

Chapter 7

South Midlands and Kent

C. N. WATERS, N. S. JONES & B. M. BESLY

Carboniferous rocks within this area extend south from the exposed Warwickshire Coalfield (see Chapter 9), limited to the laterally contiguous concealed coalfields of Oxfordshire and Berkshire and the isolated Kent Coalfield. The oldest Tournaisian and Visean strata occur at subcrop within the Berkshire and Kent coalfields and include condensed ramp carbonate successions (Avon and Pembroke Limestone groups). Little is known of the stratigraphical and geographical extent of these deposits outside of these coalfields. Namurian strata have not been proved in any of the boreholes within the region. Westphalian strata are proved in all three coalfields, with progressively younger successions onlapping toward the north-west onto the southern flank of the Wales-Brabant High. Pre-Asturian fluvio-lacustrine deposits (South Wales Coal Measures Group) are present in the Berkshire and Kent coalfields, but are restricted to isolated inliers beneath Asturian strata in the Oxfordshire Coalfield. A Westphalian to Stephanian succession of alluvial Pennant facies (Warwickshire Group) occurs within all three coalfields. The lithostratigraphical nomenclature is that of Waters *et al.* (2009).

Tournaisian

Tournaisian strata are limited to the Aston Tirrold Borehole [SU 5579 8722] of the Berkshire Coalfield and the Kent Coalfield. The strata are attributed to the Avon Group, proved at outcrop in South Wales (Chapter 5) and Bristol, Mendips and Monmouth areas (Chapter 6).

The Aston Tirrold Borehole (Fig. 7.2, Col. 3) includes grey, argillaceous, bioclastic, thinly bedded limestone, interbedded with grey silty mudstone, with miospore assemblages displaying components of the CM or PC Biozones ^{*1} (Foster *et al.* 1989).

Tournaisian strata have been recorded in two boreholes in Kent (Fig. 7.2, Col. 5), comprising dark grey crinoidal or ooidal limestone interbedded with dark grey shale (Smart *et al.* 1966; Mitchell 1981b), interpreted as equivalent to the Avon Group of South Wales and Bristol regions (Chapters 5 & 6). The Harmansole Borehole [TR 1415 5289] proved limestone of early Tournaisian age, including the diagnostic brachiopod *Eumetria* sp. ^{*1}, resting upon strata of Old Red Sandstone facies, believed to be of Devonian age (Smart *et al.* 1966; Mitchell 1981b). The Trapham Borehole [TR 2340 5710] proved a crinoidal limestone and dark grey mudstone succession with late Tournaisian coral and spiriferid fauna ^{*2} (Smart *et al.* 1966; Mitchell 1981b).

Visean

Visean strata, assigned to the Pembroke Limestone Group, are restricted to a Holkerian succession proved in the southern part of the Berkshire Coalfield and the Kent Coalfield. The Foudry Bridge Borehole [SU 7063 6602] (Fig. 7.2, Col. 4) recorded a succession of bioclastic limestone interbedded with thin calcareous mudstones to the base of the borehole. The presence of *Siphonodendron martini* suggests a Holkerian age for the carbonates ^{*1} (Mitchell, in Foster *et al.* 1989). Pale grey ooidal, or dark grey bituminous limestone, interbedded with black shale have been recorded in 14 boreholes in the Kent Coalfield (Fig. 7.2, Col. 5). Diagnostic

fauna include the brachiopods *Davidsonina carbonaria* and *Linoprotonia corrugatohemispherica*^{*3} attributed to the Holkerian Regional Substage (Mitchell 1981b).

Westphalian

During the Langsettian to early Bolsovian, the grey, mudstone-dominated fluvio-lacustrine deposits of the South Wales Coal Measures Group were deposited across the Berkshire and Kent coalfields.

In the Berkshire Coalfield the Foudry Bridge Borehole (Fig. 7.2, Col. 4; Fig. 7.3: Berkshire Coalfield (south)) shows a succession of siltstone and mudstone with coals, seatearths and thin sandstones and a marine band that yielded a fauna including *Lingula mytilloides* and foraminifers including *Ammodiscus* considered to indicate a late Langsettian age^{O^2} (Calver, in Foster *et al.* 1989). Higher in the succession, the miospores *Dictyotriletes bireticulatus*, *Densosporites* spp. and *Laevigatosporites* spp. suggest the strata range from the base of the *Carbonicola communis* Biozone to the top of the Duckmantian Regional Substage^{^3}. The absence of the Vanderbeckei Marine Band precludes subdivision of the South Wales Coal Measures Group into the South Wales Lower and Middle Coal Measures formations.

The Aston Tirrold Borehole (Fig. 7.2, Col. 3; Fig. 7.3: Berkshire Coalfield (north)) includes a succession of basic volcanic rocks (olivine basalt and dolerite) intruded by dolerite sills. This Aston Tirrold Volcanic Formation includes sedimentary intercalations and a coal seam near the base, which include palynomorphs indicative of the SS Miospore Zone^{^2} (early Langsettian) (Foster *et al.* 1989).

In the Kent Coalfield (Fig. 7.2, Col. 5; Fig. 7.3) sandstones are rare and generally thin and coals show markedly variable thicknesses and seam splitting. The Subcrenatum Marine Band is not recognised in the Kent Coalfield, nor have non-marine bivalves of the Lenisulcata Chronozone been recorded (Stubblefield & Trueman 1946). The South Wales Lower Coal Measures Formation includes the Kent No. 12 to 14 seams and is associated with non-marine bivalves of the Communis Chronozone^{~3}. The lowermost marine band proved, the Vanderbeckei (Ripple) Marine Band⁺⁴ is up to 8.8 m thick and represents the most diverse fauna recorded from this interval in Britain (Bisson *et al.* 1967). Above the marine band, non-marine bivalves of the Modiolaris Chronozone are recorded within the basal part of the South Wales Middle Coal Measures Formation^{~5}, with the base of the Lower Similis-pulchra Chronozone taken at the base of the Kent No. 11 Seam (Bisson *et al.* 1967). The Haughton (Snowdown) Marine Band includes *Lingula mytilloides*, recorded about 14 m below the Aegiranum (Lower Tilmanstone) Marine Band⁺⁶ (Stubblefield & Trueman 1946; Bisson *et al.* 1967). Two marine bands with *Lingula mytilloides*, separated by about 30 m of strata, occur below the Kent No. 6 Seam. They are interpreted as the local representatives of the Cambriense (Upper Tilmanstone) Marine Band (Bisson *et al.* 1967). The South Wales Upper Coal Measures Formation, the base of which is taken at the top of this marine band, is devoid of marine bands and includes strata of the non-marine bivalve Phillipsii Chronozone, with the top of the formation taken at the top of the Kent No. 6 Seam.

In the Oxfordshire Coalfield and the adjacent sub-Triassic extension of the Warwickshire Coalfield, a southward continuation of the Langsettian to Bolsoviaan succession of the exposed Warwickshire Coalfield is present as far south as the Moreton Morrell Borehole [SP 3077 5364]. To the south of this, thin and condensed sections of the same age are locally present in synclinal inliers beneath Asturian strata. To the southeast of Banbury, a succession of Langsettian to Bolsoviaan age, never exceeding 40m in thickness, is proved in a number of boreholes. A Duckmantian marine band (either *Vanderbeckei* or *Maltby*) has been recognised in Twyford Lane Borehole [SP 4805 3701], and the Aegiranum Marine Band has been recognised in Hollies Barn Borehole [SP 4186 3434], where the upper part of the preserved Bolsoviaan consists of basalt. A similar sub-Asturian inlier is present to the south in the area of the Northbrook [SP 4994 2246] and Vicarage Farm [SP 4918 1868] boreholes.

An Asturian (Westphalian D) succession dominated by multi-storey fluvial channel sandstones, the Pennant Sandstone Formation, has been proved in boreholes in the northern part of the Berkshire Coalfield and the Oxfordshire and Kent coalfields (Fig. 7.3). This succession, corresponding to the 'Arenaceous Coal Group' of early descriptions of the Oxfordshire Coalfield (Poole 1969), thins markedly northwards by basal onlap, and is not present in the exposed Warwickshire Coalfield. The sandstones are characterised by a distinctive metasediment-dominated litharenitic composition.

Non-marine bivalves found within argillaceous successions present in the Pennant Sandstone Formation in the Burnt Hill [SU 5720 7380] and Welford Park Station [SU 4069 7351] boreholes of the Berkshire Coalfield indicate a Tenuis Chronozone (Asturian) age (Foster *et al.* 1989). The association of the palynomorphs *Thymospora obscura* and *Punctatosporites granifer* from coal seams within the formation in the Aston Tirrold (Fig. 7.2, Col. 3), Maddie Farm [SU 3053 1823], Welford Park Station and Burnt Hill boreholes confirms the Asturian age ^{^3}, although in the last borehole the lowermost beds include miospores indicative of a late Bolsoviaan age (Foster *et al.* 1989). In the Oxfordshire Coalfield, the Apley Barn Borehole (Fig. 7.2, Col. 2) includes non-marine bivalves indicative of the Tenuis Chronozone (Chaloner, in Poole 1969) and the presence of the macroflora *Lobatopteris vestita*, of the *Dicksonites plueckenetii* Subzone (Cleal 1997), confirming an Asturian age ^{~1}.

Above the Pennant Sandstone Formation the succession in the north Berkshire and Oxfordshire coalfields is dominated by predominantly argillaceous floodplain sediments, the Grovesend Formation (former Suprapennant Formation), with alternation of coal-bearing grey measures and barren red measures used to define component members. Of these, only the lowermost Witney Coal Member includes macroflora indicative of an Asturian age, the base of the Stephanian Regional Stage probably occurring in the upper part of the member (Cleal 1997). Correlation of coal seam groups by Smith (1987) suggests that the Witney Coal Member and Burford Coal Members are the equivalents of the Milton Coals and Broughton Coals respectively of South Warwickshire. The lower part of the Grovesend Formation is thus the equivalent of the Halesowen Formation in the exposed Warwickshire Coalfield. These coal-bearing units are associated with litharenitic sandstones similar to those in the underlying Pennant Sandstone Formation.

In the Kent Coalfield (Fig. 7.2, Col. 5; Fig. 7.3) measures above the Kent No. 6 Seam include *Anthraconaia pruvosti*, of probable Tenuis Chronozone ⁻⁶ (Bisson *et al.* 1967). This suggests the absence of strata equivalent to the Upper Similis-pulchra and Phillipsii chronozones (Stubblefield & Trueman 1946).

Stephanian

Strata of Stephanian age are known only from the Grovesend Formation of the Oxfordshire Coalfield (Fig. 7.2, Col. 2; Fig. 7.3). The determination of *Odontopteris brardii* from the Burford Coal Member and *Sphenophyllum oblongifolium* from the overlying Windrush Member indicate that the upper part of the formation include macroflora assigned to the *Odontopteris cantabrica* Zone ⁻² (Cleal 1997), the base of which is coincident with the base of the Cantabrian Substage. This contrasts with palynological evidence, which indicates that the Withycombe Farm [SP 4319 4017] (Fig. 7.2, Col. 1) and Apley Barn (Fig. 7.2, Col. 2) boreholes comprise strata of the proposed miopores zones XI, XII and XIII (Smith 1987), broadly equating to the Asturian. The upper part of the Grovesend Formation in Oxfordshire comprises an alluvial red-bed succession which is poorly documented in boreholes to the west of Banbury and in the Chipping Norton area. Both borehole geophysical and seismic data suggest that this succession is the lateral equivalent of the Salop Formation of the exposed coalfields in the West Midlands, but detailed correlations are not available.

Figures

Fig. 7.1. Geological map showing the distribution of Westphalian to Stephanian subcrop of the south Midlands and Kent, adapted from BGS (1999).

Fig. 7.2. Correlation of Carboniferous successions in the south Midlands and Kent. The nomenclature is that of Waters *et al.* (2007; 2009), with details from the following publications: Col. 1 from (Dunham & Poole 1974); Col. 2 from Poole (1969); Col. 3 from Foster *et al.* (1989); Col. 4 from Foster *et al.* (1989); Col. 5 from Mitchell (1981) and Bisson *et al.* (1967).

Fig. 7.3. Correlation of Westphalian successions in the Oxfordshire, Berkshire and Kent coalfields. The nomenclature is that of Waters *et al.* (2007; 2009), with details modified from Poole (1969) and Smith (1987) for the Oxfordshire Coalfield, Foster *et al.* (1989) for the Berkshire Coalfield and Bisson *et al.* (1967) for the Kent Coalfield.





