PALYNOLOGICAL EVIDENCE CONCERNING THE AGE OF THE HYNER SHALE AND GURRINGTON SLATE FORMATIONS IN THE NEWTON ABBOT AREA, SOUTH DEVON.

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Palynomorph assemblages obtained from a well-dated horizon in the Hyner Shale Formation (Famennian/Tournaisian), are compared using scanning electron microscopy (SEM), and transmitted light microscopy techniques. The floral lists obtained independently, reveal a high proportion of identifications common to both, but with the larger assemblage coming from the SEM sample. It is suggested that this imbalance is a direct result of the oxidation techniques used to produce translucent images from coalified miospores. This distinctive assemblage was compared with that obtained from an horizon of comparable age, but contrasting fades, developed within the Gurrington Slate Formation. The palynomorph assemblages, from both the Hyner Shale and Gurrington Slate Formations of south Devon confirm a late Famennian or earliest Carboniferous age. The appearance of miospores only previously recorded from the Carboniferous within both formations is consistent with the presence of the Devonian/Carboniferous boundary at this lithostratigraphic level (Selwood *et al.*, 1985). The ostracod and SEM palynomorph biostratigraphies broadly correlate, allowing palynomorph age determinations within the region to be used with greater confidence.

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INTRODUCTION

Progress in the Upper Palaeozoic stratigraphy of south-west England has been hampered by the lack of a site-specific biostratigraphy. Macrofossils, conodonts and ostracods have proven useful but are facies dependent. Extensive areas of the "slate belt" are without effective biostratigraphic control.

This paper forms part of a larger study aimed at the creation of a palynostratigraphy for south-west England. For reasons elaborated by Dean (1989a), conventional palynology reliant upon transmitted light techniques has largely failed, due to the relatively high metamorphic grade of the sediments. To overcome this problem, the coalified palynomorphs recovered have been examined using a SEM. It was therefore necessary to compare the results obtained using both techniques, independently.

Whiteley (1983), recorded a palynomorph assemblage from a well-dated horizon in the middle Teign Valley, within a road cutting at grid reference [SX 8380 8470], using transmitted light techniques. This locality was re-sampled (BS8850), and the organic fraction obtained examined under the SEM.

To test the usefulness of the assemblage obtained, the results were compared with those from a horizon of similar age (Selwood *et al.*, 1985), but contrasting fades, in the Gurrington Slate Formation [SX 7920 7059], the sample (BS8856), being recovered from the base of a small road-side quarry.

Samples for SEM analysis were processed using conventional palynological techniques: Hydrofluoric acid was used to digest the silicates, and zinc bromide to remove the heavy minerals. The resulting organic fractions were variably coalified, and examined using a SEM, as described by Dean (1989a). As SEM specimens cannot be preserved, the images in Plate 1 are held as photographic negatives in the Palaeontological collections of the British Geological Survey, Keyworth, Nottingham.

STRATIGRAPHY

The Hyner Shale Formation crops out north of Newton Abbot, within the Teign Valley succession, (Figure 1). It consists of hard, dark blue or bluish green shales and mudstones. In upward succession it passes conformably into the Trusham Shale. Towards the top of the Hyner Shale Formation a series of calcareous nodule bands and calcareous shales, along with a siltstone horizon, yield a rich fauna of macrofossils and ostracods from the late Famennian *hemisphaerica*-*dichotoma* biozone, (Selwood *et al.*, 1985). This level yields the rich palynomorph assemblage described here.

Cropping out to the west of Newton Abbot, the Gurrington Slate Formation comprises an unknown thickness of purple and green slates.

Figure 1: Regional geology and sample localities.
flanked by grey slates to the north-west and south-east. Faunas are irregularly distributed and often poorly preserved; they are dominated by juvenile bivalves and planktonic ostracods ranging from middle Frasnian to possibly early Tournaisian in age. For comparative purposes a locality was selected which yielded a fauna of comparable age to that of the Teign Valley (Selwood et al., 1985), the sediments here being characteristic representatives of the ostracod slates extensively developed in Famennian times.

**PALYNOLOGY**

**Hyner Shale Formation**

Whiteley (1983) described a microflora from the Hyner Shale Formation that was dominated by the following genera; *Auroraspora*, *Grandispora*, *Punctatisporites*, *Retusotriletes* and *Verrucosisporites*. All were identified in the subsequent SEM study, but not the fragments of large bifurcate spores he described. Whiteley recorded the following taxa; *Auroraspora* sp., *Grandispora* sp., *Punctatisporites irvani* Hacquebard 1957, *Retusotriletes* sp., *Retusotriletes incohatus* Sullivan 1964, *Retusotriletes cf. planus* Dolby and Neves 1970, *Retispora lepidophyta* (Kedo) Playford 1976, *Verrucosisporites* sp., *Verrucosisporites nitidus* (Naumova) Playford 1964.

SEM analysis, undertaken during the present study, also noted *Retusotriletes incohatus* and *Verrucosisporites nitidus*. In addition other forms given only generic status by Whiteley could be more accurately identified by SEM analysis, these being; *Auroraspora macro* Sullivan 1968 and *Grandispora cf. cornuta* Higgs 1975.


Of the taxa identified to specific level only *Auroraspora macrua*, with a first occurrence in the late Frasnian, and *Grandispora cf. cornuta*, reported from the middle Famennian, are known from rocks older than late Famennian.

Three taxa have previously been reported only from the Carboniferous, one of these, *Auroraspora corporinga*, is potentially significant in that it is previously recorded only from the Tournaisian of Ireland. The others, *Punctatisporites springarescens*, and *Punctatisporites obliquus*, are of less significance, the former being previously reported only from Australia, and the latter widely believed to be a compressional artefact.

**Gurrington Slate Formation**

This assemblage is dominated by miospores, including the long ranging taxa, *Leiotritelles simplex* Naumova 1953 and *Retusotriletes cf. pychovii* Naumova 1953. As with the Hyner Shale sample, the majority of miospores recorded are known from previous studies to range from the middle to late Famennian into the early Tournaisian. Those with a first occurrence in the middle Famennian are: *Auroraspora solisortus* Hoffmeister, Staplin and Malloy 1955, and *Grandispora cf. cornuta*. Taxa with a first occurrence in the late Famennian are more abundant, they are; *Leiotritelles sp. A* Higgins, Clayton and Keegan 1988, *Retusotriletes incohatus*, *Microreticulatisporites araneum*, *Auroraspora asperella* (Kedo) Van Der Zwan 1980, and *Cristatisporites menendezii* (Menendez and Azeyu) Playford 1978.

Additionally the Gurrington Slate assemblage also contains representatives of *Punctatisporites ferquisensis* Tauquouerade-Lantz 1960, which is restricted to the late Devonian, and the following taxa that are more characteristic of the Carboniferous; *Punctatisporites obliquus*, *P. springarescens*, and *Raistrickia cf. corynoges* Sullivan 1968.

Miospores recorded to generic level only in the assemblage include; *Densosporites* sp., *Dictyotritelles* sp., *Hymenozonotriletes* sp., *Leiotritelles* sp., and *Velamisporites* sp.

The only element of the marine taxa identified to specific level is the late Frasnian to late Famennian acritarch *Gorgonisphaeridium elongatum* Wicander 1974.

As with the Hyner Shale sample, much of the spore content could equally be of late Famennian or early Carboniferous age. Such elements would be consistent with a position close to the Devonian/Carboniferous boundary, known to occur within the Gurrington Slate Formation, (Selwood et al., 1985). There is only sufficient miospore data to indicate an age of probable late Famennian to early Tournaisian age. The ostracod and macrofossil evidence is more precise, placing the horizon within the *hemisphaerica dichotoma* biozone of the late Famennian.

Though definitive zonal taxa are largely absent, an association, particularly with the assemblages from Ireland, can be recognized. The following miospore taxa were all recovered in this study and are all typical of the late Famennian/Tournaisian assemblage by Higgs et al. (1988), and of some of previous zonal schemes, (Clayton et al., 1977, Steel et al., 1987); *Auroraspora asperella*, *Auroraspora solisortus*, *Corbulispora cancellata*, *Cristatisporites menendezii*, *Grandispora cf. cornuta*, *Microreticulatisporites araneum*, *Retusotriletes incohatus*, and *Verrucosisporites nitidus*. The presence of *Retispora lepidophyta sensu stricto*, the zonal taxon for north-west Europe, was not confirmed by the SEM analysis in the Hyner Shale; interestingly this taxon is also absent in much of south Devon and north Cornwall (Dean, 1991).
CONCLUSIONS
The SEM study of palynomorphs from the Hyner Shale Formation confirms that it is possible to identify both spores and acritarchs without relying solely upon conventional transmitted light techniques. However, SEM analysis will not stand as a fully established taxonomic technique, until detailed taxonomic descriptions are published, (Dean, in prep.). The assemblages from the Hyner Shale and Gurrington Slate Formations are similar in broad terms, but not identical. To a degree, the presence of palynomorphs appears independent of facies.

The greater variety and size of the assemblage examined by SEM microscopy may be indicative of the extreme oxidation techniques employed in the original research (Whiteley, 1983), or it may be a result of sampling slightly lower in the Hyner Shale section. Suggested by the absence of Retispora lepidophyta. The level of preservation appears considerably better in the SEM (non oxidised) sample.

The palynological data indicates a late Famennian - early Tournaisian age for both localities, supporting the previous stratigraphic information in Selwood et al. (1985). The marine environment of deposition is confirmed; though the small proportion of marine species contrasts with the assemblage described by Dean (1989b), from the marine, basinal grey slates of east Cornwall.

The ostracod and palynomorph assemblages are proven, at this stratigraphic level, to produce similar, relatively compatible age determinations. The absence of appropriate palynomorph zonal taxa makes reference to established zonal schemes difficult, however, a number of associated stratigraphically useful miospores do occur and certain similarities can be seen, particularly with the succession in Ireland, Higgs et al. (1988).

The SEM study produced as much information, with the exception of the important Retispora lepidophyta (Kedo) Playford 1976, as the previous transmitted light study, and allowed, in some cases more accurate identifications to be made. More importantly it was possible to attempt an age determination without recourse to transmitted light microscopy.

The presence of a similar assemblage to that from the Hyner Shale, within a different facies, provides a useful test for the SEM technique within the Palaeozoic ‘slate belt’.

It is hoped that when combined with data from south-Devon and north Cornwall, described by Dean, (1991), and with work continuing in north Cornwall, it may eventually he possible to erect regional assemblage zones, or at the very least, characteristic associations, ranging from the Emsian into the early Carboniferous (Dean, in prep.).

REFERENCES


