Invertiel Quarry, Fife

[NT 272 898]

Introduction

The Invertiel Quarry GCR site is a disused quarry [NT 272 898], which lies just within the burgh boundary of Kirkcaldy and about 4 km from the town centre. It is one of the premier palaeontological sites in Britain and an internationally significant site for Brigantian (Lower Carboniferous) crinoids. The quarry has been described by Geikie (1900) and Wright (1912, 1914b, 1920).

Description

The site provides a highly fossiliferous section through part of the Lower Limestone Formation (upper Brigantian). At the base, an 8 m-thick sequence of light-grey, bedded limestone (the Charlestown Main Limestone) is overlain by a complex of lenticular limestones, argillaceous limestones and mudrocks, up to 10 m thick

(Figure 2.16). This in turn is sharply overlain by a thick cross-bedded sandstone (10 m) with plant fragments, which was also worked as a source of stone (Allen and Knox, 1934). Within the lenticular units immediately above the limestone, Wright (1912) distinguished three argillaceous units, which he labelled in ascending sequence as beds 1, 2 and 3. Other units within the complex were not, however, separately designated.

Bed 1 (1 m), which lay immediately above the Charlestown Main Limestone, has revealed the most diverse fauna including foraminifera, sponges, zaphrentid corals, *Heterophyllia,* ostracodes, productoid and other brachiopods, fenestellid bryozoans, bivalves (*Sanguinolites, Cypricardella*), gastropods (*Pseudozygopleura*), orthoconic and cyrtoconic cephalopods, *Archaeocidaris* and abundant crinoid remains (Wright, 1912). The principal crinoids were *Platycrinites* spp., *Parazeacrinites konincki, Phanocrinus calyx* and *Ureocrinus bockshii.* Bed 1 is capped by 0.75 m of crinoidal limestone. The dark calcareous shales with interbedded carbonate lenticles and nodules (6 m), which make up Bed 2, contain a fauna similar to that of Bed 1, although this diminishes in abundance as the bed is traced southwards within the quarry (Wright, 1912). A lenticular limestone (0.2–0.7 m) separated Bed 2 from Bed 3. This dark mudrock (1 m) contains a varied fauna in which crinoids are less abundant. However, in contrast to beds 1 and 2 from which only cups were recorded, rare examples of complete crowns were recorded from Bed 3 (Wright, 1912). The site has been used for landfill and only the top of the Charlestown Main Limestone, parts of the overlying mudrock and limestone complex, and the basal parts of the sandstone can now be seen within the site boundary.

Interpretation

The principal interest in the Invertiel Quarry GCR site lies in the complex of beds 1, 2 and 3 (Wright, 1912). However, the relationship of these beds to the underlying limestone and to the overlying sandstone are also important and places them within a stratigraphical and palaeoenvironmental context. The Charlestown Main Limestone is the principal limestone in the middle of the Lower Limestone Formation of West Fife (Allen and Knox, 1934) and is the local equivalent of the Blackhall Limestone of the Glasgow area (upper Brigantian, P_2; see (Figure 1.4), Chapter 1, and (Figure 2.4)). The sandstone is the equivalent of the Seafield Tower Sandstone, which is well displayed in the Kinghorn Coast GCR site (Allen and Knox, 1934).

The character and fauna of the beds between the Charlestown Main Limestone and the sandstone indicates that they represent parts of small bank features similar to those described from the Dunbar area (Whyte, 1973). These banks, which are unique to the beds above the Charlestown Main Limestone and equivalent limestones in eastern Scotland, are typified by being argillaceous accumulations with a high bioclastic content and a diverse fauna among which crinoids are usually prominent. They contrast with the carbonate banks also found within the Charlestown Main Limestone at localities such as Roscobie Quarry (see GCR site report, this chapter). The crinoid fauna of Invertiel Quarry, and particularly from beds 1, 2 and 3, was studied assiduously by Wright over a period of more than 40 years; as well as producing a large number of papers, the taxonomic results of his studies were included within his two major monographs (Wright, 1939, 1950–1960).

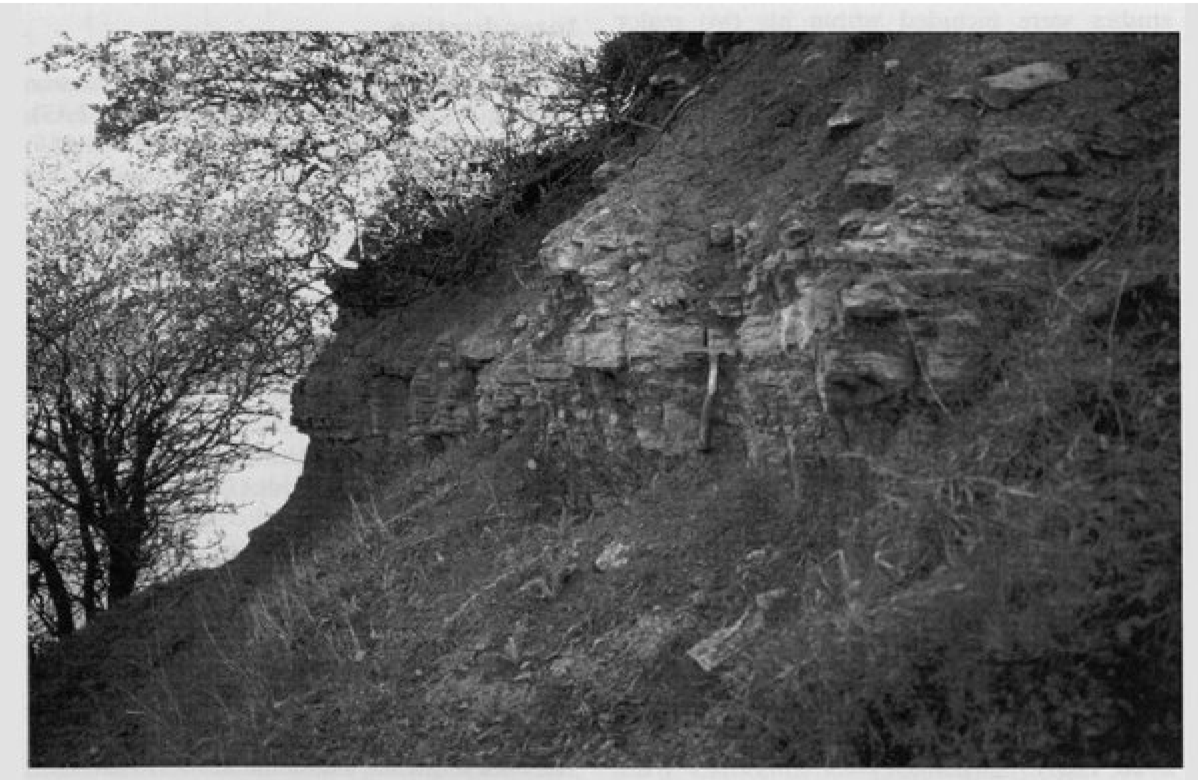
Some 39 species of crinoids, equivalent to half the total number of crinoid species known from the Scottish Carboniferous succession, have been recorded from Invertiel Quarry. For 25 of these species the type material comes from, or includes specimens from, Invertiel Quarry and for a further five species specimens from Invertiel were figured by Wright (1950–1960). The fauna, which Includes 26 species of inadunate crinoids, seven species of flexible crinoids and six species of camerate crinoids, shows rheophobic tendencies and completely lacks rheophilic camerates of the type that occur in the Clitheroe 'knoll reef' crinoid assemblages (see Chapter 6). Although most of Wright's work was essentially taxonomic in character, his studies of variation in the anal (CD) plate inter-ray of *Parazeacrtnites, Ureocrinous* and *Phanocrinus,* which were in large part based on his large collections from Invertiel Quarry, were innovative and demonstrate his understanding of evolution and the species concept (Wright, 1926, 1927).

The non-crinoid fauna of the 'Beds' is also diverse (Geikie, 1900; Reed, 1943, 1954) and includes foraminifera, sponges, tabulate and both solitary and compound rugose corals, annelid tubes, ostracodes, trilobites, bryozoans, brachiopods, bivalves, gastropods, coiled and orthoconic cephalopods, blastoids, cchinoids and a variety of fish teeth. Brachiopods and trilobites from Invertiel have been described and figured by Reed (1943, 1954) and Osmolska (1970).

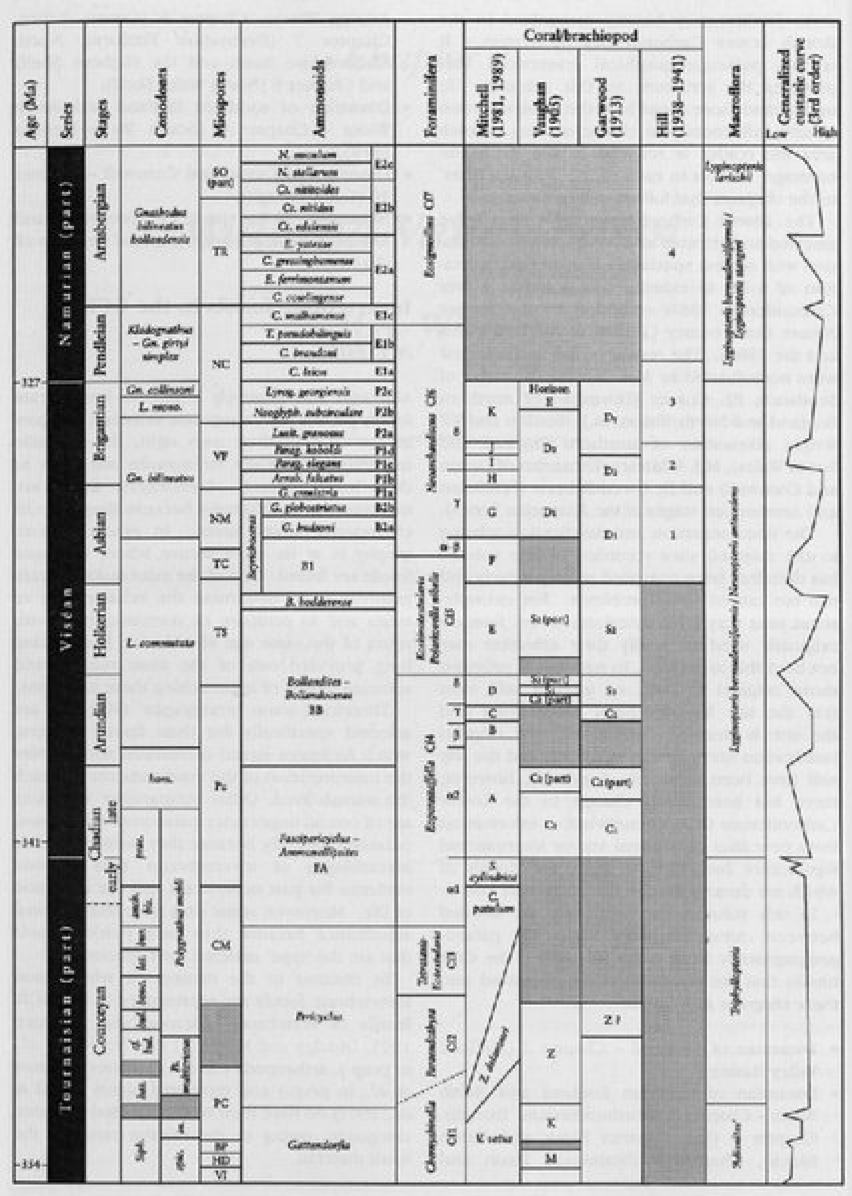
Conclusions

The Invertiel Quarry GCR site exhibits a thick development of the Lower Carboniferous Charlestown Main Limestone (Lower Limestone Formation, upper Brigantian). The fauna of the overlying shales and limestones is extremely diverse, including corals, brachiopods, sponges, molluscs, bryozoans and echinoderms. The site is particularly noted for its crinoids and has yielded type and figured specimens for a large number of crinoid species.

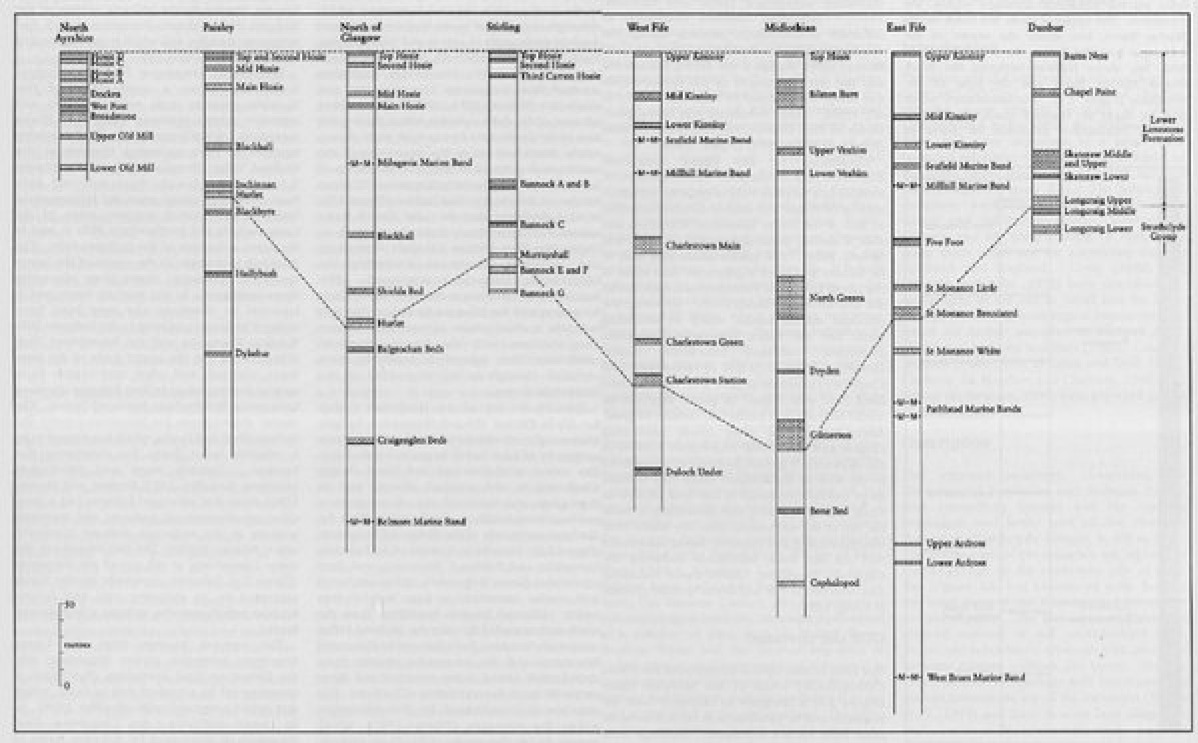
References



(Figure 2.16) Exposure of the Charlestown Main Limestone (Lower Limestone Formation, Upper Brigantian) at the Invertiel Quarry GCR site. (Photo: C. MacFadyen.)



(Figure 1.4) Chronostratigraphical and biostratigraphical classification schemes for the Lower Carboniferous Subsystem. After Riley (1993, fig. 1) with additional information for the Pendleian and Arnsbergian stages supplied by the same author. Absolute age data from Guion et al. (2000) based mainly on information by Lippolt et al. (1984), Hess and Lippolt (1986), Leeder and McMahon (1988) and Claoue-Long et al. (1995). Ammonoid abbreviations used in this figure: N. — Nuculoceras; Ct. — Cravenoceratoides; E. — Eumorphoceras; C. — Cravenoceras; T. — Tumulites; Lyrog. — Lyrogoniatites; Neoglyph. — Neoglyphioceras; Lusit. — Lusitanoceras; Parag. — Paraglyphioceras; Arnsb. — Arnsbergites; G. — Goniatites; B. — Bollandoceras. Conodont abbreviations used: Gn. — Gnathodus; Gn. collinsoni — Gnathodus girtyi collinsoni; L. mono. — Lochriea mononodosa; L. — Lochriea; horn. — Gnathodus homopunctatus; prae. — Mestognathus praebeckmanni; and,. — Scaliognathus anchoralis; bis. — Polygnathus bischoffi; bur. — Eotaphrus burlingtonensis; lat. — Doliognathus latus; bout. — Dollymae. bouckaerti; bul. — Eotaphrus bultyncki; has. — Dollymae bassi; siph. — Siphonodella; Ps. — Pseudopolygnathus; in. — Polygnathus inornatus; spit. — Polygnathus spicatus. Stipple ornament shows interzones (conodonts and miospores) or non-sequences (brachiopods).



(Figure 2.4) Correlation of the principal marine horizons in the Brigantian Lower Limestone Formation and uppermost part of the Strathclyde Group in the Midland Valley from North Ayrshire to Dunbar. Note that most of the named units figured here are, unless otherwise stated, limestones (names abbreviated). Based on various sources and including information from George et al. (1976), Cameron and Stephenson (1985), Wilson (1989) and Francis (1991).