
Rockhall Wood, Sutton, Suffolk

[TM 304 440]

Highlights

The sequence at Rockhall Wood is the best known and most important vertical sequence of the Coralline Crag available for study. It has formed the major source for type specimens for monographs of many taxonomic groups. It is the only Coralline Crag site ever known to have been commercially exploited for phosphorite. In recent years it has provided material for studies of microfauna and microflora which have attempted to place the Coralline Crag in the context of Neogene standard stratigraphy.

Introduction

The small quarries lying around Rockhall Wood, Sutton (= Sutton Knoll of the literature) which together constitute this site (Figure 10.8) have been studied by geologists since at least 1835. Fossils from the Crag of 'Sutton' are recorded by William Smith (1817).

This outlying body of Coralline Crag, which is responsible for the slight topographical rise, is approximately 12 m thick and was first described by Charles Lyell (1839). These exposures later featured prominently in the subdivision of the Coralline Crag into 'zones' by Prestwich (1871a). Quarries in the uppermost aragonite-leached sediments provided blocks of cemented Crag for use in local building. Farm buildings incorporating Coralline Crag blocks can be seen at nearby Pettistree Hall to the north of the site. The woodland on top of the hill, from which the site takes its name, was largely destroyed by gales in 1987.

The site is also known for the discovery of controversial human 'artefacts' including a flint flake and bone implements from the base of both the Coralline and Red Crag (Lankester, 1912; Moir, 1915a,b) and therefore played a part in the debate over 'Pliocene Man' during the first half of the 20th century.

The famous 'bullockyard pit' (i.e. pit D of Prestwich, 1871a) on the east side of the hill is now overgrown and the section mostly obscured. Lyell recognised buried cliff lines in this pit, with the Red Crag being juxtaposed against vertical and overhanging 'cliffs' of Coralline Crag. This pit yielded a huge fauna of molluscs, bryozoans and other marine invertebrates and is the source of many of the type specimens illustrated in Wood's classic monograph of Crag Mollusca (Wood, 1848–1882). Carter (1951) based an important study on foraminiferid faunas from this locality.

In one of the most significant early geological works, Charles Lyell in his *Principles of Geology* (Lyell, 1830–1833) set out his concept of dividing the Tertiary into Eocene, Miocene and Pliocene periods on the basis of the proportion of living to extinct mollusc species. He had by this time already visited some Crag sites such as Walton-on-the-Naze. In the fourth edition of *Principles of Geology* (1835), Lyell suggested that the Red and Coralline Crag might have been laid down during the same geological period but in different parts of the basin, based on the fact that over 150 species of mollusc were common to both formations. In this suggestion he differed publicly with Charlesworth who had been the first to subdivide the crag formation (Charlesworth, 1835). In 1838, Lyell visited the sections at Rockhall Wood. His observations made him change his mind, as there was clear evidence that the Red Crag was significantly younger than the Coralline Crag. His change of heart cast doubts on the validity of his idea of using quantitative measures of mollusc species to determine geological age and therefore the site at Rockhall Wood was influential in the development of early Tertiary stratigraphical concepts.

Under the general name of 'Sutton', Rockhall Wood has figured prominently in almost every monograph concerning the Coralline Crag fauna. This locality has remained one of the most important and popular sites for study of the Coralline Crag ever since. The site is also important for former exposures of Red Crag.

Description

A maximum of just under 12 m of Coralline Crag is preserved overlying an undulose surface of London Clay, but only the uppermost 5 m are exposed (Figure 10.9). A borehole at [TM 3046 4396] contained 10.7 m of Coralline Crag, with the top of the London Clay at +7.3 m OD (Hollyer and Allender, 1982). The Red Crag surrounds the hill (Figure 10.8) and rests either directly upon the London Clay or upon, or against, the Coralline Crag.

The best existing exposures of the Coralline Crag are on the north side of the hill. There are presently three exposures (Figure 10.8) but only one of these was shown on the map produced by Prestwich in 1871 (pit F; (Figure 10.8)). This disused quarry has existed since at least 1836 when it was worked for material for a river wall (Prestwich, 1871a). The surface of the underlying London Clay is approximately 6 m below the quarry floor. Bioturbated bioclastic sands (Ramsholt Member) lacking any well-defined sedimentary structures, are exposed at the base of the pit face and are overlain by trough cross-bedded sediments (Sudbourne Member) (Figure 10.10), (Figure 10.11). Carbonate from the dissolution of aragonitic skeletal material in the upper part of the sequence has been redistributed to cement the Crag into a porous limestone sufficiently indurated to be used locally for building. The lower limit of leached sediments is roughly equivalent to the lower limit of well-defined trough cross-bedding and is slightly above the lower boundary of the Sudbourne Member. A second type of sparry calcite cement is found in irregular lithified patches within unleached sediments of the Ramsholt Member. This cement is believed to have formed under subaerial conditions (Balson, 1983).

The famous tullockyard pit' (pit D of Prestwich) is now overgrown and obscured. The Coralline Crag in this pit formerly yielded an abundant molluscan fauna to early collectors like Lyell, Wood and Prestwich. This pit yielded almost every known species of Coralline Crag mollusc to the researches of Wood and his son (Wood, 1848–1882). Lyell (1839) recognised the existence of a buried cliff line in this pit, the Red Crag being juxtaposed to vertical and overhanging 'cliffs' of Coralline Crag. He also observed that the Coralline Crag had been bored by pholad bivalves indicating that lithification had occurred before deposition of the Red Crag.

After further excavation, Prestwich (1871b) was able to examine a better section of the contact that showed two notches which were interpreted as 'shorelines' separated by an elevation of about 3 m. Boulders of Coralline Crag encrusted with barnacles were found within the Red Crag, indicating that they fell from the cliff during deposition of the Red Crag. Abundant *Mytilus edulis*, many articulated, were found in the Red Crag, confirming shallow littoral conditions and the presence of hard substrates.

The junction between the Coralline Crag and the underlying London Clay was also formerly exposed at Rockhall Wood. The exact location of the former pit is shown by Prestwich (1871a) as pit 'H' a few hundred metres to the south-west of the bullockyard pit (Figure 10.8). This pit was excavated in 1860 and formerly showed over 7 m of Coralline Crag resting unconformably on the London Clay. At the base of the Coralline Crag the phosphorite deposit was exposed and was briefly exploited before the pit was infilled. The basal conglomerate yielded numerous fossil crustaceans derived from the London Clay, phosphatized bones and 'boxstones' (Prestwich, 1871a). Prestwich also recorded 'a rounded boulder of dark-red porphyry... weighing about a quarter of a ton', which he believed to have been transported into the area by ice (Prestwich, 1871a).

To the west of the hill an overgrown pit (Pit G of Prestwich, 1871a) previously showed a section (Prestwich, 1871b, fig. 23) of Red Crag containing abundant boulders and fragments of lithified Coralline Crag, the largest weighing up to 'more than a ton'. This pit was apparently already obscured by 1890 (Reid, 1890). A temporary excavation into the floor of this pit in 1989 showed the basal contact of the Red Crag with the London Clay, with the basal Red Crag sediments containing abundant phosphatic pebbles (Figure 10.12). Large blocks of cemented Coralline Crag, often encrusted with barnacles, are contained within Red Crag sediments showing that cementation predated deposition of the Red Crag.

The unleached Coralline Crag sediments at this site contain large numbers of well-preserved small aragonitic molluscs (see Balson and Long, 1988) dominated by bivalves (c. 82% of all individuals). The most abundant are the infaunal *Spisula subtruncata triangulata*, *Timoclea ovata*, *Corbula gibba*, *Limopsis anomala coxi*, *Pteromeris corbis*, *Goodallia triangularis*, and the epifaunal *Padodesmus squamula*, and *Modiolus* sp. Gastropods are mainly represented by *Haustator incrassata*, *Epitonium clatratulum minutum*, *Margarites trochoideus*, *Caecum mammillatum*, *Gibbula obconica*

and *Emarginula fissura* but are often less well-preserved than the bivalves. The very diverse assemblage represents a size-sorted, transported mixture from a variety of sub-littoral habitats. Bryozoan fragments are common throughout the sections and are least abraded in the lower energy facies of the Ramsholt Member. Large fragments of *Metrarabdotos monilifera* are particularly common. Carter (1951) attempted to distinguish between indigenous and transported assemblages of foraminifera, concluding that *Planorbulina mediterranensis* and *Cibicides lobatulus* were indigenous whilst most other species were transported. Common ostracods include *Aurila convexa*, *Murrayina lacunosa* and *Quadracythere macropora*, and this is the type site for *Schizocythere pliocenica* (Wilkinson, 1980).

The Neogene sequence at Rockhall Wood commences with a conglomeratic bed of remanié material containing vertebrates and sandstone concretions ('boxstones') which are derived from a fauna of possible earliest Pliocene age (Balson, 1990a) over which the Coralline Crag Sea transgressed. Deposition of silty carbonate sands with a rich benthic fauna followed. Strong tidal currents later became established which swept quantities of coarse skeletal material into the area. These were deposited by migrating sandwaves which produced the trough cross-stratification seen in the quarry faces. Later erosion, either prior to or during the Red Crag transgression, left a small elliptical remnant of Coralline Crag sitting unconformably on the London Clay.

The Red Crag transgression formed cliffs in the consolidated Coralline Crag which were later buried by Red Crag deposits which incorporated blocks of lithified sediment and fossils from the earlier deposit.

The silty sands of the Ramsholt Member are extensively bioturbated and lack the well-defined cross-bedding of the overlying Sudbourne Member, indicating that the sedimentation rate was relatively slow with relatively weak bottom currents. A minimum water depth of 50 m was suggested by Hodgson and Funnell (1987). Jenkins and Houghton (1987) suggest a well-developed thermocline and a temperature range of 10–18°C. They attribute the low species diversity of planktonic foraminifera as either due to poor preservation in these relatively shallow water deposits or due to a remote connection with the Atlantic Ocean around the north of Scotland. Raffi *et al.* (1985) suggest temperatures of 20°C for at least three or four months of the year during Coralline Crag deposition, based on the mollusc fauna.

The boundary between the Ramsholt Member and the Sudbourne Member of the Coralline Crag appears unconformable with occasional vertical burrows penetrating downwards from the plane of unconformity (Figure 10.13). The unconformity corresponds with the boundary between Prestwich's 'zones' 'e' and 'f'. The Sudbourne Member represents a change in the prevailing conditions of deposition. The trough cross-bedding shows almost unidirectional migration of small sandwaves to the west-south-west. Occasional silt drapes lie mostly between cross-bedded sets or on erosion surfaces. This is in contrast to the drapes seen at some Red Crag localities (e.g. Vale Farm, [TM 317 456]), which occur within sequences of sandy cross-beds representing periods of reduced flow or slack water in the tidal cycle. The bryozoan fauna of the Sudbourne Member is largely abraded as a result of transport. Most bryozoan species would have been unable to live on the mobile substrates offered by the migrating sandwaves.

Interpretation and evaluation

Taken together the various exposures around the small hill at Rockhall Wood allow examination of the stratigraphy of the Coralline Crag in this outlying body. The basal contact of the Red Crag which oversteps the London Clay onto and against the Coralline Crag can also be exposed by excavation. The basal contact of the Coralline Crag is not presently exposed but has been exposed in excavations in the past. The exposed section of Coralline Crag shows sediments of the uppermost part of the Ramsholt Member unconformably overlain by sediments laterally equivalent to the Sudbourne Member of the main outcrop. The contact between the two members appears sharper and better defined than at sites on the main outcrop, as for instance at The Cliff, Gedgrave and Broom Hill Pit. The lower part of the Ramsholt Member is best seen at Ramsholt Cliff nearby.

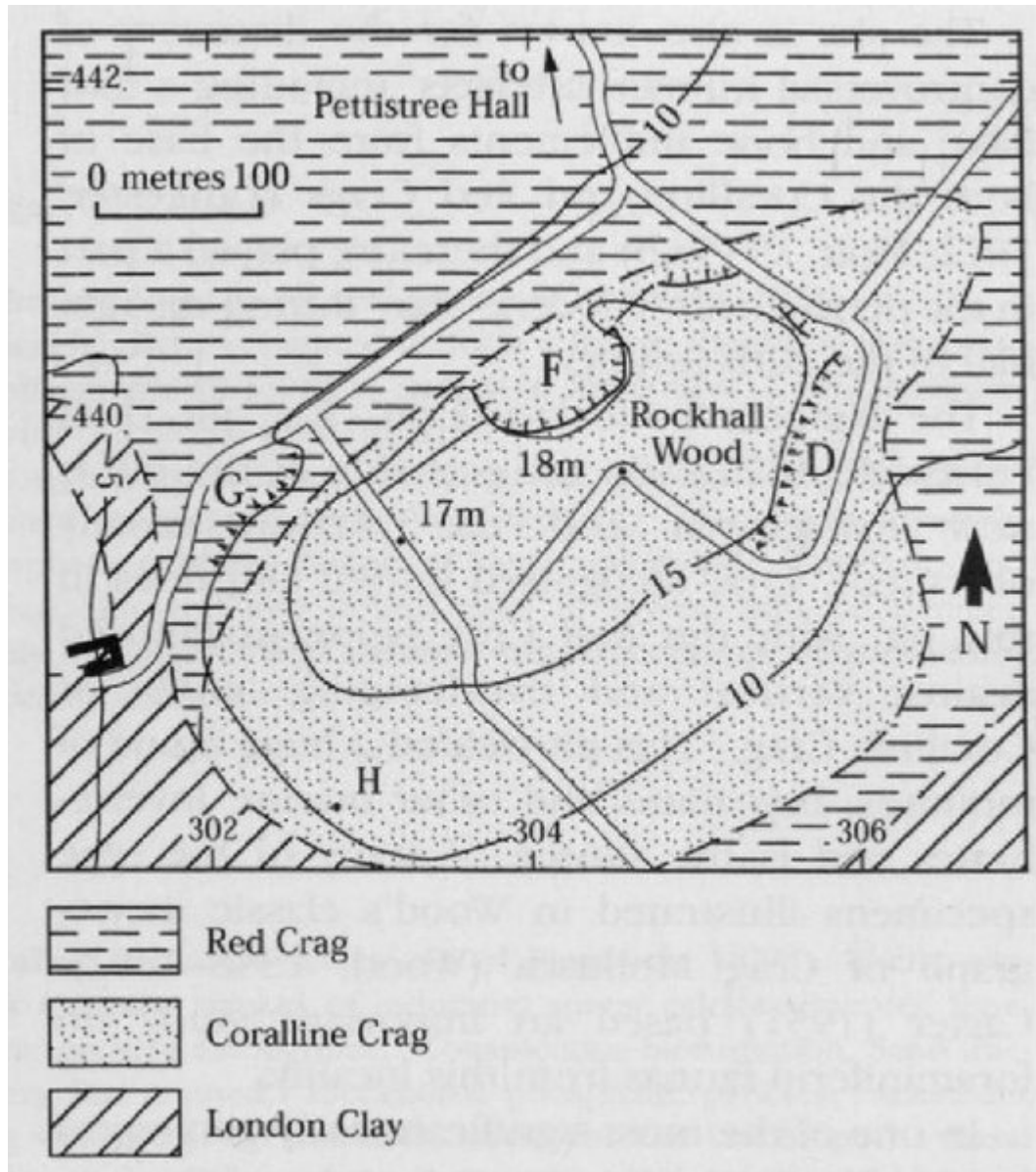
This site offers one of the very rare opportunities to see Coralline Crag overlain by Red Crag (*sensu stricto*). The only other locality is at Ramsholt Cliff nearby.

Conclusions

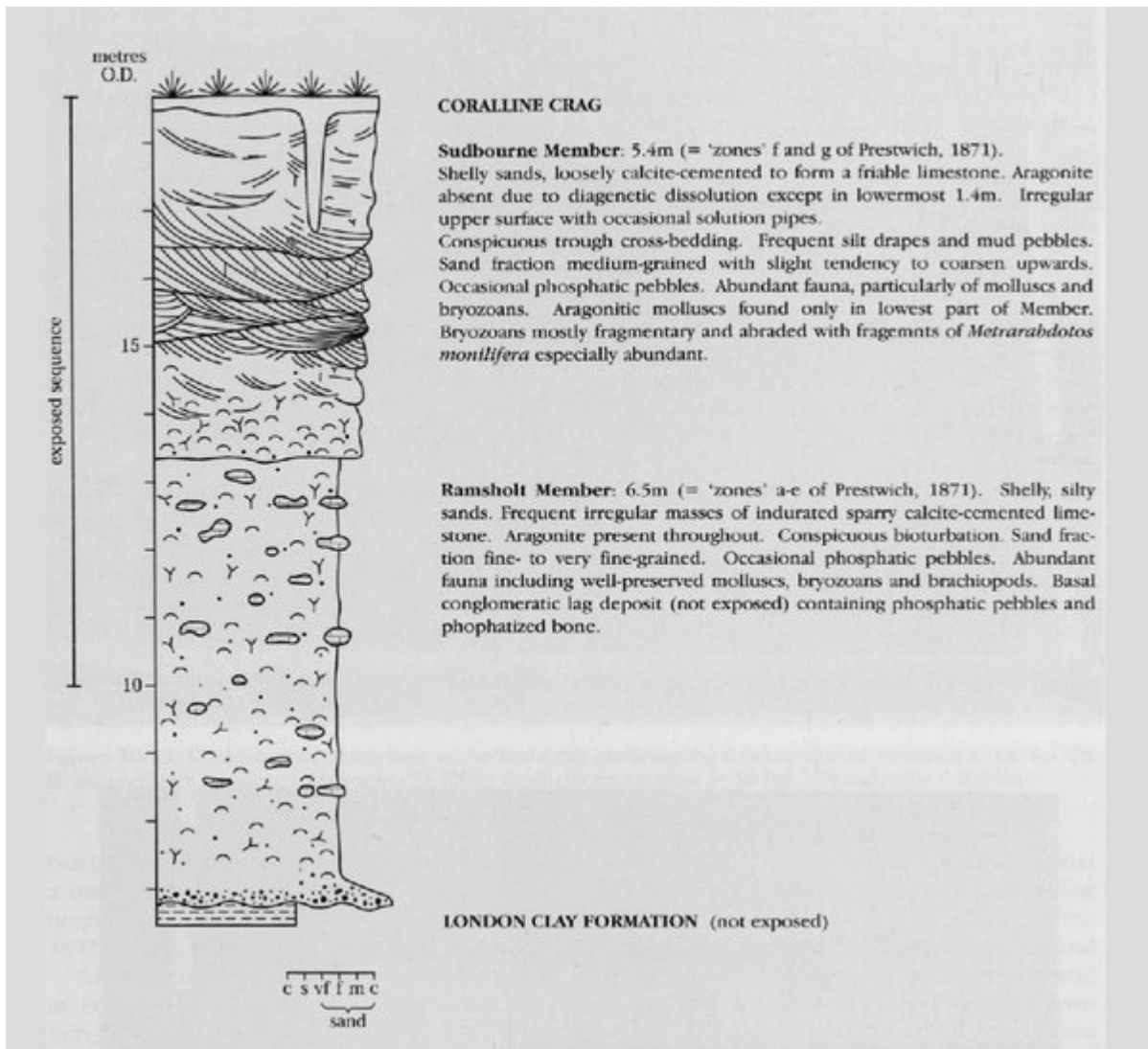
Although the Coralline Crag outcrop here is small and unconnected with the main outcrop to the north, the exposures at Rockhall Wood provide the best opportunity to study the stratigraphy of the Coralline Crag and its stratigraphical relationships to the Red Crag.

Rockhall Wood is the most renowned of all Coralline Crag localities and is a site of national importance. It has provided a prodigious marine fauna, particularly of molluscs, to researchers over the last 150 years and has been the subject of more papers and monographs than any other site in the UK Neogene. This site is without doubt one of the most important sites for the study of the Pliocene in this country.

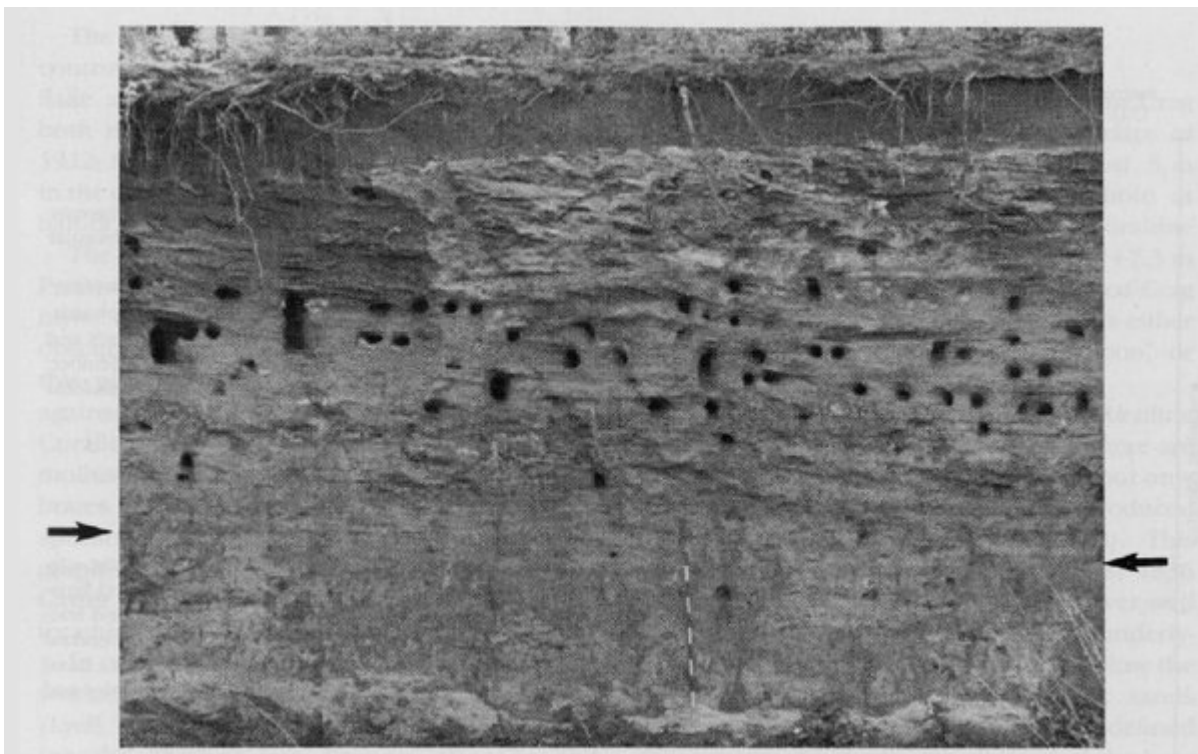
References



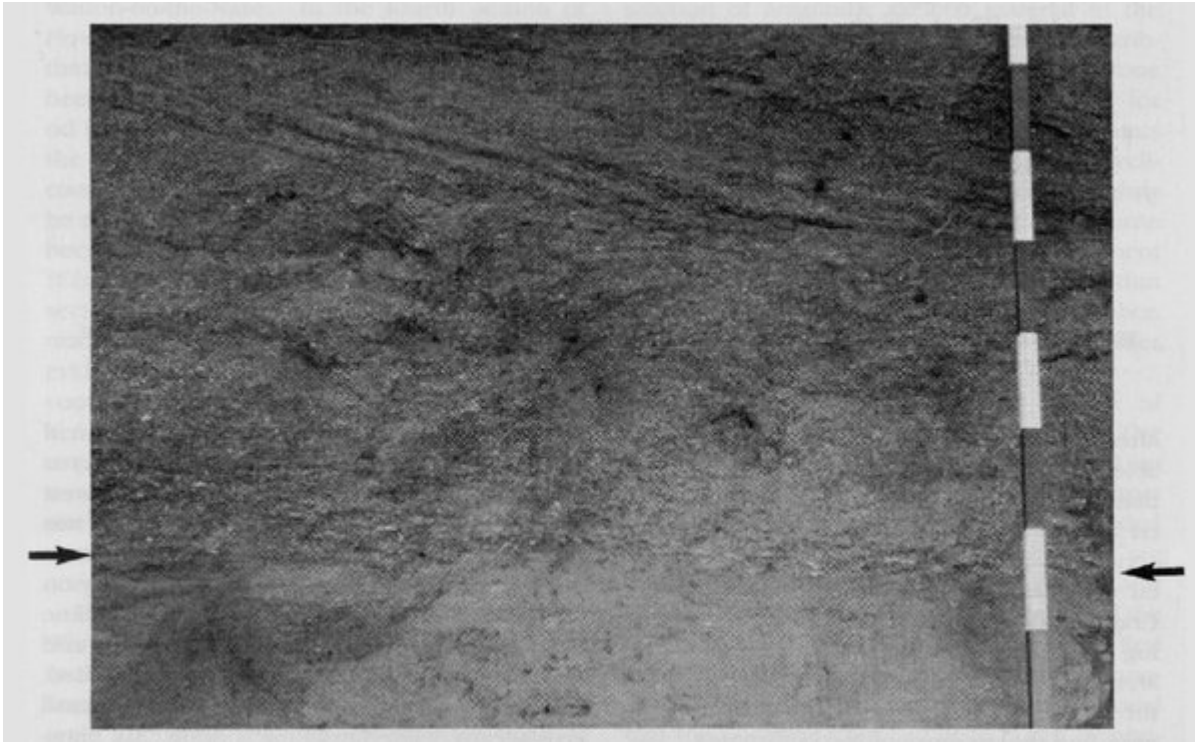
(Figure 10.8) Map of Rockhall Wood, Sutton showing the location of sections. D, F, G and H are locality designations used by Prestwich (1871a).



(Figure 10.9) Composite log of Coralline Crag section at Rockhall Wood. Clay = c, silt = s, very fine = vf, fine = f, medium = m, coarse = c. (After Balson et al., 1991.)



(Figure 10.10) Coralline Crag exposed in pit at [TM 3050 4408] in 1977. The contact between the Ramsholt Member and the overlying Sudbourne Member is arrowed. Scale is 1 m long. (Photograph: P. Balson.)



(Figure 10.11) The contact between the Ramsholt Member and the overlying Sudbourne Member arrowed. Graduations on scale = 10 cm. Note the cross-bedding in the Sudbourne Member. (Photograph: P Balson.)



(Figure 10.12) Conglomerate at the base of the Red Crag overlying the London Clay in Prestwich's (1871a) 'Pit G' exposed in a temporary excavation in 1989. Graduations on scale = 10 cm. (Photograph: P Balson.)



(Figure 10.13) Burrow extending downwards from the unconformable contact between the Ramsholt Member and the overlying Sudbourne Member in bullocicyard pit' (= pit D of Prestwich, 1871a). Graduations on scale = 10 cm. (Photograph: P Balson.)