteristic welldefined short sequence to be discussed later. The succeeding sequence comprises a predominantly sandy succession with lenticular limestone conglomerates, some laterally extensive bands and common interbedded silty rootlet beds and occasional thin coals. A still wider variation in lithology occurs throughout the full thickness of the formation (see KNIGHT 1975) but within the area under discussion only the lowermost 160 m of the type section and its lateral equivelants appear to be present (Fig. 2). On the basis of the alluvial fan model proposed by HEWARD (1978) the basal conglomerate unit of the type section is probably of proximal-to mid-fan origin; the marine intercalation represents an abrupt change of environment. It is succeeded by a relatively more distal fan association. Westwards from the type section this formation thins while in contrast it thickens eastwards.

The Sabero Marine Horizon defines the top of the characteristically conglomeratic basal unit of the Raposa Formation. The single thick conglomerate unit of the type section has been traced eastwards into the area overlying the Alejico Beds, where it thickens and develops substantial interbedded lenses of sandy and silty strata with rootlet beds and occasional thin coals. This is also apparent on the east side of the River Esla, where detailed sections across strata attributed to the Raposa Formation and below the marine horizon show a number of flat-based conglomerate bands, 5-10 m thick interbedded with sandy sequences

of 5-25 m, including thin coals and rootlet beds (Fig. 2). Applying the Alluvial fan model, the basal conglomerate unit passes from proximal mid-fan conglomerate, represented as a single unit near the western basin margin into a number of more distal mid-fan conglomerate units in an eastern direction.

It is premature to attempt a full description of the fossil flora of the Santa Olaja area; work in this area continues and further localities have recently been collected and await description. Numerically significant floras have been collected in both the Santa Olaja and Fuentes sections. In both assemblages pteridosperms predominate in the number of species and in numerical frequency. In contrast pteridophyte species are considerably less common. The proportions agree with those recongised for relatively well drained or even hill-slope environments (PEPPERS & PFEFFERKORN 1970, KNIGHT 1974). The Santa Olaja flora is from the basal conglomeratic unit of the Raposa Formation from below the marine horizon, within largely mid-fan interlobe sediments. The Fuentes flora is from strata interpreted as relatively more distal. No appreciable difference in composition between the two floras has been noted. A composite list is as follows:

Neuropteris ovata var. *grand'euryi* WAGNER	S.F.
Linopteris florini TEIXEIRA	S.F.
L. neuropteroides (VON GUTBIER) POTONIÉ	F.
Odontopteris brardi BRONGNIART	S.F.
O. cf. *obtusa* BRONGNIART	S.
Alethopteris bohemica FRANKE	S.F.
A. leonensis WAGNER	S.F.
Callipteridium striatum WAGNER	F.
C. zeilleri WAGNER	S.
Pseudomariopteris corsini (TEIXEIRA) WAGNER	F.
Dicksonites plueckeneti (VON SCHLOTHEIM) STERZEL	S.
Sphenopteris (Oligocarpia) gutbieri GOEPPERT	F.
Pecopteris arborescens (VON SCHLOTHEIM) BRONGNIART	S.F.
Alloiopteris cf. *erosa* (VON GUTBIER) WHITE	F.
Sphenophyllum oblongifolium (GERMAR & KAULFUSS) UNGER	S.F.
Annularia sphenophylloides (ZENKER) VON GUTBIER	F.
A. stellata (VON SCHLOTHEIM) WOOD	F.
Asterophyllites equisetiformis (VON SCHLOTHEIM) BRONGT.	F.

(S.–Santa Olaja de la Varga; F.–Fuentes de Peñacorada).

Only *O.* cf. *obtusa* (a single specimen) had not previously been recorded from the Sabero succession. All but two of the other species were known from the Alejico Beds and/or Raposa Fm. The exceptions are *S. (Oligocarpia) gutbieri* and *Alloiopteris* cf. *erosa*, significantly both pteridophytes. They are both long-ranging species.

The flora confirms that the described strata of the Santa Olaja-Fuentes area are wholy identifiable with the lower part of the Sabero succession, attributed to upper Stephanian A. This supports the correlation established by mapping.

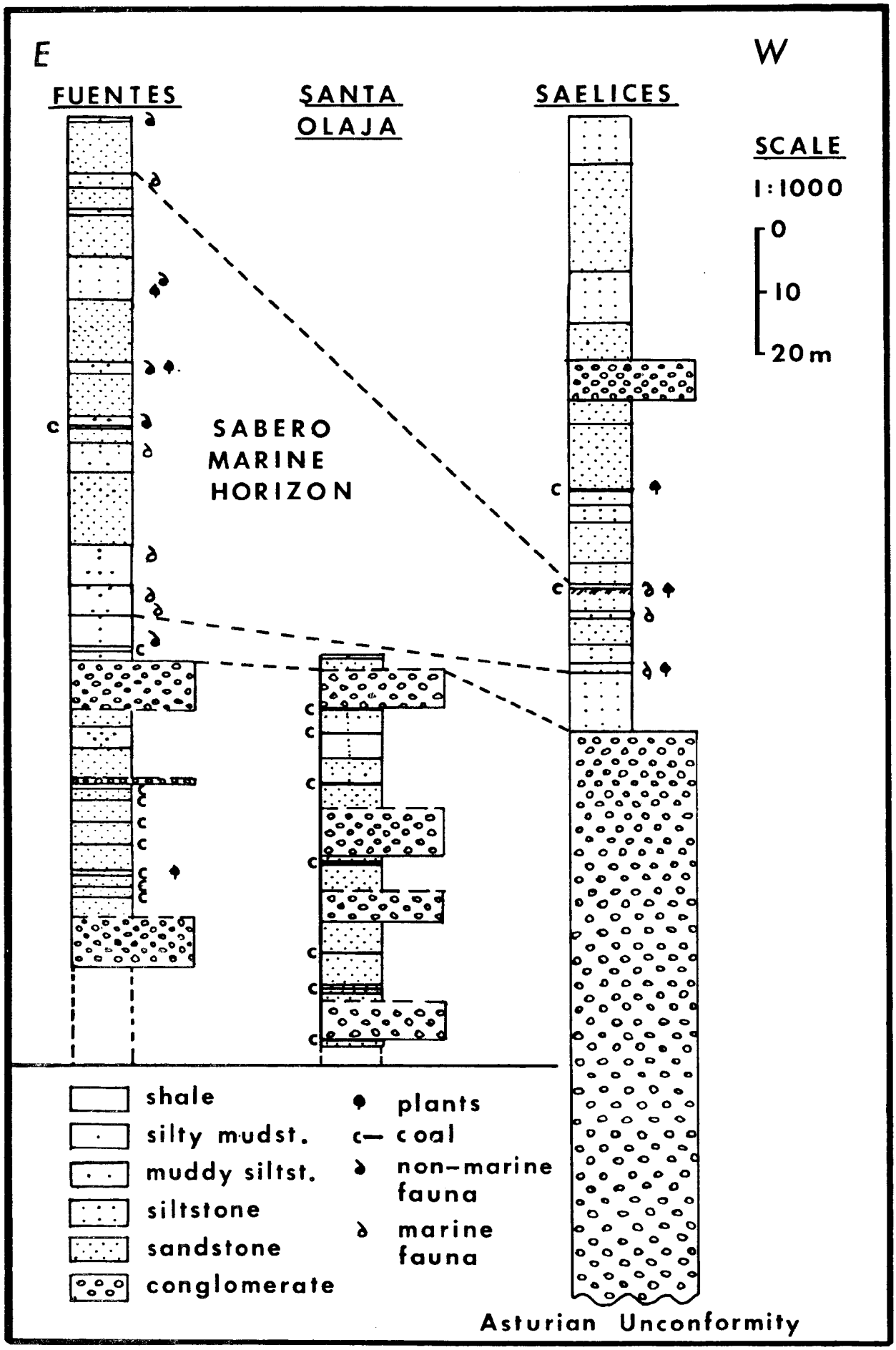

Fig. 2.–Measured sections showing westward thinning of the Sabero Marine Horizon and eastward splitting of the basal conglomerate member of the Raposa Formation.

The Sabero Marine Horizon

The recognition of marine influence is based upon the identification of bivalve assemblages. The beds containing bivalves are greenish grey or blue grey, massively and spheroidally weathering silty lutites. Each band often contains a number of levels crowded with specimens. Material is normall of largely complete, apparently decalcified valves; individual horizons may show marked differences in size variation. Between the principal concentrations more fragmentary material sometimes occurs in the more massive sediments. Specimens from the Saelices type section were identified and discussed by EAGAR & WEIR (1971), who used the term Sabero Marine Band for this sequence. This term is misleading since it invites comparison with NW European marine bands and has been replaced by the term Sabero Marine Horizon (KNIGHT 1975). The bivalve-bearing beds are interbedded with other lithologies including flat-based medium to coarse grained, fining upwards sandstones, rootlet beds and some thin coals.

The material from the Saelices section obtained from several fossiliferous bands has been described as a single assemblage containing *Septimyalina* (previously recorded as *Myalina*, since revised, EAGAR *in litt* 4.7.80) and *Curvirimula*, indicating restricted marine conditions. An assemblage of small *Anthraconaia* occurs at a slightly higher level and corresponds to a brackish fauna tolerant of partly saline conditions (EAGAR & WEIR 1971). The restricted marine faunas were recognised as completely similar to those from the Saelices section and support positive correlation between the two sections.

Restricted marine conditions make a sudden appearance above the well defined top of mid-fan conglomerates in the Saelices section. Similarly, in the Fuentes area, the marine horizon terminates the preceding mid-fan conglomerate and interlobe sequence. It is succeeded by and associated with a more distal fan association. This marine incursion appears to represent important subsidence, perhaps as a result of backfaulting. The succeeding alluvial fan deposits reflect a more distant source area. In context of the alluvial fan model of HEWARD (1978), the marine incursion would be analogous to the widespread lacustrine inundations at the base of megasequences recognised higher in the Sabero Succession.

The continuing pattern of a regional basin subsidence eastward from Sabero, reflecting relatively more distal fan sedimentation in that direction, is also apparent in the Sabero Marine Horizon. The total thickness of brackish and restricted marine sediments and associated interbedded strata totals 73 m in the Fuentes road section as against some 14 m logged in the Saelices type section.

RELATIONSHIPS OF UPPER CARBONIFEROUS SEQUENCES

The general analogy drawn between the types of sediments making up the pre and post-Asturian successions can be attributed to the similarities in their depositional environments. However, closer examination lessens these similarities.

The barren proximal fanhead canyon fills forming the basal part of the lower Cantabrian valley-fills have a red colouration attributed by OELE & MABE-

SOONE (1963) to the stripping of lateritic soils in the vicinity. This red colouration is absent in the coal-bearing sequence which constitutes a large part of the Alejico Beds. Major conglomerate units which interfinger with the Alejico coal measures are flat-based and frequently coarsening upwards, whereas the conglomerates in the lower Cantabrian red beds are fining upwards and often show an erosive base; the latter suggests a higher energy environment.

The post-Leonian grey bed succession which is devoid of marine influence, contains a single lacustrine horizon at the top. This suggests a further fining upwards trend. However, its analogue in the post-Asturian succession, viz. that part of the Raposa Fm. which follows upon the basal conglomerate unit, is a marine horizon representing restricted marine conditions. In the context of the alluvial fan model this can be regarded as the start of a coarsening upwards megasequence.

A major difference lies in the scale of the overall sedimentary environment. The Alejico Beds at Sabero represent the infilling of a relatively wider valley than those of the lower Cantabrian succession which are narrower and deeper (max. 500 m depth), but not necessarily steeper sided. In the Fuentes area the Alejico Beds show a replacement by distal fan deposits which do not relate to a palaeotopography.

Palaeocurrent directions measured in the lower Cantabrian deposits show a NNW to SSE trend which corresponds to the general orientation of the fossil valleys. South to north palaeocurrent directions were found by KNIGHT (1975) for the post-Asturian strata and these are presently confirmed for the Santa Olaja area. Sediments of the same age in a basin west of the Sabero Coalfield also show this general palaeocurrent orientation (HEWARD 1978).

GEOLOGICAL STRUCTURE

A strongly angular unconformity between the pre and post-Asturian successions become apparent while mapping. The lower Cantabrian strata show relatively small NNW-SSE trending folds which appear to have been influenced by the trend of the buried topography. They abut with angular unconformity against the Raposa Formation which occurs in a gentle WNW-ESE trending syncline. This direction is a continuation of the general E-W structural trend of the post-Asturian sequence of the Sabero Coalfield. The La Llama Fault, a major structural line west of the River Esla, has been traced into the Fuentes area and is interpreted as continuing into a major fault line affecting older strata east of the presently described area. A complex history has been deduced for this fault line (KNIGHT 1975); its latest movement is as a steeply southwards dipping reverse fault. In the regional context it delimits the relatively undisturbed northern flank of the Sabero Coalfield, showing an open structure, from the complexly folded southern flank with small, tight synclinal structures within fault bounded blocks. The same relationship is also apparent in the Fuentes area where a relatively undisturbed synclinal structure, north of the fault, contrasts with heavily disturbed strata to the south (Fig. 1). The stratigraphic position of the latter has not been verified but is suggested as within the lower part of the Raposa Formation.

A general change in dip and strike is clearly evident in a stream section

300 m SW of Fuentes where a marked unconformity has been found with the Raposa Formation banked up against thick limestone conglomerates of the lower Cantabrian. The irregular contact mapped near Santa Olaja and Fuentes suggests that a considerable topographic relief developed on the lower Cantabrian strata after their folding and uplift. The unconformity is made even more apparent by the thick limestone conglomerates of the post-Leonian succession forming the higher ground, whereas the finer grained Raposa Fm. occurs in the Fuentes valley.

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REFERENCES

EAGAR, R. M. C. & WEIR, J. (1971).–Some Spanish upper Carboniferous non-marine bivalve faunas: a preliminary statement with emphasis on facies in Northwest Spain and in Britain. *Trabajos de Geología, Fac. Ci. Univ. Oviedo*, **3**, pp. 87-98.

HELMIG, H. M. (1965).–The Geology of the Valderrueda, Tejerina, Ocejo and Sabero coal basins (Cantabrian mountains, Spain). *Leidse Geol. Meded.*, **32**, pp. 75-149.

HEWARD, A. P. (1978).–Alluvial fan and lacustrine sediments from the Stephanian A and B (La Magdalena, Ciñera-Matallana and Sabero) coalfields, northern Spain. *Sedimentology*, **25**, pp. 451-488.

KNIGHT, J. A. (1971).–The sequence and stratigraphy of the eastern end of the Sabero coalfield (León, NW Spain). *Trabajos de Geología, Fac. Ci., Univ. Oviedo*, **3**, pp. 193-229.

—— (1974).–The Stephanian A-B flora and stratigraphy of the Sabero coalfield (León, NW Spain). *C.R. 7e Congrès. Carbonifère*. Krefeld, 1971, **111**, pp. 283-315.

—— (1975).–The systematics and stratigraphic aspects of the Stephanian flora of the Sabero coalfield. PhD. Thesis, *Sheffield Univ.* (unpub), pp. 1-676.

—— (in press).–The stratigraphy of the Stephanian Rocks of the Sabero coalfield, León (NW Spain) and an investigation of the fossil flora: Pt. 1. Stratigraphy and general geology. *Palaeontographica* (B).

OELE, E. & MABESOONE, J. M. (1963).–Origin of the Stephanian red beds in the Ocejo basin (Province of León, España). *Leidse Geol. Meded*, **28**, pp. 377-388.

PEPPERS, R. A. & PFEFFERKORN, H. W. (1970).–A comparison of the floras of the Colchester (N.° 2) coal and Francis Creek shale. *Illinois State Geol. Surv.*, Guidebook Series, **8**, pp. 61-74.

WAGNER, R. H. (1957).–Nota sobre la estratigrafía del terreno hullero de Sabero (León). *Estudios Geol. XIII* (**35-36**), pp. 229-239.

——, VILLEGAS, F. J. & FONOLLÁ, F. (1969).–Description of the lower Cantabrian stratotype near Tejerina (León, NW Spain). *C. R. 6e Congrès Carbonifère*, Sheffield, 1967, **1**, pp. 115-138.

—— & WINKLER PRINS, C. F. (1979).–The lower Stephanian of Western Europe. *in* «Palaeontological charateristics of the main subdivisions of the Carboniferous». *C. R. 8e Congrès Carbonifère*, Moscow 1975, **3**, pp. 111-140.

—— & FERNÁNDEZ-GARCÍA, L. (in press).–Late Westphalian D and Cantabrian strata in the Guardo coalfield (NW Spain): Tectonics, Sedimentation, Stratigraphy. *9e Congrès, Carbonifère*, Urbana 1979.

M. Truyols-Massoni (*).–SOBRE LA FAUNA DE DACRIOCONARIDOS DEL GRUPO LA VID (DEVONICO INFERIOR, CORDILLERA CANTABRICA, NO DE ESPAÑA)

El Devónico de la Cordillera Cantábrica se caracteriza por una sucesión enteramente marina de materiales terrígenos y calcáreos con episodios arrecifales y

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