Scaat Craig

[NJ 237 568]

Highlights

The Scaat Craig site in Highland is an isolated exposure of Upper Old Red Sandstone that has yielded a unique fauna of fish scales and bone fragments, and is the type locality for three species, and a number of tetrapod-like bones have been reported recently (Ahlberg, 1991, 1995), the first material evidence (as distinct from trackways) in Britain of such advanced vertebrates in the Devonian (Chapter 15).

Introduction

'Scaat Craig' was originally the name of a knoll in the valley of the Longmorn Burn, south-east of Elgin, long since overgrown and indistinguishable. There are two exposures, the first behind the garden of 'Greenbank' house at [NJ 237 568], the second 300 m away opposite the railway bridge (Figure 8.11).

The discovery of the site, the first source of Old Red Sandstone fishes in the Moray Firth area in 1826, and the early years of collection at Scaat Craig by Mr John Martin, of the Elgin Institution, were eloquently recorded by Patrick Duff (1842, pp. 27–8), a local enthusiast.

Scaat Craig received a famous visit by J. Malcolmson and Patrick Duff, in 1838, but they did not collect anything. Although unsuccessful on his first visit to Scaat Craig, Malcolmson took to London some specimens that had previously been collected, and they caused great excitement when exhibited at the Geological Society. A tooth was immediately figured in Murchison's *Silurian System* (1839). Later in 1838 Malcolmson took specimens from here and from Cromarty to show to scholars on the continent, and a little later he went on to discover the Middle Devonian fish beds at Dipple Burn (q.v.), Tynet Burn (q.v.), Lethen Bar and Clune in 1838 and 1839. J.G. Malcolmson (1842, 1859), Gordon (1859) and A.G. Malcolmson (1921) noted that the Scaat Craig beds could not be traced laterally owing to the thickness of drift cover.

Malcolmson gave Richard Owen in London some Scaat Craig teeth, for which he (Owen, 1840–1845) erected six species of a new genus, *Dendrodus,* (*D. biporcatus, D. strigatus, D. sigmoideus, D. compressus, D. latus* and *D. incurvus*) so called because of microscopic plant-like ramifications seen in cross-section. Owen thought them to be fish teeth, and suggested that *Dendrodus* might have linked some extinct group of fishes with the labyrinthodonts. Patrick Duff (1842, p. 30) and Hugh Miller (1858) realized that these tooth taxa probably referred to specimens already named from their scales from Scaat Craig. Duff (1842) was also first to figure fish specimens from Scaat Craig, later described by Agassiz (1844–1845), such as *Cosmacanthus malcolmsoni.*

The date of the discovery of the site is important because it was so early; it predated Hugh Miller's finds on Cromarty (Miller, 1830). Gordon (1859) and Horne (1923) suggested that fossil fishes were first found at Scaat Craig in 1836, but this later date seems unlikely, because by 1838 there was enough material already collected for it to be distributed around Europe by J.G. Malcolmson, and it contradicts Duff's (1842) account. Oddly, however, the same John Martin who first collected at Scaat Craig, later (Martin, 1837) failed to mention any organic remains from these strata.

Agassiz (1835, 1844–1845) figured material from Scaat Craig in the first systematic work on fossil fishes. Other early workers who described or mentioned the site include Duff (1842), Roberts (1863), Traquair (1888a), Taylor (1910) and Mahood and Spriggs (1919). Important early collections were made by Duff, Malcolmson, Brickenden (now in NHM), Grant, Jenkins, Gordon and the Elgin Museum (Malcolmson, 1859; Traquair, 1895). More recently, tetrapod-like bones have been recognized in collections from this site, thus pushing back the earliest record for a stem-tetrapod to the Frasnian (Ahlberg, 1991, 1995).

Description

The strata at Scaat Craig are bright red, grey and yellow, coarse, friable, pebbly sandstones, rich in scales and fish fragments, and which overlie conglomeratic sandstones. The site is now rather overgrown, but Duff (1842, p. 28) described it when it was much clearer: The deposit at Scat Craig… (being) composed of soft sandstone and conglomerates, passing from coarse to the fine grained; but even the coarsest conglomerate of Scat Craig, containing rounded masses, larger than a hen's egg, of granite, gneiss, graywacke, mica slate and augite, embedded in a calcareous cement, are not of the oldest conglomerate, as is proved by isolated masses of a still older brecciated conglomerate being found embedded in it.' (Figure 8.11).

The occurrence of the fossil fish was also described by Duff (1842, p. 32): 'The section of the rock at Scat Craig is very limited not exceeding at any part fifteen feet in thickness; and from the extremely friable nature of the stone, and the embedded organisms, make it very difficult to obtain unbroken specimens, or to preserve them entire after they are extricated. I believe, however, no locality has been discovered in the old red sandstone to contain such a number and variety of bones, teeth, and other parts of fishes, so perfectly preserved. In some places the rock is mottled over by them, while at others they are scarce'. The fossils are very easy to remove from the semi-consolidated rock, but almost impossible to keep complete because they are very friable.

Scales are very common in the Scaat Craig sandstones, but larger pieces of bone are rarer. Nevertheless, they reveal much remarkably fine detail. Malcolmson (1842, 1859) stated that 'fossils are rarely found in the overlying conglomerate', and nobody else has recorded specimens from the unit yet.

Fauna

The fragmentary nature of the fossils causes nomenclatural problems, with different authors assigning different names to isolated scales, plates and bone fragments, and faunal lists for Scaat Craig by different authors may differ substantially. The faunal list given here is that of Miles (1968):

AGNATHA

Heterostraci: Psammostiformes: Psammosteidae

Psammosteus cf. *falcatus* Gross, 1942

Traquairosteus pustulatus (Traquair, 1897). Type (and ?only) locality

GNATHOSTOMATA

Placodermi: Antiarchi: Bothriolepidae

Bothriolepis paradoxa (Agassiz, 1845) Type locality

Placodermi: Anthrodira indet.

Coccosteomorph arthodire indet.

?Cosmacanthus nzalcolmsoni Agassiz, 1845 [Not an acanthodian, Denison 1979, p. 58] Type and only locality

Osteichthyes: Sarcopterygii: Osteolepiformes Rhizodonts indet.

Osteichthyes: Sarcopterygii: Porolepiformes

Holoptychius nobilissimus Agassiz, 1839

H. giganteus Agassiz, 1845

?H. decoratus Eichwald, 1846

Dipnoi: Dipteridae

Conchodus ostreiformis M'Coy, 1848 Type locality.

TETRAPODA: Elginerpetontidae

Elginerpeton pancheni Ahlberg, 1995

Type and only locality.

Psammosteid heterostracans (Figure 8.12) are represented by several specimens from Scaat Craig. The record of *Psammosteus* cf. *falcatus* is based on the abraded distal tip of a branchial plate, described by Traquair (1895) as *Psammosteus* sp., and redescribed by Tarlo (1961a) and Miles (1968). *Psammosteus falcatus* is known from the Upper Devonian of Ellesmere Island, Central Poland and Timan, where its short time range makes a useful zone fossil. *Traquairosteus pustulatus* was assigned to *Psammosteus* by Traquair (1897a), based on psammosteid plate fragments from Scaat Craig with a distinctive 'rippled' ornamentation, and the species was accepted as valid by Tarlo (1961a).

Bothriolepis paradoxa was assigned at first to *Placothorax* by Agassiz (1845), based on scattered material associated with the base of a pectoral appendage from Scaat Craig, termed by him *Pterichthys major. Placothorax paradoxus* was placed in *Bothriolepis major* by Lahusen (1880) and Traquair (1888), and all *Bothriolepis* remains from Scaat Craig were referred to that species. Miles (1968) confirmed the synonymy, and accepted the distinction of *B. paradoxa* from the other species of *Bothriolepis* found in the area, *B. gigantea* and *B. alvesiensis.* There are over 100 species of *Bothriolepis* in the Middle and Upper Devonian of Scotland, the Baltic, Russia, northern Europe, North America, China, Australia and Antarctica (Long, 1995). The coccosteomorph arthrodire has been identified by Miles (1968).

Cosmacanthus malcolmsoni is known only from three pieces of spine from Scaat Craig. The holotype was presumably found and figured by Duff (1842, pl. 7, fig. 5), before the formal description of Agassiz (1845, p. 121, pl. 33). A current view is that the specimens may be placoderm spinals resembling Phylctaeniidae, and the taxon is listed under 'Arthrodira *incertae sedis*' by Denison (1978, 1979). This referral is based on a third specimen discovered by Traquair (1897a, pp. 381–2, pl. 10, figs 2, 3) in the Brickenden Collection at the NHM. Only new material of this species can resolve the argument.

Rhizodonts indet., recorded by Miles (1969), include jawbones described as *Polyplocodus* sp. by Traquair (1895) and loose teeth which he referred to *Sauripteris crassidens,* both identifications considered doubtful by Miles.

Scattered scales of *Holoptychius nobilissimus* Agassiz, 1839 are common at Scaat Craig. Traquair (1895) suggested that *Dendrodus strigatus* and *D. sigmoides,* described by Owen (1840–1845) on teeth from Scaat Craig, might belong to this species. Two scales from Scaat Craig were figured by Agassiz (1845) as *H. giganteus,* and the teeth described as *Dendrodus latus* Duff, 1842 and *D. bifurcatus* Owen, 1848 might also belong to this species, according to Traquair (1895). This species also includes a fragmentary plate from Scaat Craig, described and figured by Agassiz (1845) as *Asterolepis malcolmsoni,* and which Traquair (1897a) identified as a broken jugular of H. *giganteus.* Finally, Traquair (1897a) described an abraded scale from Scaat Craig as *Holoptychius decoratus* Eichwald, 1846, but Miles (1968) thought this determination to be unsound (Figure 8.13).

Scaat Craig is the type locality for *Conchodus ostreiformis,* a dipnoan palatal tooth (in CAMSM). Westoll (1951) recorded this species from the Rosebrae Beds, but Miles (1968) noted that the record is undocumented.

Ahlberg (1991) reported the earliest known British tetrapod, on the basis of re-examination of old collections from Scaat Craig. A tibia, humerus and somc incomplete jaws possibly represent a single species, all being of a consistent size; but the fragmentary nature of the specimens makes it impossible to link together these isolated bones, which all show tetrapod, or very tetrapod-like features. The tibia represents the earliest tetrapod-like hind limb, comparable to specimens from the lower Famennian of Greenland.

More recently collecting at Scaat Craig has produced some 13 taxonomically different unique and phylogenetically specimens (lodged in RSM, NHM, BGS(GSM), OUM and LEICSM) studied by Ahlberg (1995). *Elginerpeton pancheni* (Figure 8.14) is represented by jaw fragments and possibly by limb and pelvic remains. Ahlberg accepts them as evidence of a Glade (including *Obruchevichthys* from the late Frasnian of Latvia and Russia) that is the sister group of all other tetrapods. This new genus was a large tetrapod with overall jaw length of 400 mm. The coronoid teeth are only slightly larger than the marginal and a premaxilla indicates a narrow triangular skull. Overall the animal may have resembled *Ichthyostega,* but no hand or feet bones are known.

Ahlberg (1995) places *Elginerpeton* in a new stem group of tetrapods, differing from all other known Devonian tetrapods in its rounded infradentary margins and in having an accessory tooth row on the dentary. The Glade thus has well-developed characteristics, distinct from the stem lineage of Famennian and later tetrapods (Chapter 15).

Interpretation

Mackie (1902), a pioneer of heavy mineral work, described the character of the sandstones at Scaat Craig as remarkably full of granitic waste, the rounding of many of the grains suggesting that they had been derived from sand dunes at the margins of the Upper Old Red Sandstone basin. The water-worn appearance of numerous fossil specimens indicates transport in active streams and perhaps some reworking from one site to another prior to deposition. The water flow was powerful and episodic.

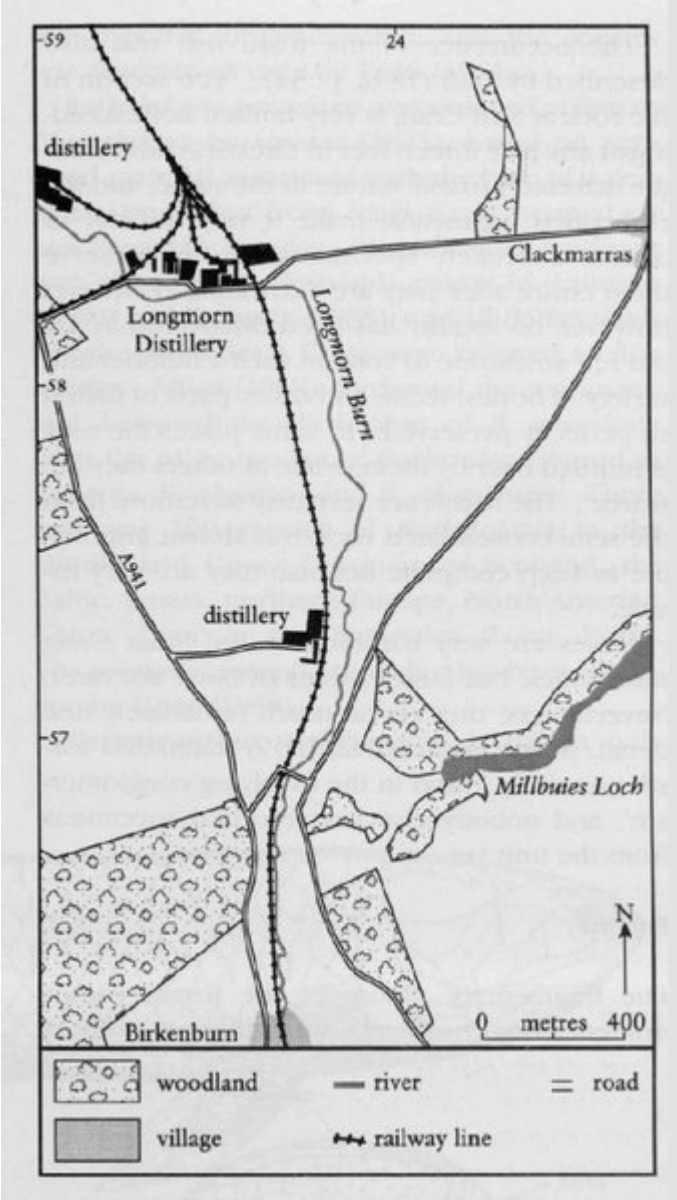
The Scaat Craig Beds have been correlated to late Frasnian equivalents in the Baltic (Westoll, *in* House *et al.,* 1977). The determination of *Psammosteus falcatus* led Tarlo (1961a) to separate the Scaat Craig Beds from the Alves Beds, placing them between the Alves and the overlying Rosebrae Beds. However, the Scaat Craig Beds are more usually considered a facies equivalent of the Alves Beds (Peacock *et al.,* 1968; see also Muckle Burn account). *Bothriolepis paradoxa* together with *Holoptychius,* occurs at one other locality, Redhall Quarry, Fochabers, and this is therefore correlated with the Scaat Craig Beds.

The abundance of vertebrate remains collected from this locality and the state of preservation are remarkable. Moreover, the fish are large and would have required considerable space in their habitat. The rather mature sediments at Scaat Craig are fluvial, and may indicate a large drainage system in which perhaps large masses of water provided a habitat not only for placoderms and sarcopterygian fish but also tetrapods. Areas of waterside vegetation may have been part of the tetrapods' habitat. Sites elsewhere yielding Late Devonian and Early Carboniferous tetrapods also contain diverse and extensive fish faunas, and indicate habitats of high organic productivity. Access to nearby marine environments is a common feature elsewhere, but remains uncertain here.

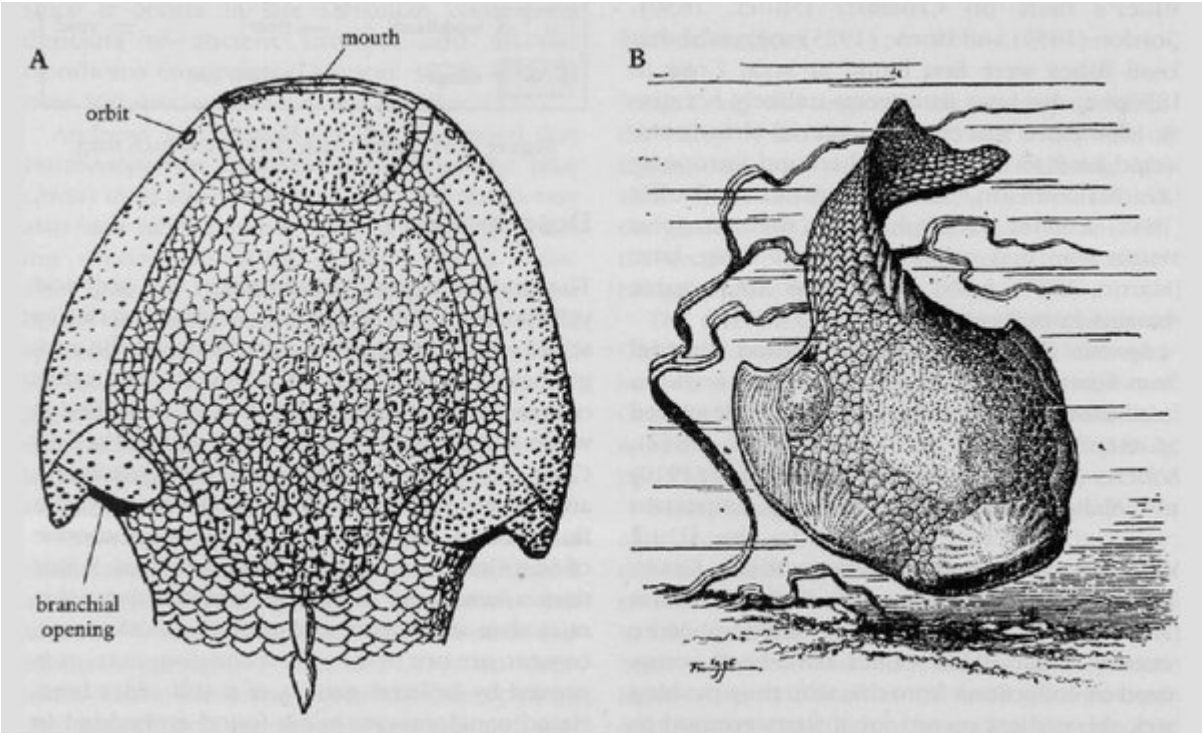
Conclusion

Scaat Craig has produced diverse and fragmentary material of a late Devonian fauna, including an early and distinctive tetrapod. The specimens have figured significantly in systematic and morphological studies of a number of Devonian fish groups, and the recent report of putative tetra-pod limb bones from the site adds to its broader significance and conservation value. Today, the site is overgrown and the rocks are poorly exposed, but reports have suggested that further careful excavation would produce valuable new collections.

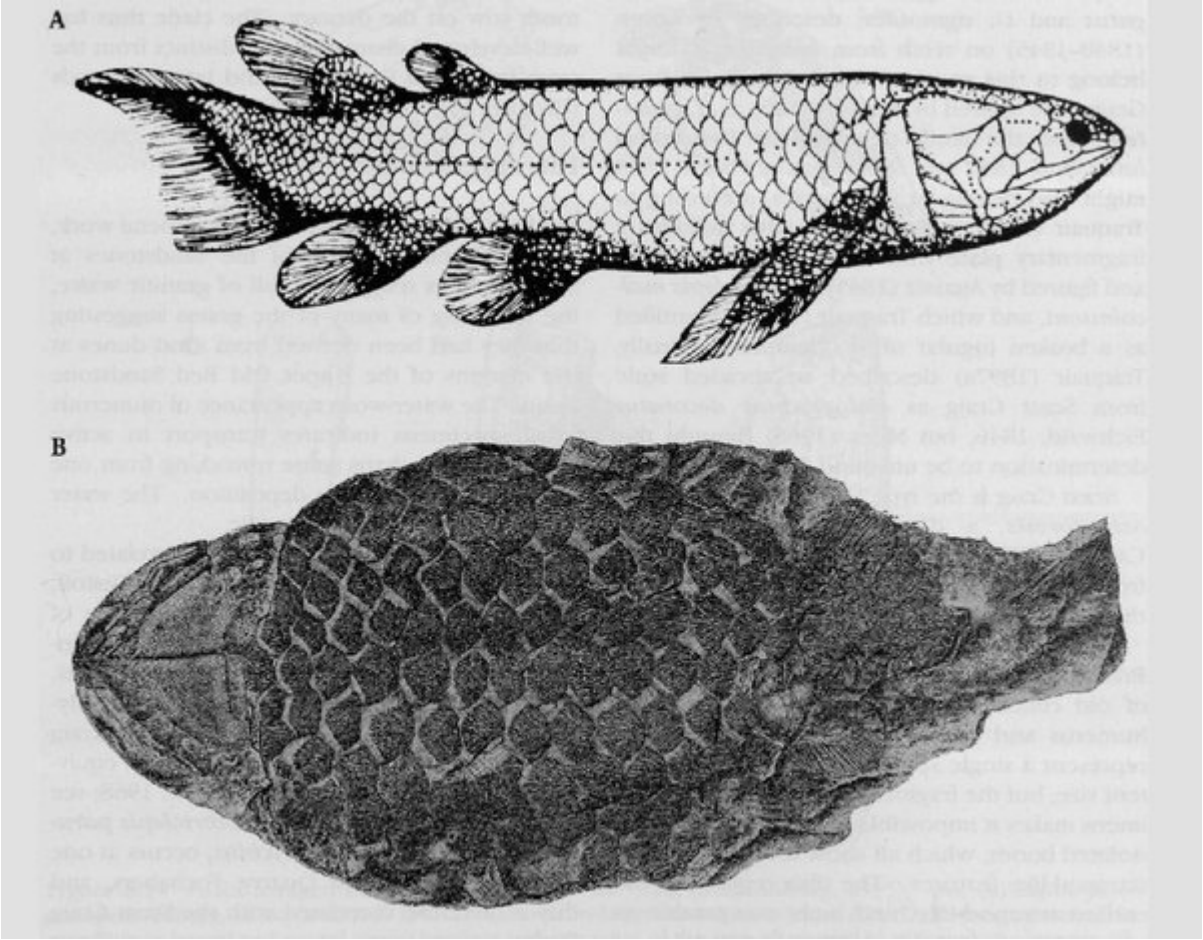
References



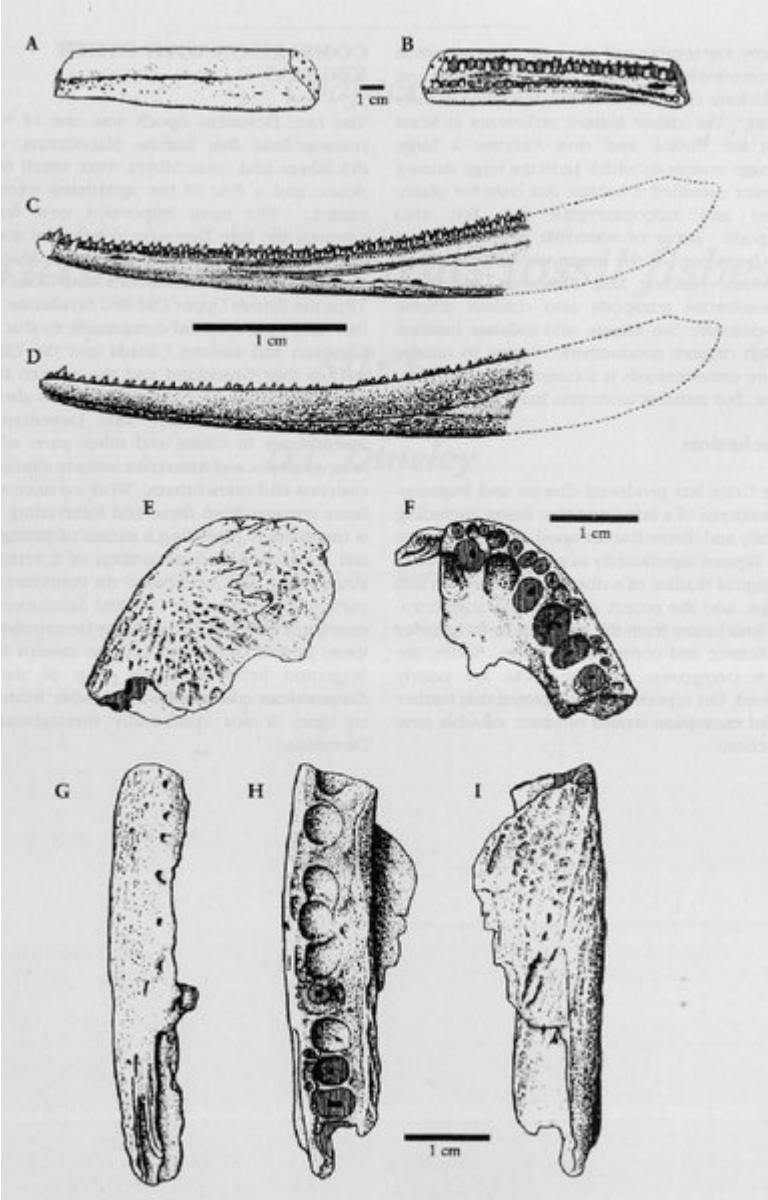
(Figure 8.11) Scaat Craig GCR site sketch map.



(Figure 8.12) Psammosteids from Scaat Craig. (A) Restored dorsal view; (B) a restoration of Psammolepis, both x 0.5 (after A. Bistrova).



(Figure 8.13) (A) Holoptychius nobilissimus Agassiz, a restoration from Scaat Craig, x 0.2; (B) Holoptychius specimen from Classbinnie, Perthshire, figure in ventral aspect, x 0.3 (after Murchison, 1872).



(Figure 8.14) Fossil tetrapod bone fragments from Scaat Craig (from Ahlberg, 1995). (A), (B) Elginerpeton pancheni Ahlberg, holotype RSM G 1967.17.1, in ventro-lateral and dorsal views. (C), (D) Reconstruction of the mandible in lateral and mesial views: brackets indicate parts of the jaws preserved in different specimens. (E), (F) the premaxilla, OUM Geol. Col D796, anterior part in dorsal and ventral views. (G)–(I) the posterior part of the premaxilla, NHM P9776, in lateral, ventral and dorsal views (vertical hatching = broken bone).