Southerham (Machine Bottom Pit)

[TQ 4320 0905] (Potential GCR site)

Highlights

The Machine Bottom Pit at Southerham in Sussex is a site of special historic interest, being the locality from which most of the large 19th century collections of Chalk fossil fishes were made by famous gentleman scholars, such as Gideon Mantell and Frank Dixon. The collections include 28 type specimens (many more or less complete specimens) and still form the basis for much Upper Cretaceous fish taxonomy.

Introduction

The chalk pits around the East Sussex town of Lewes (Figure 13.16) have long been famous for their abundant and diverse fossil fish assemblages. In the 19th and early 20th centuries much material was collected from the disused Machine Bottom Pit (or 'Grey Pit' as it is known in some of the earlier literature, e.g. Jukes-Browne and Hill, 1903) in the Chalk Marl and Grey Chalk of the Lower Chalk (Cenomanian) succession. The Lewes region (Figure 13.16) has yielded some of the best fossil fish specimens and most representative faunas from the Chalk, and the collections are rivalled only by those from the Blue Bell Hill pits (q.v.) in Kent. Individual species are in many cases represented by large numbers of specimens and many of these are in a beautiful articulated state of preservation.

Most of the complete fish specimens described from the English Chalk were recovered in the 19th century and nowhere was fossil collecting more fashionable than in the Cretaceous succession of the South Downs. Both Gideon Mantell and Frank Dixon made extensive collections in the Chalk of Sussex, and many of their fish specimens are from the Lower and Middle Chalk around Lewes (Mantell, 1822; Dixon, 1850; Jukes-Browne and Hill, 1903). The Lewes fish collections have been the subject of much scientific description, including the work of Agassiz in the early 19th century and Smith Woodward's monographic work on Chalk fishes (1902–1912). They are the source of at least 28 type specimens.

The Lower and Middle Chalk succession in the Machine Bottom Pit was described by Barrois (1876), Jukes-Browne and Hill (1903), White (1926), Gastcr (1951), Kennedy (1969) and Lake *et al.* (1987). The pit is now disused and largely overgrown, and the higher beds of the section (*Plenus* Marls and Melbourn Rock), exposed high up in the north-east face, are inaccessible (Lake *et al.,* 1987). Yet re-excavation of the lower beds is possible and could yield more specimens.

Description

The confusion over the naming of the Machine Bottom Pit at Southerham arose because prior to White's recording of the section there in 1926, the pit was known as the 'Grey Pit'. When White (1926) made his observations the pit was disused. Later the pit was reopened and greatly enlarged, until final closure in the 1970s and was given its new name (Lake *et al.,* 1987). The new Southerham Grey Pit (q.v.) is situated about 200 m to the west of the older pit.

The Machine Bottom Pit exposes approximately 30 m of Lower Chalk and the lowest beds of the Middle Chalk (Figure 13.17). The section is now largely overgrown, but was recorded in 1973 by Lake *et al* (1987) as:

	Thickness (m)
Middle Chalk	
Ranscombe Griotte Chalk Member Melbourn Rock: creamish white, hard, nodular chalk with marl partings; some of the nodular beds are markedly iron-stained	0.9
Lower Chalk	

Plenus Marls: pale grey, very marly chalkwith slight greenish tinge; two well-marked hard beds up to 0.3 m thick; sharp erosional base	4.8–5.7
Grey Chalk: greyish white chalk, massive, thickly bedded, with thin marly partings	29.2
Chalk Marl: rhythms of up to 0.9 m thick, consisting of medium grey marly chalk grading up into pale fawn hard chalk commonly with large uncrushed ammonites; the hard beds generally have sharp tops, commonly burrowed; scattered pyrite nodules	9.1

The Lewes district is particularly important for Chalk lithostratigraphy, providing stratotypes for many members, beds and marker horizons (Mortimore, 1983). The relationship between the formal lithostratigraphical nomenclature, informal terminology and the biostratigraphy of the Lewes Chalk succession is given in (Figure 13.18). This diagram also illustrates the relationship between the Chalk successions in the three fish-bearing pits at Southerham: Southerham Grey Pit (Lower Chalk), the Machine Bottom Pit (Lower-Middle Chalk) and the Lime Kiln Quarries (Middle-Upper Chalk); and the positions of major vertebrate-bearing horizons, where known (modified after Lake *et al.,* 1987).

The Chalk Marl (*M. dixoni* Zone) at the Machine Bottom Pit is not as clearly bedded as the same unit in other sections around Southerham (e.g. Grey Pit (q.v.; Lake *et al.,* 1987). Locally, the harder limestone beds are extremely rich in invertebrate fossils, with the ammonite *Acanthoceras* particularly common. The overlying Grey Chalk is thickly bedded, although again individual beds are not easily defined in the section (Figure 13.17). The zone ammonite *Acantboceras jukesbrowni* was recovered from the lowest 10 m of the Grey Chalk by Kennedy (1969) and the unit is extremely fossiliferous. Above this is a massive unit with scour structures that corresponds to the Jukes-Browne Bed 7' of the Dover-Folkestone region. Above this horizon the Grey Chalk is attributable to the *C. guerangeri* Zone (Lake *et al.,* 1987). The top of the Grey Chalk is marked by a sharp erosional contact with the overlying *Plenus* Marls (*N. juddi* Zone; (Figure 13.17)).

The rich collections made at the Southerham chalk pits in the 19th century are preserved in the BMB, NHM and CAMSM. However, the earlier workers generally labelled their material as from the 'Chalk: Southerham', 'Chalk: Lewes' or in some cases 'Chalk: Sussex'. Similar labelling is found in the large collections made by Mantell and Dixon, which were described by Agassiz and include some of the type specimens described below. Mantell's list (1822) contains a few specimens which evidently came from the Chalk Marl (*M. dixoni* Zone) and also from upper whiter part of the Grey Chalk (*M. geslinianum* Zone) of Southerham, which has led most subsequent authors (e.g. Jukes-Browne and Hill, 1903; Lake *et al.,* 1987) to record Southerham and Lewes fish specimens as from the older *S. varians* and *H. subglobosus* Zones of the Lower Chalk. Mantell's and Dixon's specimens may have also come from the Middle Chalk, as suggested by Woodward (1902–1912). This is borne out by the listing of species recorded by the Geological Survey for the Middle Chalk (mainly *T. lata* Zone) of the Lewes region (Jukes-Browne and Hill, 1903).

Fauna

The following list is from Woodward (1902–1912) and includes specimens recorded as from 'Chalk: Lewes' and 'Chalk: Southerham'. The collections are considered to have been made from the Machine Bottom Pit at Southerham (Jukes-Browne and Hill, 1903; Lake *et al.,* 1987; D. Ward, pers. comm., 1994).

Chondrichthyes: Elasmobranchii: Euselachii: Hybodontoidea

Polyacrodus (*Acrodus*) *illingworthi* (Dixon, 1850)

Ptychodus decurrens Agassiz, 1835–1839

P. latissimus Agassiz, 1835–1843

P. mammillaris Agassiz, 1835–1839

P. polygyrus Agassiz, 1835–1839

P. polygyrus var. *marginalis* Agassiz, 1835–1839

Chondrichthyes: Elasmobranchii: Neoselachii: Squalomorphii

Hexanchus (*Notidanus*) *microdon* (Agassiz, 1843)

Chondrichthyes: Elasmobranchii: Neoselachii: Galeomorphii

Cretolamna (*Lamna*) *appendiculata* (Agassiz, 1843)

C. (*Isurus*) *mantelli* (Agassiz, 1843)

C. Woodwardi (Herman, 1975)

'*Lamna*'spp.

Plicatolamna (*Oxyrhina*) *crassidens* (Dixon, 1850)

P. (*Lamna*) *sulcata* (Gcinitz, 1843)

Scapanorhynchus rhaphiodon (Agassiz, 1844)

S. subulatus (Agassiz, 1843)

Squalicorax (*Corax*) *falcatus* (Agassiz, 1843)

S. (*C*) *kaupi* (Agassiz, 1843)

Chondrichthyes: Holocephali: Chimaeriformes

Edaphodon (*Ischyodus*) *agassizi* (Buckland, 1835–1836)

E. (*I.*) *mantelli* (Buckland, 1835–1836)

E. (*Psittacodon*) *sedgwicki* (Agassiz, 1843)

Elasmodectes willetti Newton, 1878

Osteichthyes: Actinopterygii: Neopterygii: Halecostomi

Acrotemnus faba Agassiz, 1837–1844

Anomoedus (*Gyrodus*) *angustus* (Agassiz, 1837–1844)

Coelodus (*Pycnodus*) *parallelus* (Dixon, 1850)

Phacodus punctatus Dixon, 1850

Polygyrodus (*Gyrodus*) *cretaceus* (Agassiz, 1839–1844)

Polygyrodus bennetti White, 1927

Osteichthyes: Actinopterygii: Neopterygii: Halecomorphi

Lophiostomus dixoni Egerton, 1852

Tomognathus mordax Dixon, 1850

Osteichthyes: Actinopterygii: Neopterygii: Teleostei

Belonostomus cinctus Agassiz, 1837–1844

Protosphyraena ferox Leidy, 1857

P. minor (Agassiz, 1837–1844)

Ichthyodectes (*Hypsodon*) *minor* (Egerton, 1850)

Osmeroides lewesiensis (Mantell, 1822)

O. levis Woodward, 1901

Pachyrhizodus (*Acrodontosaurus*) *gardneri* (Mason, 1869) (= P. *basalis* Forey, 1977)

P. (*Thrissopater*) *megalops* (Woodward, 1901)

Plethodus expansus Dixon, 1850

P. pentagon Woodward, 1902–1911

Protelops anglicus Woodward, 1888

Xiphactinus (*Portheus*) *mantelli* (Newton, 1877)

Osteichthyes: Actinopterygii: Neopterygii: Euteleostei

Acrognathus hoops Agassiz, 1844

Aulolepis typus Agassiz, 1837–1844

Apateodus striatus Woodward, 1901

Platycormus (*Berycopsis*) *elegans* Dixon, 1850

Cimolichthys levesiensis Leidy, 1857

Ctenothrissa (*Beryx*) *microcephala* (Agassiz, 1838)

C. (*B*) *radians* (Agassiz, 1835–1838)

Dercetis elongatus Agassiz, 1835–1844

Enchodus (*Esox*) *lewesiensis* (Mantell, 1822)

Eurypholis pulchellus Woodward, 1901

Halec (*Pomognathus*) *eupterygius* (Dixon, 1850)

Hoplopteryx (*Beryx*) *lewesiensis* (Mantell, 1822)

H. (*B.*) *superbus* (Dixon, 1850)

H. simus Woodward, 1902–1911

Osteichthyes: Sarcopterygii: Actinistia

Macropoma mantelli Agassiz, 1835–1844

Macropoma sp. (coprolites)

Interpretation

The Southerham Chalk Pits reveal a flourishing assemblage of both chondrichthyans and osteichthyes, almost all of which appear to have been predatory or durophagous. The numbers of fossils and taxa suggest relatively large populations of these vertebrates near the top of broad trophic pyramids in the Chalk sea. The environment was that of a relatively shallow warm to tropical water, of high organic productivity and with little clastic input. Terrigenous sedimentation was for the most part negligible, except in Chalk Marl time. Coccolith production was high throughout. These conditions promoted a generous regime of producer organisms upon which the vertebrate populations were founded. The chondrichthyes included both benthonic and free-swimming nektonic kinds, both large and small. The feeding activities of *Ptychodus* are thought to be responsible for the widespread and thorough fragmentation of the ubiquitous inoceramid (bivalve) shells (Kennedy, *in* McKerrow, 1978). Other shark-like forms were adapted for the crushing of nektonic or planktonic hard-shelled invertebrates, which were abundant in numbers and kinds. Chimaeroids were common but the hybodont sharks were in decline. The latter are said to be more common in freshwaters during the Cretaceous.

Hybodont sharks are well represented in the Lewes collections by abundant isolated teeth, from which five type specimens were described in the early 19th century. *Polyacrodus illingworthi* (Dixon, 1850) is known only from the large, low-crowned teeth originally described by Dixon (1850) as from the Jurassic hybodont *Acrodus,* and have also been assigned to *Hybodus* (Longbottom and Patterson, 1987) and *Synechodus* (Woodward, 1902–1912).

The large crushing teeth of the Cretaceous hybodont *Ptychodus* are fairly common in the Southerham collections ((Figure 13.22)b, see Southerham Lime Kiln site report). *Ptychodus* is thought to be related to the extant Myliobatidae. It is known from isolated teeth, partial dentitions and the partially calcified vertebrae, although the species named from Southerham are based only upon teeth (Woodward, 1902–1912). The four species of *Ptychodus* from Southerham have been named upon minor differences in the shape, ornamentation and size of their teeth (Woodward, 1902–1912; Longbottom and Patterson *in* Owen and Smith, 1987). Most of the forms in the Southerham fauna possessed wide crushing teeth capable of grinding thick-shelled benthic molluscs (Cappetta, 1987).

Neoselachian sharks are also well represented in the Lewes fauna and include both squalomorphs (*Hexanchus microdon* (Agassiz)) and abundant galeomorphs (Woodward, 1902–1912). WO species of lamniform shark, the cretoxyrhinid *Cretolamna appendiculata* (Agassiz, 1843), and the anacoracid *Squalicorax falcatus* (Agassiz, 1843) were named from detached teeth recovered from the Lower Chalk at Southerham. The medium-sized (15–25 mm) piercing teeth of *Cretolamna appendiculata* are fairly common Chalk fossils (Longbottom and Patterson, 1987). In the past most lamnid teeth found within the Chalk were referred to '*Lamna*' *appendiculata,* but many now have been reassigned to several other species, including *C. woodwardi* (Herman). *Squalicorax* is an extinct Cretaceous anacoracid or thresher shark, notable for possessing teeth that bear a distinctly serrated cutting edge (Longbottom and Patterson, 1987). The small teeth (12–15 mm) of *S. falcatus* are extremely common in the Cenomanian to Campanian Chalk of southern and eastern England (Longbottom and Patterson, 1987).

Other lamnids common in the Southerham galeomorph assemblage are a second species of *Squalicorax, S.* (*C.*) *kaupi* (Agassiz), and several cretoxyrhinids, including *Cretoxyrhina mantelli* (Agassiz), *Plicatolamna crassidens* (Dixon) (Cappetta, 1975) and *P. sulcata* (Geinitz), in association with the mitsukurinids *Scapanorhynchus rhapiodon* (Agassiz) and *S. subulatus* (Agassiz) (Woodward, 1902–1912).

Chimaeroids are also common in the fish assemblages from the Machine Bottom Pit and include three type specimens (Newton, 1878; Woodward, 1902–1912). *Edaphodon* is a typical Cretaceous genus which survived into the Miocene, and is known from isolated teeth and tooth plates in the Chalk at Southerham (Figure 13.19)F. Three species, *Edaphodon*

agassizi (Buckland), *E. mantelli* (Buckland) and *Edaphodon sedgwicki* (Agassiz), have been found there (Woodward, 1902–1912). *E. sedgwicki is* known from the Lower and Middle Cretaceous successions of eastern and southern England, as well as ranging up into the Turonian Chalk. It is the largest species (with mandibular plates reaching lengths of up to 0.2 m; Woodward, 1902–1912). *Edaphodon mantelli* and *E. agassizi* are much smaller species described from the '*H. subglobosus*' Zone of the Cenomanian at Southerham. These species are known from other Lower Chalk localities, and *E. mantelli* ranges into the Turonian (Woodward, 1902–1912). *Elasmodectes willetti* Newton is the type species of the genus, known only from this small species in the Lower Chalk and a second species, *E. secans,* from the Kimmeridge Clay (Upper Jurassic; Woodward, 1892d).

The list of bony fishes from Southerham Machine Bottom Pit is as lengthy as that from Burham in Kent, but importantly contains a pycnodont component not known from the Blue Bell Hill faunas. Most of the five species of pyc-nodont from the Chalk are based upon the arrangement of teeth within fragmentary jaws, as the isolated button-like crushing teeth are not taxonomically diagnostic (Longbottom and Patterson, 1987). The best known Cretaceous pycnodonts are *Anomoeodus angustus* (Agassiz), of which articulated teeth and jaws have been recovered from rocks ranging through the Lower to Upper Chalk successions, and *Coelodus parallelus* (Dixon) which was described from a splenial dentition in the Southerham collection at BMB (Woodward, 1902–1912). Several *Coelodus* species are based upon more complete robust skeletal material from the Late Cretaceous of Italy and Austria (Woodward, 1902–1912). Other Chalk pycn-odonts are much less precisely known: the sple-nial dentition of *Acrotemnus faba* Agassiz found at Lewes by Mantell (Woodward, 1908) is the only specimen of this genus that has bean-shaped smooth teeth with keel-like coronal tips. *Phacodus punctatus* Dixon is only known from a few Turonian localities in the English Chalk and has ovoid or irregularly rounded teeth with a smooth crown (Woodward, 1908); and *Polygyrodus cretaceus* (Agassiz), also known only from the Turonian Chalk, is characterized by dentition made up entirely of small circular and conically crowned teeth, with roughly enamelled surfaces (Longbottom and Patterson, 1987). The Southerham pycnodont species *P. bennetti* White, 1927 was described from an imperfect vomerine dentition.

The halecomorph neopterygian component of the Southerham bony fish fauna is much the same as that from the Blue Bell Hill pits (q.v.) at Burham, and includes the type specimen of the large aspidorhynchid *Belonostomus cinctus* Agassiz, 1837–1844, rostrum fragments the two species of the swordfish-like pachycormid *Protosphyraena,* and remains of the rare *Tomognathus mordax* Dixon (Woodward, 1908; (Figure 13.19)D). The specialized caturid *Lophiostomus dixoni* Egerton is known from partial fish and fragmentary jaws in the Turonian Chalk of Sussex (Woodward, 1902–1912). *Lophiostomus is* a small fish with a large head (head reaches about 60 mm) which had widely gaping jaws lined with regular series of conical teeth (Woodward, 1902–1912).

The teleosts were conspicuous members of the osteichthyan fauna; some were also very large, active predatory fishes. Deep-bodied and slender fusiform types existed, and the eel-like *Dercetis,* with its wide gape and formidable array of small teeth, indicate a range of lifestyles comparable to that in many Recent shallow tropical seas. There were also numerous small fishes such as *Acrognathus,* and deep-bodied larger forms like *Berycopsis* that may have swum in schools.

Nine species of teleosts are present in the Lewes Chalk assemblage, and Southerham is the type locality for six (Woodward, 1902–1912). The fauna includes representatives of the Elopiformes, the Ichthyodectiformes, an anguilliform and the enigmatic plethodonts.

Elopiforms are represented by the type specimen of the small albuloid *Osmeroides lewesiensis* (Mantell). Another species, *O. levis* Woodward, is also found in the Southerham fauna and both were described in detail by Forey (1973a). The third 'pseudotarpon' elopiform *Protelops anglicus* Woodward is known only from fragmentary jaws lined with long, slender teeth arranged in two or more series on the border of the mouth or fused to the palate (Woodward, 1908, 1902–1912).

The large predaceous pachyrhizodontid *Pachyrhizodus,* with its characteristic dentition (Woodward, 1902–1912; Longbottom and Patterson, 1987; see Blue Bell Hill report), has also been recovered from the Lower and Middle Chalk succession in the Machine Bottom Pit. Two species, *P. gardneri* (Mason) and the type specimen of *P. megalops* (Woodward) (an imperfect head), are recorded in the collections (Forey, 1977). It is now known that *Thrissopater* is a

junior synonym of *Pachyrhizodus* (Frickhinger, 1991; (Figure 13.19)C).

The large carnivorous Ichthyodectiformes (Nelson, 1973) are represented by the type specimens of two species, *Ichthyodectes minor* (Egerton) and *Xiphactinus mantelli* (Newton), in the Southerham fauna (Woodward, 1902–1912). Fragmentary jaws of *I. minor* are known from several Thronian Chalk localities and are characterized by the sharp hollow teeth set into deep sockets (Woodward, 1902–1912; Bardack, 1965; Nelson, 1973; see Blue Bell Hill report). Better-preserved specimens of the genus were recovered from the Upper Cretaceous of Kansas and named *Portheus* by Cope (1872) and *Xiphactinus* by Leidy (1857). Newton (1877) was able to reassign much of the British material to *X. mantelli,* a large form probably attaining lengths of up to 4–5 m (Woodward, 1902–1912). The fossil material includes fragmentary jaws and large isolated bones, such as fin rays and vertebrae.

The plethodont *Plethodus* is the only genus of this enigmatic group recorded from the Chalk (Longbottom and Patterson, 1987; see Blue Bell Hill report). The typical crushing dentition is clearly seen in the type species, *P. expansus* Dixon, described from detached dental plates from the Turonian Chalk of Lewes. These plates are up to 0.1 m in length, and the species may have reached 1 m or so in length. The pentagonal dental plates of *P. pentagon* Woodward have also been recorded in the Machine Bottom Pit.

The higher teleost or euteleost fauna (Figure 13.19) of the Lower and Middle Chalk succession of Southerham is largely the same as that from Blue Bell Hill (q.v.), although there are some differences. Again all the fish taxa recognized in the Southerham fauna are highly advanced eutelosts or 'neoteleostean' fishes (Rosen and Patterson, 1969; Rosen, 1973) and the assemblage contains the same orders (Ctenothrissiformes, Aulopiformes, Mytophi-formes, Polymixiiformes and Beryciformes) as at Blue Bell Hill (q.v.). Therefore, in the following text, descriptions of fishes already described for the Blue Bell Hill report are kept to a minimum and the reader is advised to consult the Burham interpretative section for more information.

Among the neoteleosts represented at Southerham are the type specimens of three extinct Cretaceous ctenothrissoid fishes, *Aulolepis typus* Agassiz, *Ctenothrissa microcephala* (Agassiz) and C. *radians* (Agassiz). These genera are also found at Blue Bell Hill (q.v.). Both species of *Ctenothrissa* were named from fairly well-preserved fish from the Mantel Collection of Lower-Middle Chalk fishes from Southerham (Woodward, 1902–1912). *Aulolepis is* a monospecific genus restricted to the English Chalk, which differs from *Ctenothrissa in* the morphology of the head and jaws, and in possessing non-pectinate scales (Patterson, 1964, 1968; (Figure 13.19)G).

The common Chalk euteleost predatory fishes, the 'enchodonts' (aulopiforms; Goody, 1969; Rosen, 1973; Longbottom and Patterson, 1987), are represented in the Southerham fauna by six species (Woodward, 1902–1912), and like the aulopiforms at Blue Bell Hill (q.v), include representatives of three groups: the enchodon-toids, the cimolichthyids and halecoids. The eel-like dercetid *Dercetis* is also found at Southerham (Woodward, 1902–1912). The enchodont *Apateodus striatus* Woodward, 1901 ((Figure 13.19)A) had a long pointed head and snout, with a thickened palate possessing two large, well-spaced fangs (Goody, 1969; (Figure 13.19)A,A'). The enchodontoids are represented by two species, *Enchodus lewesiensis* (Mantell) and *E. pulchellus* Woodward, in the Lewes collections (Woodward, 1902–1912; Goody, 1969; (Figure 13.19)L). The cimolichthyid *Cimolichthys lewesiensis* Leidy is an elongated form with an ornamented head and a long pointed snout (Woodward, 1902–1912; (Figure 13.19)H). Several dental fangs are present on the palatine and dentary, and the laterally compressed palatal teeth have a barb at their tip (Goody, 1969; Longbottom and Patterson, 1987). *C. lewesiensis* also possessed a series of dermal scutes which ran along the dorsal edge of the body from behind the head to the dorsal fin and a second smaller series along the lateral line of the trunk (Woodward, 1902–1912). *Cimolichthys lewesiensis* is the type species, the barbed teeth of which have been found in all facies, throughout the Chalk. The halecoid *Halec eupterygius* (Dixon) is a more generalized aulopiform (Rosen, 1973; (Figure 13.19)M,N), with a deeply fusiform body and laterally compressed head, ornamented with ridges and tubercles of ganione (Goody 1969; Woodward, 1902–1912). The last enchodont at Southerham is the type specimen of the dercetid *Dercetis elongatus* Agassiz, a Chalk representative of a Cretaceous family of long, thin, eel-like fishes that possessed a very wide gaping mouth lined with numerous small, sharp teeth (Woodward, 1902–1912; Rosen, 1973). *Dercetis* is easily recognizable from large V-shaped scutes arranged in two or three series along the trunk. The shape of these can be used to differentiate species even from fragmentary or detached material (Longbottom and Patterson, 1987).

The sardinoidid myctophiform *Acrognathus boops* Agassiz is a small fish, attaining a size of a little over 0.1 m, with thick uniform cycloid scales (Rosen, 1973). *Acrognathus* possessed an elongated trunk, and a large head with huge orbits. The small delicate jaws were lined with minute teeth (Woodward, 1902–1912). Although *A. boops* is the type species of the genus, the material recovered from the Chalk at Lewes and pits in Surrey is fragmentary (Woodward, 1902–1912). The genus is better known from a second species, *A. libanicus* Woodward, from the Upper Cretaceous of Lebanon (Rosen, 1973).

Acanthomorphs in the Chalk fauna of Lewes include the polymixiid *Berycopsis elegans* (Dixon), the trachichthyoids *Hoplopteryx lewesiensis* (Mantell), *H. superbus* (Dixon) and *H. simus* Woodward, 1902, and the holocentroid *Caproberyx*. *Hoplopteryx* was a deep-bodied fish that is characterized by expanded sensory canals upon the frontal region of the skull, an upturned mouth lined with tiny teeth and large eye (Woodward, 1902–1912; (Figure 13.19)B). Species of *Hoplopteryx* from the English Chalk were commonly referred to the extant beryci-form genus *Beryx* by early authors (e.g. Agassiz, 1833–1845; Dixon, 1850), but the various genera can be distinguished by many characters (Woodward, 1902–1912). *Holopteryx lewesiensis* reached up to 0.3 m. It bore a large dorsal fin which extended along almost half the length of the back and had finely rugose ornamented scales. *Caproberyx suberbus* was a much bigger fish, attaining 0.45 m, had a more elongated trunk than *H. lewesiensis* and more strongly ornamented scales (Patterson, 1964). *Holopteryx simus* is known from Burham, Kent (q.v.), and is a small species (length about 0.2 m), which possessed unusually coarse and well-developed ornament on the bones of the head (Woodward, 1902–1912). All three species occur in Lower Chalk ('*H. subglosus*'Zone) of Kent and Sussex, with *H. superbus* also found in the Middle Chalk of the same region, and *H. lewesiensis* ranging up to the *M. cortestinunium* Zone of the Upper Chalk of Surrey (Woodward, 1902–1912).

The Southerham fauna includes a nearly complete type specimen of the Cretaceous coelacanth *Macropoma mantelli* Agassiz ((Figure 13.19)K). This species is known from several complete specimens from the Turonian of the Machine Bottom Pit and other localities in southeast Britain (Woodward, 1902–1912). *Macropoma mantelli* reached lengths of up to 0.6 m and possessed a large, robust head, the bones of which were coarsely ornamented with pits and tubercles. The jaws were lined with irregularly arranged large and small conical teeth, whilst the palatal bones possessed clustered large teeth. Coprolites assigned to this coelacanth are also found in the Lewes collections.

Fossil reptiles recovered from the Lower and Middle Chalk succession of the Machine Bottom Pit (Jukes-Brown and Hill, 1903, pp. 46–58, 404) include turtles, plesiosaurs and mosasaurs, as well as the piscivorous pterosaurs. Predatory tetrapod communities, dependent upon fish in the Late Cretaceous seas, are known from many parts of the world. Those in southern England would have apparently had an abundant food supply, to judge from the record of fishes in the Chalk here. Although the quarry is not an SSSI for these marine reptiles, the fauna is listed in the review of fossil reptile sites (Benton and Spencer, 1995). However, the authors mistakenly ascribe the finds to the Grey Pit at Southerham (q.v.), because of the confusion over names.

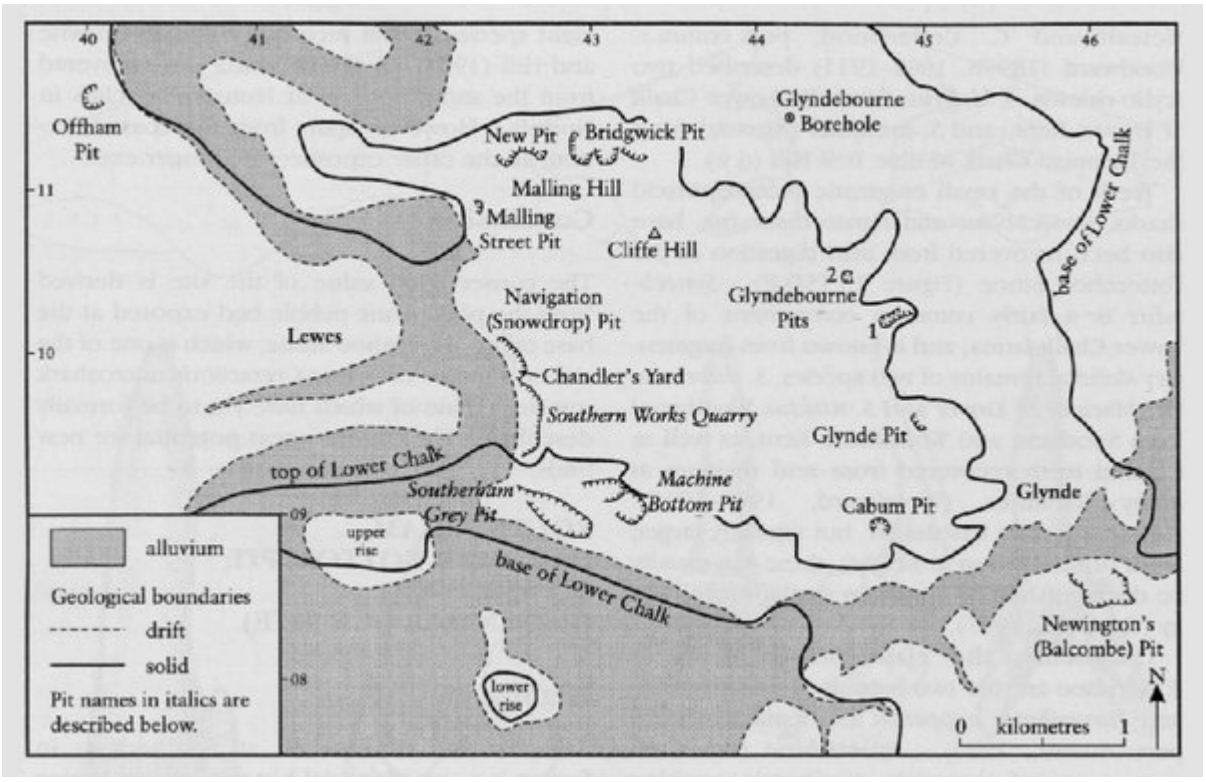
Comparison with other localities

The faunas are broadly similar in composition and preservation to those described from Burham in Kent (q.v.). However, in detail there are minor differences, such as in the absence of pycnodonts in the Burham assemblages, but overall the two faunas complement one another.

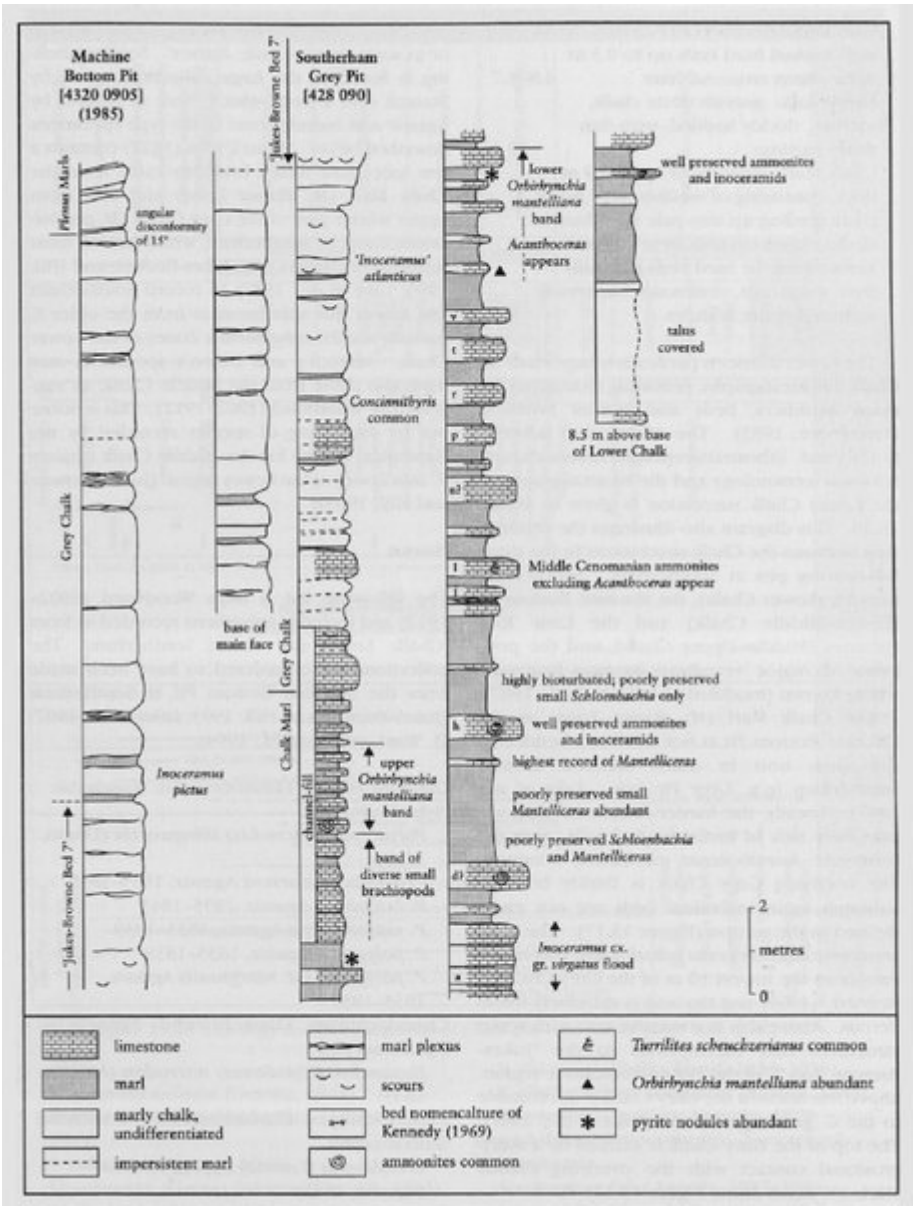
Conclusion

The Machine Bottom Pit at Southerham has yielded one of the most complete Lower and Middle Chalk fish faunas, including 27 type specimens, which provide its conservation value. Eleven of these are amongst the earliest neoteleosts, the largest living group of bony fishes, and the Southerham specimens are important in defining basal characteristics of the group.

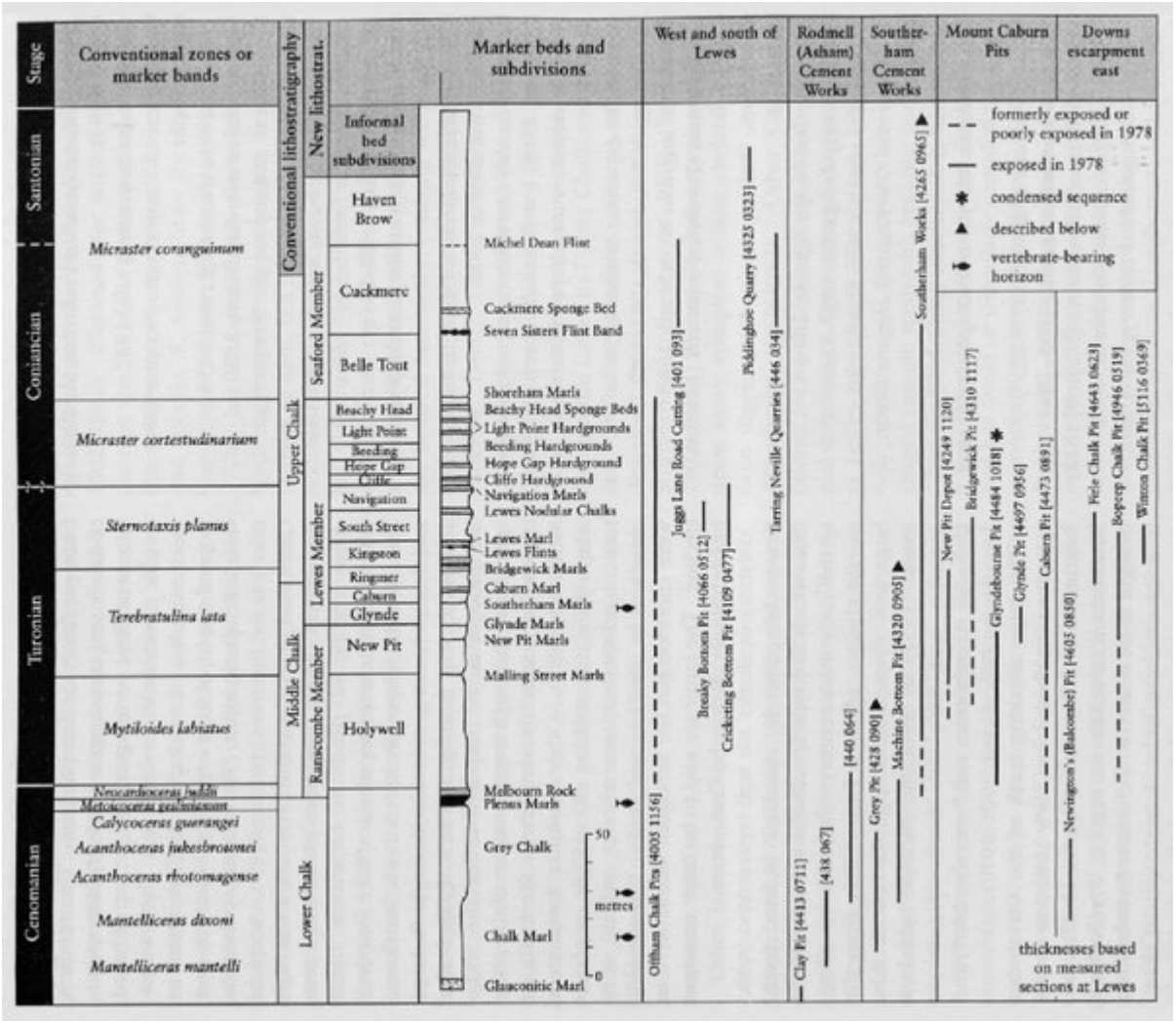
References



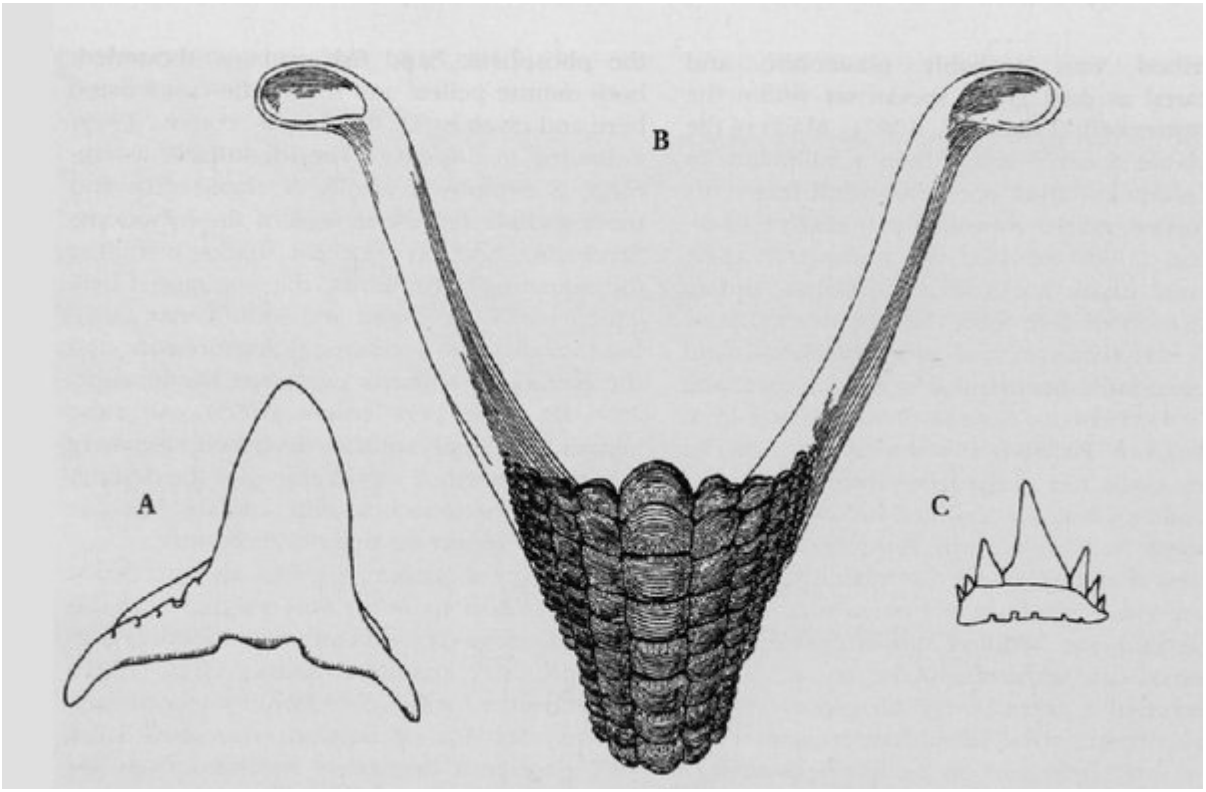
(Figure 13.16) Map of chalk pits around the Mt Caburn area, Lewes (after Lake et al., 1987).



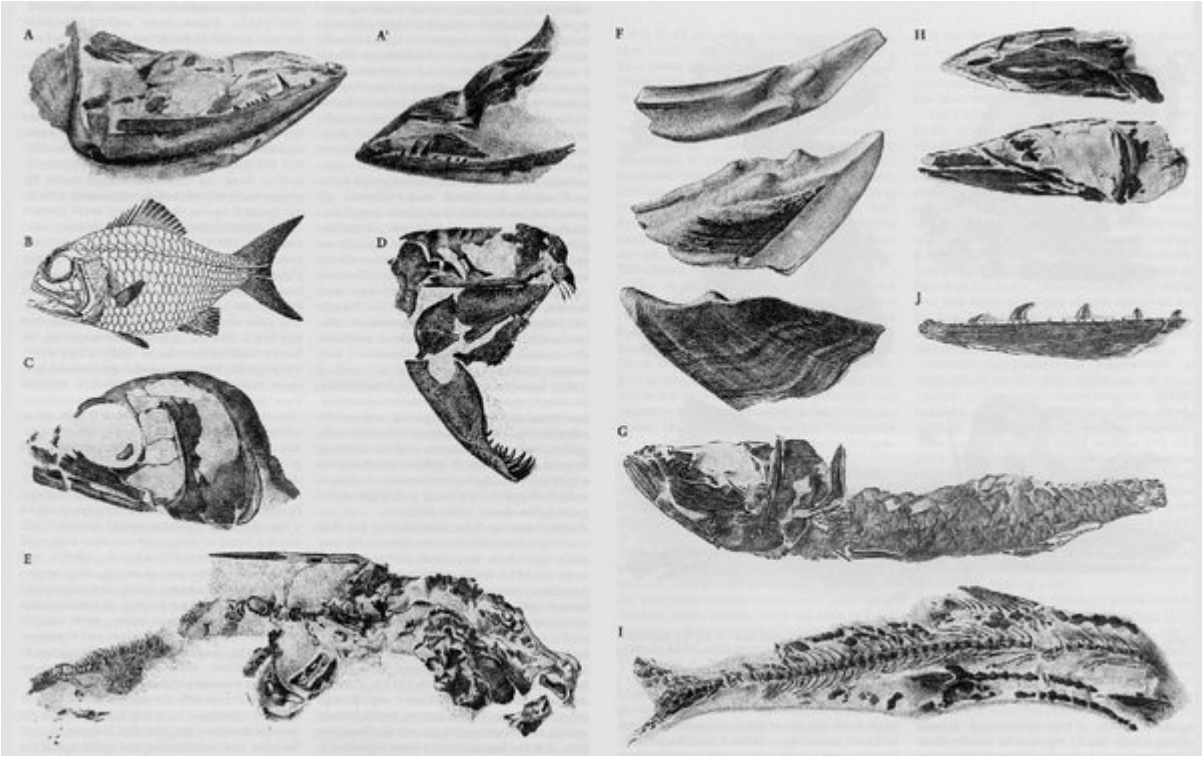
(Figure 13.17) Chalk sections in the Machine Bottom Pit and Southerham Grey Pit (after Lake et al., 1987).



(Figure 13.18) Lithology and biostratigraphy of Chalk pits near Lewes (after Lake et al., 1987).



(Figure 13.22) Chondrichthyan fishes from the Chalk at Southerham Lime Kiln Quarry (A) Plicatolamna crassidens x 1.0; (B) Ptychodus decurrens Agassiz, a restoration of the lower jaw x 1.0; (C) Paranometodon angustidens x 2.0. (From Longbottom and Patterson, 1987.)



(Figure 13.19) Fossil fishes from the Chalk of the Lewes area (after Woodward, 1895b). All distorted head and jaw parts; (A), (A') Apateodus striatus Woodward, distorted head, right and left lateral views, both are c. x 1.0; (B) Hoplopteryx lewesiensis Woodward, restoration x 0.5; (C) Thrissopater megalops Woodward, head with left pectoral arch, x 0.6; (D) Tomognathus mordax Dixon, imperfect skull and left mandible, x 1; (E) Elasmodectes willetti Newton, right side of head and part of trunk, x 0.8.(F) Edaphodon agassizi (Buckland), left mandibular dental plate in labial, lingual and upper views, x 1; (G) Aulolepis typus Agassiz, incomplete head and trunk in left lateral view, x 3; (H)–(j) Cimolichthys lewesiensis Leidy: (H) head and opercular region in dorsal and left lateral views x 0.35, (I) damaged trunk and tail parts x 0.35, (J) labial aspect of left dentary x 0.9.(K) Macropoma mantelli Agassiz, crushed skull in right lateral view, x 0.6; (L) Enchodus lewisiensis Mantell, head and anterior part of trunk in lateral view, x 0.9; (M), (N) Halec eupterginus (Dixon): (M) head and abdominal region in lateral view, x 0.9, (N) head in lateral view, x 1.