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An Upper Palaeozoic palaeontological and biostratigraphical summary of Scotland Sheet 23E (Lanark)

M T Dean

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An Upper Palaeozoic palaeontological and biostratigraphical summary of Scotland Sheet 23E (Lanark)

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Siluro-Devonian faunas

Lanark Group

Swanshaw Formation: tracks.

Comments: the tracks, possibly of a crustacean, were observed in 1863 near Howgate [NS9217 3484], but they 'disappeared' shortly after their discovery (Geikie and others, 1873, p.14). A specimen of *Cephalaspis* sp. was recorded (in pencil on the Old and New Series field maps) as got from an old quarry north of Lesmahagow [NS8143 4059]. It's repository was stated to be the National Museum of Scotland, but a search of the catalogues at the museum could find no trace of a cephalaspid (or anything else) from that locality (Dr R L Paton, written communication, 10 March 2000). The genus *Cephalaspis* ranges from the Upper Silurian to the Middle Devonian (Moy-Thomas, 1971, p.10).

Carboniferous floras and faunas

Wilson (1989 and 1967 respectively) published comprehensive accounts of the marine faunas found in Dinantian and lower Silesian (Namurian) rocks of central Scotland and indicated their similarities throughout those subsystems (see also Wilson *in* Lumsden, 1964, 1967a, 1967b; Lumsden, 1965; Dean, 1996, 1998b). Forsyth and Brand (1986) showed the character and distribution of non-marine faunas in upper Silesian (Duckmantian and Bolsovian) rocks over a similar area (see also Lumsden and Calver, 1958; Lumsden, 1965). This part of the account is a strict interpretive summary of the faunal characteristics of the Carboniferous rocks found in the area of Sheet 23E (Lanark) ('the district'). Tables showing the distribution of selected fossils from the Dinantian, Namurian and Westphalian rocks of the district are given in appendices 1 to 4. Information sources (palaeontological and bibliographical) are summarised in appendices 5 and 6.

Strathclyde Group

'Kirkwood Formation'

Calmospora microrugosa, C. pallida, Colatisporites sp., *Convolutispora* sp., *Crassispora aculeata*, cf. *C. trychera, ?Discernisporites* sp., *Granulatisporites granulatus, Knoxisporites* sp., *Lycospora pusilla, Microreticulatisporites concavus, Punctatisporites* cf. *solidus, Raistrickia nigra, Reticulatisporites* sp., *Waltzispora* sp.

Comments: the palynomorphs in the combined list come from three samples of the Stoneyknowes Borehole (NS83NE/83) [NS8817 3569] between 253.96m and 294.74m

depth. They indicate a post Tournaisian age, ranging from possibly early Holkerian, to late Asbian or younger (see Owens, 1982).

Lawmuir Formation: Dinantian, Brigantian (P1 Goniatite Zone, VF Miospore Zone)

Dykebar Limestone: plant fragments, *Serpuloides* sp., *Beecheria* aff. *treakensis*, chonetid, *Composita* sp., *Crurithyris urii, Eomarginifera longispina?, E. setosa, Lachrymula latior, ?Latiproductus* sp., *Lingula mytilloides, L. squamiformis, Linoproductus* cf. *concinniformis, ?Linoprotonia* sp., *Productus concinnus, P. redesdalensis?*, spiriferid, *Donaldina* sp., *Glabrocingulum beggi, Ianthinopsis* sp., *Naticopsis variata, Retispira tenuis?, Straparollus (Straparollus) dyonysii?, Actinopteria persulcata, Anthraconeilo (Palaeoneilo)* cf. *laevirostrum, Aviculopecten knockonniensis, A.* cf. *plicatus, Aviculopinna* cf. *mutica, Cypricardella* sp., *Edmondia sulcata, E. unioniformis, Leiopteria hendersoni?, L.* cf. *laminosa, L.* cf. *thompsoni, Limipecten dissimilis, Myalina* aff. *peralata, Naiadites crassus, Palaeolima* cf. *simplex, ?Parallelodon* sp., *Pernopecten sowerbii, Phestia (Polidevcia) attenuata, Pterinopectinella granosa, Sanguinolites clavatus, ?S. plicatus, S. striatolamellosus, Schizodus* cf. *axiniformis, S.* cf. *salteri, Streblochondria elliptica?, Streblopteria ornata?*, *Wilkingia maxima*, ?coiled nautiloid (indeterminate), orthocone nautiloid (indeterminate), goniatite (indeterminate), ostracods, crinoid columnals, *Archaeocidaris* sp., fish fragments indeterminate, root traces, burrow traces.

Comments: see Wilson (1989) and Dean (1996). The Dykebar Limestone (standard name) may be referred to locally as the Craigburn Shell Bed, Netherfield Limestone, Fiddler Shell Bed, or Fraser and Raeburn Shell beds. Productoids and pectenids are the most common constituents of a brachiopod and mollusc dominated fauna. Wilson (1989, p.104) commented on the lack of corals, and stated that the pleurotomarian gastropod *Glabrocingulum beggi* is confined to the Dykebar Limestone in central Scotland. He also referred to the first entry of many species (including *Streblopteria ornata?*) which are present in the succeeding beds.

The Dykebar Limestone has been collected for fossils in the Douglas Coalfield area in the upper Craig Burn [NS8720 3308] (see Dean, 1996), and in the southeast Central Coalfield area in the Mossside Burn [NS8641 5065] (see Brand, 1983b, locality 11). It was also ploughed up as a fossiliferous sandstone at Stanmore Farm [NS8923 4460] (see Dean, 1999).

Hollybush Limestone: *Clisiophyllum* sp., *Siphonodendron junceum, S. pauciradiale, S. scoticum?, Syringopora* sp., *?Zaphrentites* sp., *Rhabdomeson* sp., *?Antiquatonia* sp., *Avonia youngiana, ?Beecheria* sp., *?Brachythyris* sp., *Cleiothyridina* sp., *Composita* sp., *Crurithyris urii?, Echinoconchus elegans, E.* cf. *punctatus, ?Eomarginifera* sp., *Gigantoproductus* cf. *giganteus, Latiproductus latissimus?, Lingula mytilloides, Linoproductus* sp., *Martinia* sp., *Pleuropugnoides pleurodon?, Productus concinnus?, ?Promarginifera* sp., *Pugilis* cf. *pugilis, Rugosochonetes* sp., *Schellweinella radialis, Schizophoria resupinata, Spirifer bisulcatus?, Spiriferellina* sp., *Tornquistia* cf. *scotica*, high spired gastropod (indeterminate), *Actinopteria persulcata, Aviculopecten* sp.,

Cypricardella sp., *Edmondia sulcata?, Leiopteria* cf. *thompsoni, Limipecten dissimilis, Lithophaga lingualis, Modiolus* sp., *Myalina flemingi?, Naiadites crassus, Palaeolima* cf. *simplex, Pernopecten sowerbii, ?Phestia (Polidevcia)* sp., *Posidonia becheri?, Sanguinolites* aff. *costellatus, ?Schizodus* sp., *?Solenomorpha* sp., *?Streblochondria* sp., *?Wilkingia* sp., *Conocardium* sp. orthocone nautiloid (indeterminate), ostracods, crinoid columnals, fish fragments.

Comments: see Wilson (1989). The Hollybush Limestone (standard name) may be referred to locally as the Craigburn Limestone, Basket Shell Bed, *'Productus giganteus'* Limestone, or the Cot Castle Shell Bed. The fauna (which is dominated by productoids) includes corals, thick shelled brachiopods (including many *Gigantoproductus* sp. and *Latiproductus* cf. *latissimus*), *Avonia youngiana, Cleiothyridina* sp., *Rugosochonetes* sp., *Tornquistia* cf. *scotica*, *Posidonia becheri?* and *Conocardium* sp. The bivalve *Posidonia becheri* has not been recorded from younger beds (Wilson, 1989, p.104).

The Hollybush Limestone has been collected for fossils in the Douglas Coalfield area in the upper Craig Burn at [NS8709 3320] (see Dean, 1996). In the southeast Central Coalfield area it has been collected for fossils in the Fiddler Burn within [NS8493 4764] to [NS8478 4746], the River Nethan at [NS8162 4586], the River Clyde at [NS8285 4613], and in the Mossside Burn at [NS8633 5086] (see Brand, 1983a, localities 3, 6 and 24; 1983b, locality 12).

Blackbyre Limestone: algal growths?, foraminifera, *Aulophyllum fungites*, caninoid, *Clisiophyllum* sp., *Dibunophyllum bipartitum bipartitum, Siphonodendron junceum, Syringopora* sp., *Zaphrentites* sp., *Fenestella* sp., trepostomatous bryozoan, encrusting bryozoan, *Serpuloides* sp., *Alitaria* cf. *panderi, Angiospirifer trigonalis?, Antiquatonia* cf. *hindi, Avonia youngiana, ?Balanoconcha* sp., *Beecheria* sp., *Buxtonia* sp., *Cleiothyridina* sp., *Composita ambigua, Crurithyris* cf. *urii, Echinoconchus elegans, Eomarginifera lobata, E.* cf. *longispina, E. setosa?, Gigantoproductus giganteus, G.* cf. *gigantoides, Globosochonetes parseptus, Lachrymula* sp., *Latiproductus* cf. *latisimus, Lingula mytilloides, L. squamiformis, Martinia* sp., *Phricodothyris* sp., *Pleuropugnoides pleurodon, Productus* cf. *concinnus, ?Promarginifera* sp., *Pugilis pugilis?, Rhipidomella michelini, Rugosochonetes celticus, Schellweinella* sp., *Schizophoria resupinata, Tornquistia polita*, whorl of large gastropod (indeterminate), *?Platyceras* sp., *Actinopteria persulcata, Aviculopecten* sp., *Edmondia* cf. *pentonensis, Euchondria* sp., *Limipecten* sp., *Myalina* sp., *Naiadites crassus, Pernopecten sowerbii, Pterinopectinella* sp., *Sanguinolites abdenensis, Schizodus* cf. *salteri, Sedgwickia* sp., *Solemya* cf. *excisa, S. primaeva, Streblochondria* sp., *Streblopteria ornata, Sulcatopinna flabelliformis,* orthocone nautiloid (indeterminate), goniatite (indeterminate), trilobite fragments, ostracods, *?Ureocrinus* sp., *Archaeocidaris* sp.

Comments: see Wilson (1989). The Blackbyre Limestone (standard name) may be referred to locally as the Douglas Under Limestone, Under Limestone or Nodular White Limestone. The fauna is rich in corals (including *Dibunophyllum bipartitum bipartitum* and *Siphonodendron junceum*) and brachiopods especially productoids and athyrids.

Pectenids are the most common bivalves. As in the Hollybush Limestone, gastropods are very poorly represented.

Fossiliferous exposures of the Blackbyre Limestone collected in the Douglas Coalfield area include those in cuttings on the M74 at Wildshaw Limeworks [NS8759 2841] (see Brand, 1990). Those in the southeast Central Coalfield area include in the Fiddler Burn within [NS8493 4764] to [NS8478 4746] and in the River Nethan at [NS8162 4586] (see Brand, 1983a, localities 6 and 24).

Non-marine faunas of the Lawmuir Formation: *Curvirimula* cf. *scotica* was found sporadically in argillaceous beds associated with the Blackbyre and Dykebar limestones in the Crofthill No.1 Bore (NS95SE/27)[NS9866 5300], the Crofthill No.2 Bore (NS95SE/28)[NS9814 5274] and the West Forth No.6 Bore (NS95SW/61)[NS9344 5271]. Fragments of *Naiadites* sp. were found above the Hollybush Limestone at c.18.7m depth in the Braidwood Bore No.1 (NS84NW/98)[NS8475 4800].

Lower Limestone Formation: Dinantian to Namurian, Brigantian to Pendleian (P2 to E1 Goniatite zones, VF to NC Miospore zones).

Hurlet Limestone: algal material, plant material, *Aulophyllum fungites, Caninia* sp., *Dibunophyllum bipartitum, Heterophyllia* sp., *Hexaphyllia marginata, H. mirabilis, Siphonodendron junceum, S. pauciradiale, Syringopora* sp., *Zaphrentites* sp., *Fenestella* spp., *Rhabdomeson* sp., encrusting bryozoan, trepostomatous bryozoa, *Serpuloides carbonarius, Spirorbis* sp., *?Actinoconchus* sp., *Alitaria* sp., *Angiospirifer* cf. *trigonalis, Antiquatonia hindi, A. insculpta, A. muricata?, Avonia youngiana, Balanoconcha* sp., *Beecheria hastata, Brachythyris* sp., *Buxtonia* sp., *Cancrinella* cf. *undata, Cleiothyridina* sp., *Composita ambigua, Crania ryckholtiana, Crurithyris urii, ?Dictyoclostus* sp., *Echinoconchus elegans, E. punctatus?, Eomarginifera lobata, E. longispina, E. praecursor?, E. setosa?, Fluctuaria* cf. *undata, Gigantoproductus giganteus, Globosochonetes* cf. *parseptus, Krotovia spinulosa, Lachrymula inusitata, Latiproductus* cf. *latissimus, Lingula mytilloides, L. squamiformis, Linoprotonia* sp., *Liralingua wilsoni, Orbiculoidea nitida, O. cincta, Phricodothyris* cf. *lineata, P.* cf. *insolita, Pleuropugnoides* cf. *pleurodon, Plicochonetes* sp., *Productus carbonarius, P. concinnus, P. redesdalensis, Promarginifera* sp., *Pugilis pugilis, Reticularia* sp., *Rhipidomella michelini, Rugosochonetes celticus, R. speciosus, Schellwienella* sp., *Schizophoria resupinata, ?Serratocrista* sp., *Spirifer bisulcatus?, S. crassus* group, *Spiriferellina* cf. *octoplicata, Tornquistia* cf. *polita, Bellerophon* sp., *Donaldina* sp., *Euphemites urii,* murchisoniid, *Naticopsis* sp., *Retispira* cf. *striata, Strobeus ventricosta, Dentalium* sp., *Actinopteria persulcata, Anthraconeilo (Palaeoneilo) luciniformis, Aviculopecten tabulatus, Aviculopinna mutica, Cypricardella rectangularis, ?Dunbarella sp., Edmondia senelis?, E. sulcata, Euchondria* sp., *Leiopteria* sp., *Limipecten dissimilis, Lithophaga lingualis, Modiolus* sp., *Myalina* sp., *Naiadites crassus, Nuculopsis gibbosa, Palaeolima simplex, ?Paleyoldia* sp., *Parallelodon* sp., *Pernopecten sowerbii, Posidonia corrugata, Pterinopectinella* sp., *Sanguinolites abdenensis, S. costellatus, S. plicatus, S. striatolamellosus, Schizodus* cf. *axiniformis, Streblochondria* sp., *Streblopteria laevigata, S. ornata, Sulcatopinna flabelliformis, Wilkingia* sp., *Conocardium* sp., *Orthoceras*

sulcatum, ?Poterioceras sp., *?Temnocheilus* sp., *Paladin* sp., ostracods, *?Ureocrinus* sp., *Archaeocidaris* sp., fish fragments.

Comments: see Wilson (1989). The Hurlet Limestone (standard name) may be referred to locally as the Hawthorn Limestone, Main Limestone, Douglas Main Limestone or Cobbinshaw Main Limestone. However, the implied correlation between the Hurlet Limestone of the Glasgow area and Douglas Main Limestone remains relatively weak (see Wilson *in* Lumsden, 1967a, pp.14-15, 21; Wilson, 1989, p.98; Dean, 1998). An abundant coral-brachiopod fauna is present, dominated by productoids, but also with many athyrids and pectenid bivalves. The most common fossils include *Siphonodendron junceum, Eomarginifera* spp., *Lingula* spp., *Phricodothyris* spp., *Productus* spp., *Schizophoria* cf. *resupinata, Actinopteria persulcata* and *Pernopecten sowerbii*. Also present is *Krotovia spinulosa* (which is confined to the Hurlet and Blackhall limestones in central Scotland) and all the principal members of the Macnair Fauna (see Wilson, 1989, p.104).

Fossiliferous exposures of the Hurlet Limestone collected in the Douglas Coalfield area include those in old quarries on the west side of Wedder Law at Wildshaw [NS8769 2820] (see Brand, 1990). Such exposures in the southeast Central Coalfield area include those in Braidwood Burn [NS8431 4812], an un-named stream at Crossbank [NS8254 4577], old limeworks at Crossford at ?[NS8266 4642], Waygateshaw Main Limestone Pit [NS8371 4881], probably a pit on Bashaw Farm [NS8707 5211], and old quarries on Mossside Farm [NS8658 5119], Thorn Farm [NS8709 5154] and Thornmuir Farm [NS8807 5767] (see Brand, 1983a, localities 1, 4, 5, 27; 1983b, localities 3, 10, 13, 14).

Craigenhill Limestone: *Saccamminopsis fusulinaformis, Serpuloides* sp., *Eomarginifera lobata, Lingula mytilloides, Tornquistia* cf. *polita, Euphemites* sp., *Actinopteria persulcata, Sanguinolites costellatus, Streblopteria ornata*, orthocone nautiloid indeterminate, crinoid columnals.

Comments: the Craigenhill Limestone is only present in northern parts of the district (see Wilson, 1989, figs 4 and 7, p.98). The combined fauna comes from four borehole records in the general areas of Wilsontown and Braidwood and quarry exposures at Thorn Farm [NS8709 5154] and Thornmuir Farm [NS8807 5767] (see Brand, 1983b, localities 13 and 14). It is sparse, but typically contains *Streblopteria ornata* (see Wilson, 1989, p.104).

Blackhall Limestone and Neilson Shell Bed: conulariid, *Microcyathus* cf. *cyclostomus, Siphonodendron junceum, Zaphrentites* sp., *?Ceriopora* sp., *Fenestella* sp., *Pennirepora* sp., *Polypora* sp., trepostomatous bryozoa, *Serpuloides* sp., *Angiospirifer* cf. *trigonalis, Antiquatonia muricata, Avonia youngiana, Beecheria* sp., *Buxtonia* sp., *?Cleiothyridina* sp., *Composita* cf. *ambigua, Crurithyris urii, ?Echinoconchus* sp., *Eomarginifera* cf. *lobata, E. longispina, E. setosa, Lingula mytilloides, L. squamiformis, Liralingua* sp., *Orbiculoidea cincta*, orthotetoid, *Phricodothyris* cf. *lineata, Pleuropugnoides* sp., *Productus* cf. *carbonarius, P. concinnus?, Pugilis pugilis?, ?Rhynchopora* sp., *Rugosochonetes celticus, R. speciosus, Schizophoria* sp., *Spirifer*

bisulcatus?, Spiriferellina sp., *Tornquistia* cf. *polita, T. scotica, T. youngi, Angyomphalus* cf. *radians, Donaldina* sp., *Euphemites urii, Glabrocingulum* cf. *armstrongi, G. atomarium, Ianthinopsis* sp., *Naticopsis* cf. *consimilis, Palaeozygopleura scalaroidea, Pseudozygopleura* sp., *Retispira decussata, R. striata, Straparollus (Euomphalus) carbonarius, Strobeus* sp., *Dentalium* sp., *Actinopteria persulcata, Anthraconeilo (Palaeoneilo) laevirostrum, A. (P.) luciniformis, A. (P.) mansoni, Aviculopecten* sp., *?Aviculopinna* sp., *?Cypricardella* sp., *Edmondia transversa?, Euchondria* sp., *Leiopteria* cf. *thompsoni, Limipecten dissimilis, Modiolus* sp., *Nuculopsis gibbosa, Parallelodon* cf. *semicostatus, Pernopecten fragilis, P. sowerbii, Phestia brevirostris, P. (Polidevcia) attenuata, Posidonia corrugata, Pterinopectinella granosa?, Sanguinolites costellatus, Schizodus* sp., *Streblochondria* sp., *Sulcatopinna* cf. *flabelliformis, S.* cf. *mutica, Catastroboceras* sp., *Liroceras* sp., *Orthoceras* sp., quadrate nautiloid indeterminate, *Reticycloceras sulcatum,* goniatite indeterminate, trilobite fragments, ostracods, crinoid columnals and calyx plates, *Archaeocidaris* sp., echinoderm fragments indeterminate, fish fragments.

Comments: see Wilson (1989), Wilson *in* Lumsden (1967a, p.15), Lumsden (1967a, p.19 and references therein). The Blackhall Limestone (standard name) may be referred to locally as the Muirkirk Wee Limestone, Douglas Wee Limestone or Foul Hosie Limestone. The Neilson Shell Bed normally occurs in the mudstone above the limestone or in argillaceous intercalations in the upper part of the limestone where it is thickly developed. An abundant fauna is present, strongly represented by productoids, with many chonetids, spiriferids and nuculids. Typically common forms include *Crurithyris urii, Eomarginifera* spp., *Euphemites urii, Retispira* spp., *Straparollus (Euomphallus) carbonarius, Nuculopsis gibbosa* and *Phestia (Polidevcia) attenuata*. *Microcyathus* cf. *cyclostomus, Glabrocingulum atomarium* and *Catastroboceras* sp. also occur, the last two species in noteworthy numbers. *Tornquistia scotica* is confined to the Hurlet and Blackbyre limestones in central Scotland, but the most significant species present are *Tornquistia youngi* and *Pernopecten fragilis* which are, at present, only known at this horizon (Wilson, 1989, pp.104-105).

Fossiliferous exposures of the Blackhall Limestone and Neilson Shell Bed collected in the Douglas Coalfield area include that in the Craig Burn at ?c.[NS8696 3334] (see Lumsden, 1967a, p.7; Wilson *in* Lumsden, 1967a, pp.13-14). Those in the southeast Central Coalfield area include probably a quarry at Mountainblaw [NS9735 5586], old shale heaps at Raesgill, Jocks Burn [NS8246 4997], probably an old quarry on Bashaw Farm [NS8744 5237] and shale heaps in an old quarry on Hillhead Farm [NS8610 5099] (see Brand, 1991, locality 2; 1983a, locality 14; 1983b, localities 2, 7).

Hosie Limestones

See Wilson (1989). Correlation of the Hosie Limestones (standard name) with the highly variable group of MacDonald Limestones in the Douglas sequence is dangerous and inadvisable. But for the sake of simplicity the following attempt has been made, based on Lumsden (1967a, p.19, fig.4). The Main Hosie Limestone may be referred to locally as the lowest part of the McDonald Limestones, or the Birkfield Limestone. The Mid Hosie

Limestone may be referred to locally as part of the McDonald Limestones sequence, or the 2nd Kingshaw Limestone. The 2nd Hosie Limestone may be referred to locally as part of the McDonald Limestones sequence, or the 1st Kingshaw Limestone. The Top Hosie Limestone may be referred to locally as the highest part of the McDonald Limestones sequence.

Main Hosie Limestone: *Ortonia carbonaria*, *Zaphrentites* sp., *Fenestella* sp., *Hyphasmopora buskii, ?Lanarkopora* sp., *Palaeocoryne* sp., *Penniretepora* sp., *Rhabdomeson* sp., *Sulcoretepora parallela*, encrusting bryozoan, trepostomatous bryozoa, *Serpuloides carbonarius, Angiospirifer* cf. *trigonalis, Avonia youngiana, Beecheria hastata, Buxtonia* sp., *Composita ambigua, Crania* sp., *Crurithyris urii, Echinoconchus elegans, Eomarginifera lobata, E. longispina, E. setosa?, ?Kochiproductus* sp., *Lingula mytilloides?, L. squamiformis, Orbiculoidea cincta,* orthotetid, *Overtonia fimbriata, Phricodothyris* cf. *lineata, Pleuropugnoides* sp., *Productus* sp., *?Promarginifera* sp., *Pugilis pugilis, ?Pugnax* sp., *?Reticularia* sp., *Rugosochonetes celticus, R. speciosus?, Schizophoria* cf. *resupinata, Spirifer* cf. *bisulcatus, Spiriferellina perplicata, Tornquistia* sp., *Donaldina* sp., *Euphemites* cf. *urii, Naticopsis variata?, ?Pseudozygopleura* sp., *Dentalium* sp., *Aviculopecten plicatus?, Euchondria* sp., *Limipecten dissimilis, Lithophaga lingualis, Nuculopsis gibbosa, Pernopecten sowerbii, Phestia (Polidevcia) attenuata, Posidonia corrugata, Pterinopectinella* cf. *granosa, Solemya* sp., *Streblochondria* sp., *Streblopteria ornata?*, orthocone nautiloid indeterminate, goniatite indeterminate, trilobite fragments, crinoid columnals, *Archaeocidaris* sp., fish fragments including a palaeoniscid scale, *Cauda-galli?*

Mid Hosie Limestone: algae, *Siphonodendron junceum, Zaphrentites* sp., ?bryozoa indeterminate, *Avonia youngiana, Beecheria treakensis?, Cleiothyridina* sp., *Composita ambigua, Crania ryckholtiana, Crurithyris urii, Echinoconchus elegans, Eomarginifera lobata, E. longispina, E.* cf. *setosa, Lachrymula* cf. *inusitata, Lingula* sp., *Liralingua wilsoni, Orbiculoidea* cf. *cincta,* orthotetid, *Phricodothyris* sp., *Pleuropugnoides* cf. *pleurodon, Productus* cf. *concinnus, Pugilis* sp., *Rugosochonetes* cf. *celticus, Schizophoria resupinata, Spiriferellina octoplicata?, Tornquistia* cf. *polita, Donaldina* sp., *Euphemites urii, Glabrocingulum* sp., *Naticopsis* sp., *Platyceras* sp., *Retispira* cf. *decussata, R*. cf. *striata, Dentalium* sp, *Actinopteria* cf. *persulcata, Anthraconeilo (Palaeoneilo) mansoni, Aviculopecten* sp., *Cardiomorpha* sp., *Edmondia* sp., *Euchondria* sp., *gen. et sp. nov., ?Leiopteria* sp., *?Modiolus* sp., *Myalina* cf. *mitchelli, Nuculopsis gibbosa, Parallelodon* cf. *semicostatus, Pernopecten sowerbii, Phestia (Polidevcia) attenuata, Posidonia corrugata, Pterinopectinella* sp., *Sanguinolites costellatus, S. striatolamellosus, Schizodus* sp., *Streblochondria* sp., *Streblopteria ornata*, orthocone nautiloid indeterminate, trilobite fragments, ostracods, crinoid columnals, burrow traces.

2nd Hosie Limestone: *Zaphrentites* sp., trepostomatous bryozoa, *Avonia youngiana, Composita* sp., *Eomarginifera* cf. *lobata, E.* cf. *longispina, E. setosa?, ?Lachrymula* sp., *Lingula squamiformis, Liralingua* sp., *Orbiculoidea cincta*, orthotetoid, *Pleuropugnoides* cf. *pleurodon, Productus* cf. *concinnus, ?Pugilis* sp., *Schellweinella* sp., *Schizophoria* cf. *resupinata, Naticopsis* cf. *variata*, modioloid?, *Nuculopsis gibbosa, Pernopecten*

sowerbii, Phestia (Polidevcia) attenuata, Streblochondria sp., orthocone nautiloid indeterminate, ostracods, crinoid columnals, *Archaeocidaris* sp.

Top Hosie Limestone: corals indeterminate, *?Fenestella* sp., *?Penniretepora* sp., *Polypora* sp., *Rhabdomeson* sp., trepostomatous bryozoa, *Serpuloides carbonarius, Actinoconchus* aff. *paradoxus, Antiquatonia muricata, A. sulcata?, Avonia youngiana, Balanoconcha saccula?, Beecheria treakensis?, Brachythyris* sp., *Brochocarina trearnensis?, Buxtonia* sp., chonetid, *Composita ambigua, Crurithyris* sp., *Echinoconchus elegans?, Eomarginifera setosa?, Lingula mytilloides, L. squamiformis, Liralingua wilsoni, Orbiculoidea* cf. *nitida, Phricodothyris* sp., *Pleuropugnoides pleurodon?, Productus concinnus, ?Pugilis* sp., *Schellweinella* sp., *Schizophoria* sp., *Spirifer bisulcatus* group, *Spiriferellina* sp., *Euphemites* sp., *Naticopsis variata?, Retispira decussata, ?Strobeus* sp., *?Dentalium sp., ?Aviculopecten* sp., *Euchondria* sp., *?Lithophaga* sp., *Myalina* sp., *Naiadites crassus, Pernopecten sowerbii, Phestia (Polidevcia) attenuata, Posidonia corrugata, Sanguinolites* cf. *striatolamellosus, Schizodus* sp., *Solemya primaeva, ?Streblochondria* sp., *Sulcatopinna flabelliformis, Wilkingia* cf. *maxima, Conocardium* sp., *Orthoceras* sp., goniatite indeterminate, trilobite fragments, ostracods, crinoid calyx plates and columnals, *Archaeocidaris* sp., echinoderm fragments indeterminate, fish fragments, burrow traces, coprolite?

Comments: see Wilson (1989, pp.105-107). In the district, corals are relatively scarce throughout the Hosie Limestones. Trepostomatous bryozoa and the bivalve *Posidonia corrugata* occur in more significant numbers in the Main and Top Hosies, and of the list of common and widespread, abundant and characteristic species given by Wilson (1989), *Avonia youngiana, Pleuropugnoides* sp., *Productus* sp., *Pernopecten sowerbii* and *Phestia (Polidevcia) attenuata* are found in all four beds. Other forms noteworthy for their relative abundance are *Fenestella* sp. in the Main Hosie Limestone, *Eomarginifera* spp. in the Main and Mid Hosie limestones, and *Lingula* spp. and orthotetids (including *Brochocarina trearnensis?* and *Schellweinella* sp.) in the Top Hosie Limestone.

Fossiliferous exposures of the Hosie Limestones in the Douglas Coalfield area probably include those in the Poniel Water c.[NS8021 3306] (see Wilson, 1957, locality 3; Lumsden 1967a, p.5; Wilson *in* Lumsden, 1967a, p.14, locality 14). Those in the southeast Central Coalfield area include the River Nethan [NS8166 4627] and [NS8163 4613], Jocks Burn [NS8278 4998] to [NS8277 4998], [NS8272 4995] and [NS8251 5015], Mouse Water [NS9599 5657], Dippool Water [NS9864 5393], [NS9865 5390] and [NS9963 5527], and Upper Haywood [NS9691 5575] and [NS9694 5556] (see Brand, 1983a, localities 12, 13, 20, 21; 1983c, locality 13; 1991a, locality 3; Dean, 1998a).

Non-marine faunas of the Lower Limestone Formation: *Naiadites* sp. and a fish scale were recorded below the Main Hosie Limestone at 10.97m depth in the Lesmahagow Bore 3 Tower 8 (NS83NW/107/3)[NS8397 3922]. A specimen of *Curvirimula* sp. was recovered from above the Craigenhill Limestone at 19.81m depth in the Braidwood No.1 bore (NS84NE/49)[NS8506 4838], and also (with fish fragments) from the Raesgill Ironstones (which occur between the Blackhall and Main Hosie limestones) at outcrop in

an old quarry between Dyke Row and Mossside [NS8607 5224] (see Brand, 1983b, locality 4).

Limestone Coal Formation: Namurian, Pendleian (E1 Goniatite Zone; NC Miospore Zone).

Johnstone Shell Bed: *Serpuloides carbonarius, Angiospirifer* cf. *trigonalis, Buxtonia* sp., *Composita ambigua, ?Crurithyris* sp., *Eomarginifera* cf. *lobata, Lingula mytilloides, L. squamiformis, Linoproductus* sp., *Liralingua wilsoni, Pleuropugnoides* cf. *greenleightonensis, P.* cf. *pleurodon, Productus carbonarius?, P. concinnus, Rugosochonetes* sp., *Schellweinella* sp., *Schizophoria* cf. *resupinata, ?Stenoscisma* sp., *Donaldina* sp., *Euphemites urii, ?Glabrocingulum* sp., *Naticopsis variata, Retispira* cf. *decussata, R.* cf. *striata, Straparollus* sp., *Dentalium* sp., *Anthraconeilo (Palaeoneilo) laevirostrum, A. (P.) luciniformis, A. (P.) mansoni, Aviculopecten* cf. *scoticus, Aviculopinna* cf. *mutica, Cardiomorpha hindi?, ?Dunbarella* sp., *Edmondia* cf. *maccoyi, E. sulcata, E.* cf. *unioniformis, Euchondria* sp., *Leiopteria* sp., *Limipecten* sp., *Lithophaga lingualis, Modiolus* sp., *Myalina mitchelli, Palaeolima* sp., *Pernopecten sowerbii, Phestia (Polidevcia) attenuata, Sanguinolites costellatus, S. plicatus, S. sp. nov., S. striatolamellosus, S.* cf. *striatus, S.* cf. *tricostatus, Schizodus* cf. *axiniformis, S.* aff. *pentlandicus, S.* cf. *taiti, ?Sedgwickia attenuata, Solemya* sp., *Streblochondria* sp., *Streblopteria ornata, Wilkingia maxima?*, orthocone nautiloid indeterminate, goniatite indeterminate, trilobite fragments, ostracods, crinoid columnals, fish fragments, trace fossils.

Comments: see Wilson (1967) and Lumsden (1964). The Johnstone Shell Bed in central Scotland is normally developed in two 'leaves', the lower of the two normally carrying the richer faunal assemblage. In the district either 'leaf', or the single united bed, may be reduced to a *Lingula*-band. The lower leaf can also be developed as a limestone (the Slingstane Limestone). All the dominant forms in the Johnstone Shell Bed listed by Wilson (1967, p.456) are present in the above faunal list, with particularly large numbers of *Lingula squamiformis, Pleuropugnoides* cf. *pleurodon, Productus* spp. and *Streblopteria ornata*. The same author discussed the lateral distribution of species including *Composita ambigua, Schizophoria* cf. *resupinata*, orthotetids (including *Schellweinella* sp.), and *Aviculopinna mutica* (see also Wilson, 1967, p.463).

Fossiliferous exposures of the Johnstone Shell Bed collected in the Douglas Coalfield area include that in the Poniel Water [NS8024 3310] (see Wilson, 1957, locality 4; also Lumsden, 1964, pp.46-47). Such exposures collected in the southeast Central Coalfield area include the Fiddler Gill at [NS8468 4727], the Fiddler Burn at [NS8457 4702] and probably at [NS8472 4733], the River Nethan at [NS8160 4640], and probably the Mashock Burn at [NS8423 4681] (see Brand, 1988b; 1983a, localities 7, 8, and 16).

Black Metals Marine Band: *Serpuloides carbonarius, Angiospirifer* cf. *trigonalis, Buxtonia* sp., *Lingula mytilloides, L. squamiformis, Liralingua wilsoni, Orbiculoidea craigii, O.* cf. *nitida, Pleuropugnoides* cf. *greenleightonensis, P.* cf. *pleurodon, Productus concinnus, Pugilis pugilis?, Serratocrista* sp., *Euphemites* sp., *Anthraconeilo*

(Palaeoneilo) mansoni, Edmondia cf. *senilis, Myalina mitchelli?, Naiadites* (*crassus* - like), *Nuculopsis gibbosa, ?Sedgwickia* sp., *?Streblochondria* sp., orthocone nautiloid indeterminate, ostracods, crinoid columnals, arthropod fragments indeterminate, fish fragments.

Comments: see Wilson (1967). The marine band is poorly developed in the Douglas Coalfield area (see Lumsden, 1964) and in general the fauna is less rich than that of the Johnstone Shell Bed. In the district, the marine band is often developed in two 'leaves', and either 'leaf' (or the single united bed) may be reduced to a *Lingula*-band.

All the dominant forms listed by Wilson (1967, p.457), except *Streblopteria ornata*, are present in the Black Metals Marine Band in the district, with particularly large numbers of *Lingula squamiformis*. His observations regarding the lack of *Aviculopinna mutica* and numerical superiority of *Buxtonia* sp. over *Productus* sp. are corroborated.

Fossiliferous exposures of the Black Metals Marine Band in the Douglas Coalfield area include that in the Poniel Water at [NS8023 3322] (see Wilson, 1957, locality 5; also Lumsden, 1964, p.48). Such exposures in the southeast Central Coalfield area include Jocks Burn at [NS8342 5018] and probably at [NS8614 5041], the River Nethan at [NS8163 4654], and probably in the Mosshat Burn at [NS9813 5589] (see Brand, 1983a, locality 17; 1983b, locality 9; 1983c, locality 12; 1991a, locality 1).

Minor marine bands, *Lingula* bands and non-marine faunas of the Limestone Coal Formation: in the southeast Central Coalfield area, minor marine bands have been proved sporadically in strata above the Top Hosie Limestone (with *Myalina mitchelli*) and above the 'China Coal' (with *Lingula mytilloides, L. squamiformis* and *Orbiculoidea* cf. *nitida*). *Lingula*-bands have also been noted above the ' Haywood Under Coal' (with *Lingula squamiformis*) and from below the ' Wilsontown Main Coal' to below the 'Balbardie Gas Coal' (with *Lingula mytilloides, L. squamiformis* and indeterminate fish fragments). The non-marine faunas are dominated by *Naiadites* spp. (including *N. tumidus?* and *N. magnus*). The genus commonly occurs associated with the Johnstone Shell Bed with rare *'Paracarbonicola' pervetusta* (see Brand, 1983d; 1998), and with the Black Metals Marine Band, with a eurypterid? at Jocks Burn [NS8342 5018] (see Brand 1983c, locality 12). Other occurences include stratigraphically above and below the 'Wilsontown Gas Coal', above the 'Main Coal', between the First and Second Carluke coals, between the 'China' and 'Woodmuir Main' coals and above the 'Auchenheath Gas Coal'. *?Hibbertopterus* sp. was recovered from strata at 85.95m depth in the Wilsontown Deep Bore (NS95NE/81)[NS9518 5563], c.31m above the Top Hosie Limestone (see Brand, 1991b). *Curvirimula* sp. and an indeterminate arthropod fragment were recovered from between the Index Limestone and 'China Coal' at 26.01m depth in the Kingshill No.3 Pit Bore No.15 (NS85SE/47) [NS8579 5444].

In the Douglas Coalfield area (see also Lumsden, 1964, in particular p.55), *Lingula*-bands have been noted sporadically between the 'Kirkroad' and 'Horn' coals (with *Lingula mytilloides* and indeterminate fish fragments) and above the 'Nameless Coal' (with *Lingula* sp.) The non-marine faunas include *Naiadites* sp. from between the 'Skaterigg'

and ‘Big Drum’ coals, from above the Black Metals Marine Band and from below the Index Limestone (the last mentioned with ostracods and indeterminate fish fragments). These occurrences were noted at c.448m, 526.2m and c.401m depth respectively in the Mainshill Bore Douglas (NS83SE/40) [NS8578 3252]. *?Paracarbonicola* sp. has been recovered from the top of the Johnstone Shell Bed in the Happendon Wood Bore (NS83SE/38) [NS8510 3382] and the Mainshill Bore Douglas (see Brand, 1998, and above).

Upper Limestone Formation: Namurian, Pendleian to Arnsbergian (E1 to E2 Goniatite zones; TK to SO Miospore zones). For correlation of the Douglas Coalfield succession with that of Central Scotland see Lumsden (1967b, pp.35-39).

Index Limestone: *Ortonia carbonaria, Paraconularia* sp., *Syringopora* sp., *Serpuloides carbonarius, Ceriopora* sp., *Diastopora megastoma, Fenestella* sp., *Paleocoryne* sp., trepostomatous bryozoa, *?Avonia* sp., *Beecheria* sp., *Buxtonia* sp., *Cleiothyridina* sp., *Composita ambigua, Crania* sp., *Gigantoproductus* aff. *irregularis, Latiproductus latissimus?, Lingula mytilloides, L. squamiformis, Liralingua wilsoni, Orbiculoidea* cf. *cincta, O. nitida, Phricodothyris* sp., *Pleuropugnoides* cf. *pleurodon, Productus* sp., *?Promarginifera* sp., *?Reticularia* sp., *Rugosochonetes* sp., *Schellweinella* sp., *Schizophoria* sp., *Spiriferellina* cf. *octoplicata, ?Stenoscisma* sp., *?Trigonoglossa* sp., *Baylea* sp., *Borestus wrighti?, Donaldina* sp., *Euphemites hindi?, E. urii, Ianthinopsis* sp., *Meekospira* sp., *Naticopsis* cf. *variata*, *Retispira* cf. *decussata, R. striata, Straparollus (Euomphalus) carbonarius, Dentalium* sp., *Anthraconeilo (Palaeoneilo) laevirostrum, A. (P.) luciniformis, A. (P.) mansoni?, Aviculopecten inequalis?, A.* cf. *scoticus, Aviculopinna* cf. *mutica, Cardiomorpha* sp., *Cypricardella* sp., *Edmondia punctatella?, E.* cf. *senilis, E. sulcata, ?Euchondria* sp., *Leiopteria* sp., *?Limipecten* sp., *Lithophaga lingualis, Myalina mitchelli, M.* cf. *verneuili, Nuculopsis gibbosa, ?Palaeolima* sp., *Paleyoldia macgregori, Parallelodon* cf. *semicostatus, Pernopecten* sp., *Phestia (Polidevcia) attenuata, Posidonia corrugata, Prothyris scotica, ?Pterinopectinella* sp., *Sanguinolites* cf. *costellatus, S.* cf. *plicatus, S. tricostatus?, S. variabilis* group, *Schizodus* sp., *Streblochondria* sp., *Streblopteria ornata, Sulcatopinna flabelliformis, Wilkingia elliptica, W. maxima?, Ephippioceras* sp., *Epidomatoceras neilsoni, Reticycloceras sulcatum*, orthocone nautiloid indeterminate, *?Anthracoceras* sp., *Weberides* cf. *mucronatus, Poteriocrinus quinqueangularis*, arthropod fragments indeterminate, *Archaeocidaris* sp., fish fragments.

Comments: see Wilson (1967, pp.457, 461), Wilson *in* Lumsden (1967b, p.32). A fairly abundant fauna but almost devoid of corals. It is dominated by brachiopods (especially lingulids and productoids), gastropods and bivalves (especially nuculids and pectenids). The common presence of algal concretions and *Latiproductus* cf. *latissimus* in the limestone is highly characteristic, as is the presence in the associated mudstones of *Serpuloides carbonarius, Pleuropugnoides* cf. *pleurodon, Lingula* spp., orthotetids (including *Schellweinella* sp.), *Euphemites* spp., *Meekospira* sp., *Retispira* spp., *Anthraconeilo (Palaeoneilo) luciniformis, Posidonia corrugata, Sanguinolites* spp. and *Streblopteria ornata*. *Meekospira* sp. has its acme occurrence in the Index Limestone.

Fossiliferous exposures of the Index Limestone collected in the Douglas Coalfield area include that in an old quarry at Longhill Burn [NS8218 3329] (see Lumsden, 1967b, p.22; Wilson *in* Lumsden, 1967b, pp.31-32). Such exposures collected in the southeast Central Coalfield area include that in an old quarry near Easter Greenwell at ?[NS9334 5542] and probably that in another old quarry near the UP Church, Climpy at ?[NS9297 5551] (see Brand, 1991c, localities 1 and 3).

'Huntershill Cement Limestone': *Beecheria* sp., *Lingula* aff. *squamiformis, Pleuropugnoides* sp., productoid, *Schellweinella* sp., bellerophontid, *Euphemites* sp., *Anthraconeilo (Palaeoneilo) laevirostrum, Aviculopecten* sp., *Edmondia* sp., *Euchondria* sp., *Myalina* sp., *Phestia (Polidevcia) attenuata, Posidonia* cf. *corrugata, Sanguinolites angustatus* group, *S. plicatus?, S. variabilis* group, *Schizodus axiniformis, Streblochondria* sp., *Streblopteria ornata*, trilobite fragments, crinoid columnals, burrows.

Comments: see Wilson (1967, p.457). The Huntershill Cement Limestone (Macgregor and others, 1925, p.73) comprises a thin marine band occuring at the top of the Bishopbriggs Sandstone in the Glasgow area. Its identification in the area of Sheet 23E is likely confused with the development of a fossiliferous band at the top of the Index Limestone roof-shales. Its separate consideration is probably incorrect.

The fauna, which is impoverished, mainly contains orthotetids, *Sanguinolites* spp. *Schizodus* sp. and *Streblopteria ornata*. Wilson (1967, p.457) referred to the presence of a fauna restricted to orthotetids in a sandy limestone (the 'Shell Band Limestone') developed above the immediate roof-shale to the Index Limestone in the Douglas Coalfield area. The 'Shell Band Limestone' is exposed in an old quarry at Longhill Burn [NS8218 3329] (see Lumsden, 1967b, pp.22, 37; Wilson *in* Lumsden, 1967b, pp.31-32).

Lyoncross Limestone: sponge?, *Aulophyllum* sp., *Syringopora* sp., *Serpuloides carbonarius, Fenestella* sp., *Rhabdomeson* sp., trepostomatous bryozoa, *Antiquatonia* cf. *muricata, ?Avonia* sp., *?Buxtonia* sp., *Composita* cf. *ambigua, Echinoconchus* cf. *punctatus, Eomarginifera* cf. *lobata, E.* cf. *longispina, Gigantoproductus* sp., *Latiproductus* cf. *latissimus, Lingula mytilloides,* orthotetid, *Pleuropugnoides* cf. *pleurodon, Productus carbonarius?, ?Promarginifera* sp., *Pugilis* cf. *pugilis, ?Pugnax* sp., *Rugosochonetes* sp., *?Sinuatella* sp., *Stenoscisma* sp., *Baylea* cf. *parva, Donaldina* sp., *Euphemites* cf. *ardenensis, E.* cf. *hindi,* loxonematid, *Retispira* cf. *decussata, Straparollus (Euomphalus) carbonarius, Anthraconeilo (Palaeoneilo) laevirostrum, A. (P.) luciniformis, A. (P.) mansoni, Aviculopecten scoticus?, Cypricardella* sp., *Edmondia sulcata?, ?Euchondria* sp., *Leiopteria* cf. *thompsoni, Limipecten* sp., *Nuculopsis gibbosa, Palaeolima* cf. *simplex, Parallelodon* cf. *semicostatus, Pernopecten* sp., *Phestia (Polidevcia) attenuata, ?Prothyris* sp., *Schizodus* cf. *impressus, Sedgwickia* sp., *Streblochondria* sp., *Streblopteria ornata, Sulcatopinna* cf. *flabelliformis, Wilkingia elliptica?*, orthocone nautiloid indeterminate, trilobite fragments, crinoid columnals.

Comments: see Wilson (1967, p.458), Wilson *in* Lumsden (1967b, pp.32-33). The fauna comprises mostly brachiopods (including productoids) and bivalves (including nuculids

and pectenids). Wilson (1967, p.458) referred to the presence of *Eomarginifera* spp. and *Streblopteria ornata* in the Lyoncross Limestone of central Scotland. This is the stratigraphically highest occurrence of the last mentioned bivalve in the area of Sheet 23E (see also Wilson, 1967, pp.461, 481-482). Fossiliferous exposures of the Lyoncross Limestone include those collected in the Douglas Coalfield area at Poniel Water [NS8232 3335] (see Lumsden, 1967b, p.24; Wilson *in* Lumsden, 1967b, pp.31-33)

Orchard Limestone: sponge?, caniniid, *Clisiophyllum* sp., *Hexaphyllia* sp., *Zaphrentites* cf. *disjuncta, Serpuloides carbonarius?, Fenestella* sp., *Pennirетepora* sp., *?Rhabdomeson* sp., trepostomatous bryozoa, *Alitaria* sp., *Antiquatonia costata, A*. cf. *muricata, Avonia youngiana, Beecheria* sp., *Buxtonia* sp., *Cleiothyridina* sp., *Composita* cf. *ambigua, ?Crurithyris* sp., *Echinoconchus* cf. *punctatus, Eomarginifera* cf. *lobata, E. longispina, E. praecursor?, ?Gigantoproductus* sp., *Isogramma* sp., *Lachrymula latior?, Latiproductus latissimus?, Lingula mytilloides, L. squamiformis, Linoproductus* sp., *Linoprotonia* sp., *Liralingua* sp., *Orbiculoidea* cf. *cincta, O.* cf. *nitida, Pleuropugnoides* sp., *Productus carbonarius?, Pugilis pugilis?, ?Pugnax* sp., *Rugosochonetes* cf. *celticus, ?Schellwienella* sp., *Schizophoria* cf. *resupinata, ?Schuchertella* sp., *?Sinuatella* sp., *Spirifer* cf. *bisulcatus, Spiriferellina* cf. *insculpta, S.* cf. *perplicata, Tornquistia* cf. *polita, Baylea parva?, Bellerophon* cf. *anthracophilus, Donaldina* sp., *Euphemites* cf. *ardenensis, E.* cf. *hindi, Glabrocingulum armstrongi, ?Latischisma* sp., *Macrochilina* sp., *?Meekospira* sp., *Naticopsis* cf. *variata, Pseudozygopleura rugifera?, Retispira* cf. *decussata, R.* cf. *striata,* soleniscid, *Straparollus (Euomphalus) carbonarius, Dentalium* sp., *Anthraconeilo (Palaeoneilo) laevirostrum, A. (P.) luciniformis, A. (P.) mansoni, Aviculopecten scoticus?, Aviculopinna* cf. *mutica, Cardiomorpha* sp., *?Clinopistha* sp., *Cypricardella* cf. *rectangularis, Edmondia sulcata, E.* cf. *transversa, Euchondria* sp., *Leiopteria* sp., *Limipecten* cf. *dissimilis, ?Lithophaga lingualis, Nuculopsis gibbosa, Palaeolima* cf. *simplex, Parallelodon* cf. *semicostatus, Pernopecten sp. nov., Phestia (Polidevcia) attenuata, Posidonia corrugata, ?Prothyris* sp., *Pterinopectinella murchisoni?, Sanguinolites striatolamellosus, Schizodus* sp., *Streblochondria* cf. *elliptica, Sulcatopinna* cf. *mutica, Wilkingia elliptica?, Catastroboceras* sp., orthocone nautiloid indeterminate, goniatite indeterminate, *Weberides* cf. *mucronatus*, ostracods, crinoid columnals, *Archaeocidaris* sp.

Comments: see Wilson (1967, pp.458, 460-461, 463-464, 472-473), Wilson *in* Lumsden (1967b, p.33). A rich fauna dominated by brachiopods (in particular productoids) and molluscs (especially pectenid and nuculid bivalves). Corals (including *Zaphrentites* sp.) and bryozoa (especially *Fenestella* sp. and trepostomatous forms) are also well represented. Other common forms are *Antiquatonia* spp. (including *A. costata,* which occurs commonly only at the Orchard Limestone), *Eomarginifera* spp., *Latiproductus* cf. *latissimus, Schizophoria* sp., *Straparollus (Euomphallus) carbonarius* (which has its acme occurrence at the Orchard Limestone)*, Phestia (Polidevcia) attenuata, Posidonia corrugata*, indeterminate nautiloids, and trilobite fragments (including *Weberides* cf. *mucronatus*). Also worthy of note is the single specimen of *Isogramma* sp., a brachiopod genus that is extremely rare in the British Carboniferous (Wilson *in* Lumsden, 1967b, p.33; see also Brand, 1970b).

Fossiliferous exposures of the Orchard Limestone collected in the Douglas Coalfield area include those in the Poniel Water at [NS8242 3328] and in the Craig Burn at [NS8682 3368] (see Lumsden, 1967b, p.26; Wilson *in* Lumsden, 1967b, pp.31-33). Such exposures in the southeast Central Coalfield area include in a burn behind Gillfoot House at [NS8311 4766], in Belstone Burn at [NS8484 5138], and probably at a track side near Gowan Glen [NS83735 47560] (see Brand, 1983a, locality 10; 1983c, locality 3; 1988b, locality 2).

'Douglas Extra Limestone': *Hexaphyllia* sp., *Fenestella* sp., *Penniretepora* sp., trepostomatous bryozoa, *Antiquatonia* sp., *?Brachythyris* sp., *Buxtonia* sp., *Eomarginifera praecursor?, ?Gigantoproductus* sp., *Lingula mytilloides*, orthotetid, *Pleuropugnoides* sp., *Productus* sp., *Pugilis pugilis?*, spiriferid, *?Stenoscisma* sp., *Euphemites* sp., *Glabrocingulum* sp., *Retispira* cf. *striata, Anthraconeilo (Palaeoneilo) laevirostrum?, A. (P.) mansoni, Aviculopecten scoticus?, ?Cardiomorpha* sp., *Edmondia sulcata, ?Euchondria* sp., *Limipecten dissimilis?, Myalina* sp., *Phestia (Polidevcia) attenuata, ?Posidonia* sp., *Prothyris scotica, ?Pterinopectinella* sp., *Sanguinolites* cf. *plicatus, Schizodus* aff. *carbonarius, ?Sedgwickia* sp., *Solenomorpha minor, Streblochondria* sp., *Wilkingia elliptica*, orthocone nautiloid indeterminate, trilobite fragments, crinoid columnals, *Archaeocidaris* sp., *Planolites* sp., coprolites.

Comments: a poor fauna of mostly productoid brachiopods and pectenid bivalves. *Buxtonia* sp., *Pleuropugnoides* sp., *Phestia (Polidevcia) attenuata*, and *Streblochondria* sp. are the more common forms in this local marine development found north of Douglas. Fossiliferous exposures collected for fossils include the sequence in the Craig Burn from [NS8673 3398] to [NS8683 3367] (see Lumsden, 1967b, pp.26, 37; Wilson *in* Lumsden, 1967b, pp.31-34).

Calmy Limestone: *Ortonia carbonaria, Conularia* sp., *?Aulina rotiformis*, caniniid, *Clisiophyllum* sp., *?Dibunophyllum* sp., *Lithostrotion* aff. *decipiens*, lonsdaleoid?, *?Microcyathus* sp., *Siphonodendron* aff. *junceum, S. pauciradiale, Zaphrentites disjuncta, Serpuloides carbonarius, Spirorbis* sp., *Diastopora megastoma,* encrusting bryozoan, *Fenestella* sp., *Goniocladia cellulifera, Palaeocoryne* sp., *?Penniretepora* sp., *Polypora* sp., *?Rhabdomeson* sp., trepostomatous bryozoa, *Alitaria* sp., *Angiospirifer trigonalis, Antiquatonia hindi?, A.* cf. *insculpta, A. muricata?, A.* cf. *scotica, Beecheria* cf. *hastata, Buxtonia* sp., *Composita ambigua, Crania ryckholtiana, Crurithyris* sp., *Echinoconchus* sp., *Eomarginifera lobata?, E. longispina?, E. praecursor?, Latiproductus* cf. *latisimus, Gigantoproductus* sp., *Hustedia* cf. *radialis, ?Isogramma* sp., *Lachrimula* cf. *inusitata, Leptagonia smithi, Lingula mytilloides, L. squamiformis, L. straeleni?, ?Linoproductus* sp., *Liralingua wilsoni, Orbiculoidea* cf. *cincta, O.* cf. *nitida, Phricodothyris* sp., *Pleuropugnoides* cf. *pleurodon, ?Plicochonetes* sp., *Productus carbonarius, Pugilis pugilis?, Pugnax pugnus, Rugosochonetes caledonicus, R. celticus, R. speciosus*, *Schellweinella* sp., *Schizophoria resupinata, Serratocrista* sp., *Sinuatella* cf. *sinuata, Spirifer bisulcatus, Spiriferellina* cf. *octoplicata, S.* cf. *perplicata, Stenoscisma* sp., *Tornquistia* sp., *Trigonoglossa scotica, Baylea parva, Bellerophon anthracophilus, Donaldina* sp., *Euphemites ardenensis, E.* cf. *hindi, E. urii, Glabrocingulum armstrongi, ?Leptozyga* sp., *Meekospira* sp., *?Mourlonia* sp., *Naticopsis variata?, Orthonema* cf.

pygmaeum, Palaeozygopleura scalaroidea, Platyceras velestus, Pseudozygopleura robroystonensis, P. rugifera, Retispira decussata, R. cf. *striata, ?Soleniscus* sp., *Strobeus* sp., *Dentalium* sp., *Actinopteria regularis, Anthraconeilo (Palaeoneilo) laevirostrum, A. (P.) luciniformis?, A. (P.) mansoni, Aviculopecten* sp., *Cardiomorpha hindi, Cypricardella* sp., *Edmondia punctatella, E. sulcata, E*. aff. *unioniformis, Euchondria sp. nov., Leiopteria* sp., *Limatulina* sp., *Modiolus* sp., *Myalina mitchelli, M. pernoides?, M*. cf. *verneuili, Nuculopsis gibbosa, Palaeolima* cf. *simplex, Paleyoldia macgregori, Parallelodon semicostatus, Pernopecten* sp., *Phestia (Polidevcia) attenuata, Posidonia corrugata, ?Promytilus* sp., *Prothyris scotica, Pterinopectinella* sp., *Sanguinolites abdenensis* group, *S. clavatus?, S. costellatus?, S. striatolamellosus, S. tricostatus?, Schizodus taiti, ?Sedgwickia sp., Solemya primaeva?, Solenomorpha* cf. *minor, Streblochondria* sp., *Wilkingia elliptica, Cyrtoceras* sp., *Ephippioceras* sp., *?Epidomatoceras* sp., *Nautilus* sp., *Orthoceras sulcatum, Rayonoceras* sp., *Tylonautilus nodiferus, Anthracoceras* aff. *glabrum, A. mooreae, A. paucilobum, Eumorphoceras bisulcatum, Paladin* sp., *Phillipsia* cf. *eichwaldi,* crinoid columnals, *Archaeocidaris* sp., fish fragments.

Comments: see Wilson (1967, pp.458-461, 473), Wilson *in* Lumsden (1967b, pp.34-35). A diverse fauna rich in various corals, bryozoa, brachiopods, molluscs, cephalopods and arthropods. The more numerous forms include *Serpuloides* sp., *Composita* cf. *ambigua, Lingula mytilloides, Productus* sp., *Schizophoria* cf. *resupinata, Euphemites* spp. (including *E. ardenensis,* which has its acme occurrence at the Calmy Limestone), *Anthraconeilo (Palaeoneilo) mansoni, Edmondia* spp., *Nuculopsis gibbosa, Phestia (Polidevcia) attenuata*, indeterminate orthocone nautiloids, and trilobite fragments. The most important species present, those that occur commonly only at the Calmy Limestone, include *Pugnax pugnus*, *Sinuatella* cf. *sinuata* and *Actinopteria regularis*. Elements present of the *Edmondia punctatella* Band at the base of the marine cycle, include *Actinopteria regularis, Edmondia punctatella* (which has its acme occurrence at the Calmy Limestone), *Dentalium* sp. (or indeterminate orthocone nautiloids), *Sanguinolites* cf. *clavatus* and indeterminate fish fragments. *Tylonautilus nodiferus* s.s. has not been found stratigraphically below the Calmy Limestone in Scotland. Currie (1954, p.535) stated that the ammonoid genus most abundantly represented in the Arnsbergian (E2) Stage in Scotland is *Anthracoceras*. Noting the occurrence in the Calmy Limestone of *A. paucilobum* (pp.569-571; pl.4, fig.20; text-fig.5B), *A.* aff. *glabrum* (pp.568-569; text-fig.5T), and scarce *Eumorphoceras bisulcatum* (p.583), she recognised *Anthracoceras mooreae* (pp.536, 574-575) as the characteristic species of the bed (see also Brand, 1983b, locality 6).

Fossiliferous exposures of the Calmy Limestone collected in the Douglas Coalfield area include that in the Craig Burn at [NS8666 3403] (see Lumsden, 1967b, p.28; Wilson *in* Lumsden, 1967b, pp.31, 34-35). Such exposures in the southeast Central Coalfield area include a quarry near Sandyholm at [NS8145 4813], shale heaps in old quarries on the farms of Bashaw and Gair [NS8666 5260] and Hill of Westerhouse [NS8860 5341], probably in the Maregill Burn between [NS8291 4805] and [NS8294 4807], and probably in an old quarry at Climpy at ?[NS9290 5647] (see Brand, 1983a, localities 15, 26; 1983b, localities 5, 6; 1991c, locality 2).

Plean Limestones: *Serpuloides carbonarius, Buxtonia* sp., *Composita* sp., *Crania* sp., *?Crurithyris* sp., *Echinoconchus* cf. *punctatus, ?Eomarginifera* sp., *Lingula mytilloides, L. squamiformis, ?Linoproductus* sp., *Orbiculoidea* cf. *nitida,* orthotetid, *Pleuropugnoides* sp., *Productus* sp., *?Promarginifera* sp., *Pugilis* cf. *pugilis, Schizophoria* cf. *resupinata,* spiriferid, *Bellerophon* sp., *Donaldina* sp., *Euphemites hindi?, Glabrocingulum armstrongi?*, loxonematid, *Dentalium* sp., *Anthraconeilo (Palaeoneilo) laevirostrum, Aviculopecten tabulatus?, Cardiomorpha* cf. *hindi, Edmondia primaeva?, E.* cf. *senelis, Limipecten fallax?, Modiolus* sp., *Myalina* sp., *Nuculopsis gibbosa, Paleyoldia macgregori, Phestia (Polidevcia) attenuata, Prothyris scotica, Sanguinolites angustatus* group, *S. clavatus, S. variabilis* group, *Schizodus* cf. *impressus, Sedgwickia gigantea?, Wilkingia elliptica*, nautiloid indeterminate, goniatite indeterminate, crinoid columnals, ?arthropod fragment indeterminate, ?bone fragment indeterminate, fish fragments.

Comments: the combined fauna from up to three marine bands in the district is dominated by brachiopods (especially *Lingula mytilloides* and productoids) and bivalves (especially nuculids and *Sanguinolites* spp.) Of the important forms given by Wilson (1967, p.459), the list includes *Schizophoria* cf. *resupinata, Myalina* sp., *Nuculopsis gibbosa, Sanguinolites* cf. *clavatus* and *Modiolus* sp. *Pugilis* cf. *pugilis* also occurs. See also Lumsden (1967b, p.29). Wilson (*in* Lumsden, 1967b, pp.31, 35) gave the Plean Limestone faunas from the 'Douglas No.27 Bore' (NS83SE/9)[NS8603 3418] and the Douglas, Happendon Bore 1 (NS83SE/19)[NS8589 3353] in the Douglas Coalfield area.

Castlecary Limestone?: ?algal patches, productoid trail (large), *Productus* sp., *?Spirifer* sp., bivalve fragments indeterminate, crinoid columnals.

Comments: see Wilson (1967, pp.459, 462-463), Lumsden (1967b, pp.17, 43), Wilson *in* Lumsden (1967b, p.35). The fauna comes from the Douglas Castle Policies Bore 141 (NS83SE/16) [NS8547 3273] at c.264m depth. The correlation of this bed with the Castlecary Limestone is very uncertain, as is that at c.240m depth in the Douglas, Happendon Bore 1 which gave no fauna. The occurrence of ?algal patches is supportive, but there is no palaeontological record of *Curvirimula* sp. and fish remains in any carbonaceous shale immediately overlying the limestone in either borehole (see also Lumsden, 1967b, p.38).

Non-marine faunas of the Upper Limestone Formation: *Curvirimula* sp. dominates and can be found sporadically, associated with the Index Limestone in the southeast Central Coalfield area. It may occur, possibly below the Lyoncross Limestone, below the Orchard Limestone, and possibly below the Calmy Limestone in the Douglas Coalfield area. It is associated with the Plean Limestones in both areas. *?Paracarbonicola* sp. may be found between the Lyoncross and Orchard limestones in the Douglas Coalfield area (see Brand, 1998).

Passage Formation: Namurian to Westphalian, Arnsbergian to Langsettian (E2 to G2 Goniatite zones, SO to SS Miospore zones)

See Wilson (1967); Lumsden, (1967b); Dean (1998). For comparitive purposes, the faunas from the Passage Formation marine bands in the southeast Central and Douglas coalfields are listed separately. The tentative correlation is based on Lumsden (1967b, pp.35-39). In nearly all cases it can be seen that the faunas from the Douglas Coalfield area are the richer.

No.0 Marine Band: *Linoproductus* sp., *Orbiculoidea* sp., *Schellweinella* sp.

Happendon Limestone 1: algal material, *Buxtonia* sp., *Lingula* cf. *squamiformis, Linoprotonia* sp., *Orbiculoidea craigi*, orthotetoid, *Productus carbonarius?, ?Schellweinella* sp., *Euphemites hindi, Edmondia* sp., *Palaeolima* sp., *Phestia (Polidevcia) attenuata, ?Sanguinolites* sp., *Schizodus taiti?, ?Wilkingia* sp., nautiloid indeterminate, crinoid columnals.

No.1 Marine Band: *Lingula mytilloides*, *Schellweinella* sp., *Donaldina* sp., *?Dentalium* sp., *?Leiopteria* sp., *?Modiolus* sp., *Promytilus* sp.

Happendon Limestone 2: *?Composita* sp., *Lingula mytilloides, Orbiculoidea* sp., orthotetoid, *Productus carbonarius?, Schizophoria* sp., bellerophontid, *Retispira* cf. *decussata, Dentalium* sp., *Modiolus* sp., *Myalina* sp., *Nuculopsis gibbosa, Phestia (Polidevcia) attenuata, Schizodus* cf. *taiti,* nautiloid indeterminate, crinoid columnals, *Planolites* sp.

No.2 Marine Band (Roman Cement): *Serpuloides* sp., *Composita* cf. *ambigua, Lingula mytilloides, L. squamiformis, Productus* sp., *Schellweinella* sp., *Schizophoria* cf. *resupinata, ?Retispira* sp., *Dentalium* sp., *Aviculopecten* sp., *Limipecten* cf. *dissimilis,* crinoid columnals.

Happendon Limestone 3: *Serpuloides* sp., *Angiospirifer* cf. *trigonalis, Composita* sp., *Lingula mytilloides, L. squamiformis, Linoproductus* sp., *Pleuropugnoides* sp*., Productus carbonarius?, Rugosochonetes caledonica, ?Schellweinella* sp., *Schizophoria* cf. *resupinata, ?Modiolus* sp., *Palaeolima* sp., *Phestia (Polidevcia) attenuata, ?Sanguinolites* sp., orthocone nautiloid indeterminate, goniatite indeterminate, crinoid columnals.

No.3 Marine Band group: *Serpuloides carbonarius?, Lingula mytilloides, L. squamiformis.*

'Manson Marine Band group' (including Manson Shell-Bed): *Serpuloides* sp., *Polypora* sp., trepostomatous bryozoa*, ?Composita* sp., *?Crurithyris* sp., *Lingula*

mytilloides, L. squamiformis, ?Linoproductus sp., *Orbiculoidea* cf. *nitida*, orthotetoid, *Phricodothyris* sp., *Productus carbonarius?, Schizophoria* sp., *?Spirifer* sp., *Bellerophon* sp., *Donaldina* sp., *Euphemites* cf. *multilira, ?Latischisma* sp., loxonematid, *Retispira* sp., *Dentalium* sp., *Actinopteria* sp., *?Edmondia* sp., *?Limipecten* sp., *Myalina* cf. *peralata, ?Pterinopectinella* sp., *Sanguinolites* cf. *plicatus, S.* cf. *striatolamellosus, ?Schizodus* sp., *Solemya* cf. *primaeva*, nautiloid indeterminate, ?goniatite indeterminate, crinoid columnals, *Planolites* sp.

No.5 Marine Band group: *Serpuloides carbonarius, Lingula* cf. *mytilloides*.

'Marine Band group between the Manson Shell-Bed and Porteus Band': *Paraconularia* sp., *Serpuloides* sp., *?Brachythyris* sp., *Lingula mytilloides, Orbiculoidea* cf. *nitida,* orthotetoid, *Productus* sp., *?Donaldina* sp., *?Strobeus* sp., pectenid, ostracods, fish fragments, *Planolites* cf. *ophthalmoides.*

No.6 Marine Band group ('Ginstone Marine Band'): nil.

Porteus Band: *Serpuloides* sp., *Lingula mytilloides*.

No.6 Marine Band group ('Goodockhill Marine Band'): *Serpuloides* sp., *Buxtonia* sp., *Lingula mytilloides, Orbiculoidea* sp., orthotetid, *?Palaeolima* sp., fish fragments.

Adamson Band: foraminifera, *Serpuloides* sp., *Lingula mytilloides, ?Donaldina* sp., ?murchisoniid, *Modiolus* sp., fish fragments.

Comments: the combined faunas in each area comprise mainly brachiopods and molluscs. In both places *Lingula mytilloides* is easily the most dominant form, but orthotetids are also relatively important. Significant numbers of annelids and cephalopods also occur in the Douglas Coalfield area.

In the southeast Central Coalfield area, *Schizodus taiti* is a notworthy absentee (see Wilson, 1967, p.460). *Lingula mytilloides* is particularly common in the Nos 1 and 2 Marine bands, the No.3 Marine Band group, and the 'Goodockhill Marine Band' of the No.6 Marine Band group. Orthotetids (including *Schellweinella* sp.) and *Schizophoria* cf. *resupinata* are relatively important in the No.2 Marine Band (they are also found in the corresponding Happendon Limestone 3 in the Douglas Coalfield area, see Wilson, 1967, p.460). An old bing of a pit to the 'Goodockhill Marine Band' (the Goodockhill Slateyband Ironstone) was collected from near Bowridge [NS8489 5266] (see Brand, 1983c, locality 2).

In the Douglas Coalfield area (see also Wilson *in* Lumsden, 1967b, p.35), *Serpuloides* sp. is most common in the 'Marine Band group between the Manson Shell-Bed and Porteus Band'. *Lingula mytilloides* has been recovered from all the Marine bands and Marine

Band groups except the Happendon Limestone 1. *Orbiculoidea* species are relatively common in the Happendon Limestone 1, the 'Manson Marine Band group' and the 'Marine Band group between the Manson Shell-Bed and Porteus Band'. Orthotetids (including *?Schellweinella* sp.) are common in the marine beds between the Happendon Limestone 1 and 'Manson Marine Band group' inclusive (but see Lumsden, 1967b, p.38). Cephalopods (including indeterminate nautiloids and goniatites) are common in the Happendon Limestone 3 and 'Manson Marine Band group'.

Wilson (*in* Lumsden, 1967b, pp.31, 35) included in his list of fossils from the Douglas Coalfield area the combined Passage Formation faunas from the Douglas, Happendon Bore 1 and the Douglas Castle Policies Bore 141. See also Lumsden (1967b, pp.29-31).

Non-marine faunas of the Passage Formation: in the southeast Central Coalfield area *Curvirimula* cf. *candela* was recovered from the probable Netherwood Coal roof at c.59m depth in the Hallcraig No.1 Bore (NS85SW/393) [NS8307 5129]. *?Naiadites* sp. and indeterminate fish fragments were noted above what is probably the Bowhousebog Coal at c.159m depth in the Lands of Dura No.1 Bore (NS95NW/24) [NS9031 5668].

In the Douglas Coalfield area, *?Anthraconaia* sp. or *?Carbonicola* sp., *Curvirimula* sp., *Naiadites* sp., *Euestheria* sp. and a fish tooth are associated with the 'Manson Marine Band group'. *?Curvirimula* sp. and an ostracod have been recovered associated with the 'Marine Band Group between the Manson Shell-Bed and the Porteus Band'. *?Modiolus* sp. (or *Curvirimula* sp.), *Carbonita* cf. *humilis* and a palaeoniscid fish scale are associated with what is probably the Porteus Band; and megaspores, *?Anthraconaia* sp., *Carbonicola* cf. *bipennis, C. extenuata?, C. proxima, Curvirimula* sp., *Naiadites* cf. *hibernicus, Carbonita* cf. *humilis* and *C.* cf. *pungens* have been recovered associated with the Adamson Band. The latter fauna is considered representative of the *Anthraconaia lenisulcata* Non-Marine Bivalve Zone (see also Lumsden and Calver, 1958, p.40; Eagar, 1962; Lumsden, 1965, pp.84, 86-87; Brand, 1983f, p.181).

Coal Measures

See also Lumsden and Calver (1958), Lumsden (1965), Dean (1998). The Subcrenatum Marine Band is taken as the base of the Westphalian Series (and the Coal Measures) in the English, Welsh and Western European coalfields (Lumsden, 1965, p.80 and references therein; see also Lumsden and Calver, 1958, p.37; Ramsbottom and others, 1978). It has not yet been recognised in Scotland, but it may correlate with one of the higher marine bands of the Passage Formation (No.6) and with the Porteus Band of the Douglas Coalfield. The base of the Coal Measures in Scotland is drawn at a slightly higher stratigraphical level than this and is taken at the base of the Lowstone Marine Band, its local correlative, or at a plane of disconformity. In the Douglas Coalfield the Passage Formation passes upwards conformably into Coal Measures (Lumsden and Calver, 1958, p.38), the base of the latter being taken at the base of the Harwood Band (Browne and others, 1996).

Whilst the Coal Measures in the district are divided into Lower, Middle and Upper formations (see Browne and others, 1996, and below) the following part of the account has been simplified to give biostratigraphical faunal summaries of the affecting, constituent Non-Marine Bivalve zones. However, a lithostratigraphical listing of fossiliferous exposures in the Lower and Middle Coal Measures should also prove useful and is provided below. Exposures in the Upper Coal Measures are given in the text.

Fossiliferous exposures of the Lower Coal Measures collected in the district in the Douglas Coalfield area include those in Eggerton Burn at [NS8495 3196] and [NS8492 3172], in Arnesalloch Burn at c.[NS836 285] and c.[NS830 289], and in Burnhouse Burn at c.[NS843 306] (see Lumsden, 1965, p.87; Lumsden and Calver, 1958, pp.38-47). Such exposures in the southeast Central Coalfield area include probably the Lowstone Marine Band in Townhead Burn at [NS8226 4890], probably the Upper Drumgray Coal in the River Nethan at [NS8141 4554], the Kiltongue Musselband in South Calder Water at [NS8329 5673] and in the Garrion Burn at [NS8238 5332], [NS8190 5330] and [NS8177 5340], the Kiltongue Musselband to Virtuewell Coal in the River Nethan at [NS8146 4577], and the Bellside Ironstone position in Garrion Burn at [NS8170 5340] (see Brand, 1983a, localities 23, 25; 1983c, localities 4-7; 1983e, locality 3; 1988b).

Fossiliferous exposures of the Middle Coal Measures collected in the district in the Douglas Coalfield area include those in Burnhouse Burn at c.[NS842 307], Broadlea Burn at c.[NS827 311] and Windrow Burn at c.[NS820 298] (see Lumsden and Calver, 1958, pp.47-54). Similarly collected exposures in the southeast Central Coalfield area include the Musselband Coal in Auchter Water at [NS8367 5484], strata between the Pyotshaw and Ell coals in Garrion Burn at [NS8081 5265], what is probably the Cambuslang Marble in Garrion Burn at [NS8082 5268], strata above the Upper Coal in Garrion Burn at [NS8062 5249], and strata c.21m above the same coal in the same stream at [NS8093 5288] (see Brand, 1983c, localities 1, 8-11).

Anthraconaia lenisulcata **Non-Marine Bivalve Zone (upper part)** [Lower Coal Measures: Langsettian (SS Miospore Zone)]. In the southeast Central Coalfield, from the base of the Lowstone Marine Band to the base of the Armadale Ball Coal. In the Douglas Coalfield, from the base of the Harwood Band to the base of the Castle Coal.

No fauna has been recovered within the district that is common to both areas. *Carbonicola* cf. *extenuata* was found in the southeast Central Coalfield, and *Anthraconaia sp. nov., Carbonicola* cf. *torus, Curvirimula* cf. *tenuoides* and *Naiadites* sp. have been recovered from the Douglas Coalfield.

In the southeast Central Coalfield area, the Lowstone Marine Band contains *Lingula mytilloides* (the dominant form), an indeterminate high spired gastropod whorl and ostracods. The Sub-Glenfuir *Lingula*-band has yielded *Lingula mytilloides*.

In the Douglas Coalfield area the Harwood Band contains sponge spicules?, *Serpuloides* sp., *Lingula mytilloides* (the dominant form), *Lingula squamiformis, Orbiculoidea* sp., *Donaldina* sp., *Euphemites* sp., *?Retispira* sp., *?Dentalium* sp., *?Sanguinolites* sp.,

nautiloid (indeterminate) and *Planolites* cf. *ophthalmoides*. *'Estheria'* sp., *Leaia* sp. and indeterminate fish fragments have been noted above the Poniel Coal. *Lingula mytilloides, Geisina arcuata* and *Planolites* sp. (large) have been noted above the Douglas Coal (which has associated megaspores).

***Carbonicola communis* Non-Marine Bivalve Zone** [Lower Coal Measures: Langsettian (RA Miospore Zone)]. In the southeast Central Coalfield, from the base of the Armadale Ball Coal to the base of the Killtongue Musselband. In the Douglas Coalfield, from the base of the Castle Coal to the top of the Kennox Musselband Coal.

The fauna common to both areas within the district includes variants of *Carbonicola acuta, C. bipennis, C. browni, C. communis, C. martini, C. polmontensis, C. pseudorobusta, C. rhindi, C. rhomboidalis, C. robusta,* and *Curvirimula trapeziforma.* Of these, *Carbonicola browni, C. rhindi*, and perhaps *C. polmontensis*, are particularly numerous in the Douglas Coalfield, *C. pseudorobusta* and *C. robusta* are fairly common in both areas, and *C. rhomboidalis* is apparently more numerous in the southeast Central Coalfield.

Forms recovered only from the southeast Central Coalfield area include variants of *Carbonicola cristagalli, C. sp. nov*. and *Naiadites quadratus.* Those recovered only from the Douglas Coalfield area include variants of *Anthraconaia* sp., *Carbonicola aldami, C. obliquissima, C. obtusa, Curvirimula scotica* and *C. subovata*.

In the southeast Central Coalfield area, boreholes at Law Village include plant fragments, ostracods, ?fish fragments (indeterminate) and coprolites in what is probably the musselband above the Shotts Gas Coal, and burrows in the roof of the ?Mill Coal.

In the Douglas Coalfield area, of note is an associated fauna of *Carbonita* sp., *Geisina arcuata* and indeterminate fish fragments which occurs above the Castle Coal, and a *Planolites*-band which has been sampled above the Main Coal. The ostracod genus *Carbonita* was typical of fresh or slightly brackish water facies around coal swamps (Brazier, 1980, p.137).

***Anthraconaia modiolaris* Non-Marine Bivalve Zone** [Lower to Middle Coal Measures: Langsettian to Duckmantian (RA to NJ Miospore zones)]. In the southeast Central Coalfield, from the base of the Killtongue Musselband to the base of the Cambuslang Marble Coal. In the Douglas Coalfield, from the top of the Kennox Musselband Coal to the top of the Dunglass Coal.

Tha fauna common to both areas in the district includes variants of *Anthraconaia salteri, A. williamsoni, Anthracosia aquilina, A. beaniana, A. disjuncta, A. ovum, A. phrygiana, A. regularis, A. retrotracta, Anthracosphaerium exiguum, A. turgidum, Carbonicola bipennis, C. martini, C. oslancis, C. rhomboidalis, C. subconstricta, Naiadites productus, N. quadratus* and *N. triangularis.* Of these, *Anthracosia ovum, A. phrygiana* and *Naiadites quadratus* are numerically predominant. *Anthracosia aquilina* and *A. disjuncta* are also particularly common in the Douglas Coalfield area.

Forms recovered only from the southeast Central Coalfield area include variants of *Carbonicola venusta* and *Naiadites subtruncatus*, but those recovered only from the Douglas Coalfield area are much more diverse and include variants of *Anthraconaia fugax, A. lanceolata, A. modiolaris, A. oblonga, A. obscura, A. polita, A. pulchella, A. robertsoni, A. sp. nov., A. wardi, Anthracosia acutella, A. aquilinoides, A. barkeri, A. caledonica, A. faba, A. fulva, A. lateralis, A. nitida, A. planitumida, A. simulans, A. subrecta, Anthracosphaerium affine, A. bellum, A. propinquum, Carbonicola acuta, C. antigua, C. cristagalli, C. embletoni, C. obtusa, C. pectorata, C. pseudorobusta, C. robusta, Naiadites alatus, N. angustus, N. carinatus, N. flexuosus* and *N. obliquus*.

In the southeast Central Coalfield area, the Vanderbeckei (Queenslie) Marine Band, which marks the base of the Middle Coal Measures in Scotland (Browne and others, 1996, p.37), has a proven fauna of foraminifer, *Spirorbis* sp., *Lingula mytilloides*, indeterminate fish fragments, conodont elements and burrow traces, with associated *Geisina arcuata*. This ostracod, with *Carbonita* sp., is a common constituent of the Kiltongue Musselband (see for example Brand, 1983c, locality 6). *Euestheria* sp. and *Leaia* sp. were noted above the Bellside Ironstone in the No.13 Bore Coltness (NS85NW/27)[NS8049 5717].

In the Douglas Coalfield area (see also Lumsden and Calver, 1958) the Vanderbeckei (Queenslie) Marine Band has a proven fauna of *Ammonemas* sp. and *Lingula mytilloides*. The *Euestheria*-band (with *Euestheria* sp.) has been noted between the Seven Foot and Humph coals (see also Calver *in* Lumsden and Calver, 1958, p.58). *Geisina arcuata* is common in the Kennox Musselband, which may also contain *G.* cf. *fabulina* and *Carbonita* sp. The ostracod *Geisina arcuata* is common in most British Coalfields up to the Vanderbeckei Marine Band. Whilst the species very occasionally may be found in a mid Upper Modiolaris Chronozone position, the genus next occurs in the middle of the Lower Similis – Pulchra Chronozone where it is found in beds associated with the Maltby Marine Band (Lumsden and Calver, 1958, p.53).

Lower *Anthracosia similis – Anthraconaia pulchra* Non-Marine Bivalve Zone [Middle Coal Measures: Duckmantian (NJ Miospore Zone)]. In the southeast Central Coalfield, from the base of the Cambuslang Marble Coal to the base of the Aegiranum (Skipsey's) Marine Band. In the Douglas Coalfield, from the top of the Dunglass Coal to the base of the Aegiranum (Skipsey's) Marine Band.

The fauna common to both areas in the district includes variants of *Anthraconaia pulchella, Anthracosia aquilinoides, A. atra, A. caledonica, Anthracosphaerium* sp., and *Naiadites obliquus*. The last mentioned bivalve is that most common.

Forms recovered only from the southeast Central Coalfield area include variants of *Anthraconaia oblonga, Anthracosia aquilina, A. disjuncta, A. fulva, A. nitida, Naiadites alatus, N. quadratus* and *N. subtruncatus*. Those recovered only from the Douglas Coalfield area include variants of *Anthraconaia fugax, A. librata, A. pulchra, A. sp. nov., A. williamsoni, Anthracosia acutella, A. concinna, Naiadites angustus* and *N. productus*.

There is no faunal evidence of any marine or *Lingula*-bands in the Zone in the southeast Central Coalfield area. However, *Euestheria* sp., with sporadic *Spirorbis* sp., occurs near the base in the Cambuslang Marble, and *'Estheria'* sp. and *Euestheria* sp. may also occur above the Glasgow Upper Coal.

In the Douglas Coalfield area, in the Douglas No.2 bore (NS82NW/152)[NS8180 2916] there is evidence for a marine band with *?Lingula* sp. and indeterminate spinose productoids c.54m below the Aegiranum (Skipsey's) Marine Band. About 13m below this position, in the same bore, there is a *Lingula*-band with *Lingula mytilloides* (see also Lumsden and Calver, 1958, p.52). In the Gallow Knowe Bore (NS83SW/204)[NS8388 3117] this position may also include a foraminifer. *Euestheria* sp. has been noted in the equivalent bed to the Cambuslang Marble in both these boreholes, and also in the Gallow Knowe Bore in the roof of a coal at c.112m depth.

Upper *Anthracosia similis – Anthraconaia pulchra* Non-Marine Bivalve Zone [Upper Coal Measures: Bolsovian (SL Miospore Zone)]. Strata from the base of the Aegiranum (Skipsey's) Marine Band in both coalfields, to the top of the Cambriense (Bothwell Bridge) Marine Band in the southeast Central Coalfield, and the local equivalent (if any) in the Douglas Coalfield.

A fauna of *Anthraconaia pruvosti?* (Weir and Leitch *non* Chernyshev) and *Naiadites* sp. has only been recovered within the district from the Douglas Coalfield area from a bed c.157m above the Aegiranum (Skipseys) Marine Band in the Douglas No.2 bore (see Lumsden and Calver, 1958, pp.54, 59).

There is no faunal evidence within the district for the Aegiranum (Skipsey's) Marine Band in the southeast Central Coalfield area. But in the Douglas Coalfield area, the marine band in the Douglas No.2 bore at c.292m depth, the Douglas Castle No.69 bore (NS82NW/153)[NS8221 2993] at c.55m depth, and the Gallow Knowe Bore at c.35m depth, has a combined fauna of *Serpuloides* sp., *Cancrinella? (Dictyoclostus) craigmarkensis*, chonetid (indeterminate)*, Lachrymula pringlei, Lingula mytilloides, Orbiculoidea* sp., *Tornquistia diminuta?*, high spired gastropod indeterminate, *Dunbarella* sp., *Pernopecten carboniferus?, ?Posidonia* sp., *?Metacoceras* sp., *Homoceratoides jacksoni*, crinoid columnal, fish scale, conodont elements (see also Lumsden and Calver, 1958, p.54 and references therein). A possible marine band, likely to be within the Upper Similis-Pulchra Chronozone, was noted c.168m above the Aegiranum (Skipsey's) Marine Band in the Douglas No.2 bore. The fauna was recorded as *?Myalina* sp. (or *Naiadites* sp.) (see also Lumsden and Calver, 1958, pp.54, 59). This may represent the local eqivalent of the Cambriense (Bothwell Bridge) Marine Band in the Douglas Coalfield area.

***Anthraconauta phillipsi – A. tenuis* Non-Marine Bivalve Zone** [Upper Coal Measures: Bolsovian to Westphalian D (SL to OT Miospore zones)]. Coal Measures strata above the Cambriense (Bothwell Bridge) Marine Band in the southeast Central Coalfield and the local equivalent (if any) in the Douglas Coalfield.

A fauna of *Anthraconauta* cf. *phillipsi* has only been recovered within the district from the Douglas Coalfield area (see also Lumsden and Calver, 1958, p.59). It was collected from a small stream section c.425m W 9 degrees S of Hazelside Farm c.786m N 43 degrees E of the School at Glespin c.[NS8104 2873] (see also Lumsden and Calver, 1958 p.54).

Appendix 1. The distribution of selected fossils from the Dinantian and basal Silesian (Top Hosie Limestone) marine rocks of Sheet 23E. LF: Lawmuir Formation; Hu, CL and Ho: Hurlet, Craigenhill and Hosie limestones; BN: Blackhall Limestone and Neilson Shell Bed combined.

	LF	Hu	CL	BN	Ho
ANTHOZOA					
Dibunophyllum bipartitum (McCoy, 1849)	/	/			
Microcyathus cyclostomus (Phillips, 1836)				cf	
Siphonodendron junceum (Fleming, 1828)	/	/		/	/
BRYOZOA					
Fenestella sp.	/	/		/	/
trepostomatous bryozoa		/		/	/
BRACHIOPODA					
Avonia youngiana (Davidson, 1860)	/	/		/	/
Cleiothyridina sp.	/	/		?	/
Crurithyris urii (Fleming, 1828)	/	/		/	/
Eomarginifera spp.	/	/		/	/
Gigantoproductus sp.	/	/			
Krotovia spinulosa (J. Sowerby, 1814)		/			
Latiproductus latissimus (J. Sowerby, 1822)	?	cf			
Lingula spp.	/	/		/	/
orthotetid spp.		/			/
Phricodothyris spp.		/			
Pleuropugnoides sp.	/	/		/	/
Productus spp.	/	/		/	
Rugosochonetes sp.	/	/		/	/
Schizophoria resupinata (Martin, 1809)	/	/			/
Tornquistia scotica Brand, 1970	cf			/	
Tornquistia youngi Wilson, 1966				/	
GASTROPODA					
Euphemites urii (Fleming, 1828)		/		/	/
Glabrocingulum atomarium (Phillips, 1836)				/	
Glabrocingulum beggi E. G. Thomas, 1940	/				
Retispira spp.				/	/
Straparollus carbonarius (J. de C. Sowerby, 1814)				/	
BIVALVIA					
Actinopteria persulcata (McCoy, 1851)	/	/	/	/	cf
nuculid spp.	/	/		/	/
Pernopecten fragilis Wilson, 1966				/	
Pernopecten sowerbii (McCoy, 1844)	/	/		/	/
Posidonia becheri Bronn, 1828	?				
Posidonia corrugata Etheridge jun., 1873		/		/	/
Streblopteria ornata (Etheridge jun., 1873)	?	/	/		/
CEPHALOPODA					
nautiloids	/	/		/	/
ammonoid	/			/	/

Appendix 2. The distribution of selected fossils from the main Namurian marine beds (except the Top Hosie Limestone) of Sheet 23E. JS: Johnstone Shell Bed; BM: Black Metals Marine Band; IL, LL, OL, CL, Pl and ?Cc: Index, Lyoncross, Orchard, Calmy, Plean and ?Castlecary limestones; PF: Passage Formation.

	JS	BM	IL	LL	OL	CL	Pl	?Cc	PF
ALGAE									
algal material			/			/		?	/
ANTHOZOA									
Zaphrentites sp.					/	/			
BRYOZOA									
trepostomatous bryozoa			/	/	/	/			/
BRACHIOPODA									
Antiquatonia costata (J. de C. Sowerby, 1827)					/				
Buxtonia sp.	/	/	/	?	/	/	/		/
Eomarginifera spp.				/	/	/			
Isogramma sp.					/	?			
Latiproductus latissimus (J. Sowerby, 1822)			?	cf		cf			
Lingula mytilloides J. Sowerby, 1812	/	/	/	/	/	/	/		/
Lingula squamiformis Phillips, 1836	/	/	/		/	/	/		/
orthotetid spp.	/		/		/	/			
Pleuropugnoides pleurodon (Phillips, 1836)	cf	cf	cf	cf		cf			
Productus spp.	/								
Pugilis pugilis (Phillips, 1836)		?		cf	?	?	cf		
Pugnax pugnus (Martin, 1809)						/			
Sinuatella sinuata (de Koninck, 1851)						cf			
GASTROPODA									
Euphemites ardenensis (Weir, 1931)				cf	cf	/			
Meekospira sp.			/		?	/			
Retispira spp.	/		/		/	/			
Straparollus carbonarius (J. de C. Sowerby, 1814)			/	/	/				
BIVALVIA									
Actinopteria regularis (Etheridge jun., 1873)						/			
Edmondia punctatella (Jones, 1865)			?			/			
Modiolus sp.	/					/	/		/
Myalina sp.	/	/	/			/	/		/
nuculid spp.	/	/	/	/	/	/	/		/
Posidonia corrugata Etheridge jun., 1873			/		/	/			
Sanguinolites clavatus Etheridge jun., 1876						?	/		
Streblochondria sp.	/	?	/	/	/	/			
Streblopteria ornata (Etheridge jun., 1873)	/		/	/					
CEPHALOPODA									
Tylonautilus nodiferus (Armstrong, 1866)						/			
Anthracoceras spp.						/			
Eumorphoceras bisulcatum Girty, 1909						/			
ARTHROPODA									
trilobite fragments	/		/	/	/	/			

Appendix 3. Characteristic non-marine faunas of the Coal Measures occuring in Sheet 23E. Non-Marine Bivalve zones : Al: *Anthraconaia lenisulcata*; Cc: *Carbonicola communis*; Am: *Anthraconaia modiolaris*; Lsp: *Lower Anthracosia similis - Anthraconaia pulchra*; Usp: *Upper Anthracosia similis – Anthraconaia pulchra*; Apt: *Anthraconauta phillipsi – A. tenuis*. For zonal lithostratigraphical limits see text.

Non – marine bivalves (variants of)	**Non-Marine Bivalve zones**					
	Al	**Cc**	**Am**	**Lsp**	**Usp**	**Apt**
Anthraconaia pruvosti (Tchernyshev, 1931)					/	
A. pulchella Broadhurst, 1959				/		
A. salteri (Leitch, 1940)			/			
A. williamsoni (Brown, 1849)			/			
Anthraconauta phillipsii (Williamson, 1836)						/
Anthracosia aquilina (J. de C. Sowerby, 1840)			/			
A. aquilinoides (Tchernyshev, 1931)				/		
A. atra (Trueman, 1929)				/		
A. beaniana King, 1856			/			
A. disjuncta Trueman & Weir, 1951			/			
A. ovum Trueman & Weir, 1951			/			
A. phrygiana (Wright, 1929)			/			
A. regularis (Trueman, 1929)			/			
Anthracosphaerium exiguum (Davies & Trueman, 1927)			/			
A. turgidum (Brown, 1843)			/			
Carbonicola bipennis (Brown, 1843)	/	/	/			
C. browni Trueman & Weir, 1946		/				
C. communis Davies & Trueman, 1927		/				
C. extenuata Eagar, 1956	/					
C. martini Trueman & Weir, 1947		/	/			
C. oslancis Wright, 1929			/			
C. polmontensis (Brown, 1849)		/				
C. proxima Eagar, 1956	/					
C. pseudorobusta Trueman, 1929		/				
C. rhindi (Brown, 1843)		/				
C. rhomboidalis Hind, 1894		/	/			
C. robusta (J. de C. Sowerby, 1840)		/				
C. subconstricta (J. Sowerby, 1813)			/			
C. torus Eagar, 1954	/					
Curvirimula tenuoides (Dewar, 1939)	/					
C. trapeziforma (Dewar, 1939)		/				
Naiadites hibernicus Eagar, 1962	/					
N. obliquus Dix & Trueman, 1932				/		
N. productus (Brown, 1849)			/			
N. quadratus (J. de C. Sowerby, 1840)			/			
N. triangularis (J. de C. Sowerby, 1840)			/			

Appendix 4. Fossils of the main Westphalian Marine bands of Sheet 23E (see text). (S) = southeast Central Coalfield; (D) = Douglas Coalfield; No6 = No.6 Marine Band group (of which PB = Porteus Band, Gh = 'Goodockhill Marine Band', AB = Adamson Band); BCM = the marine band at the base of the Coal Measures (of which LS = Lowstone Marine Band, HB = Harwood Band); VQ = Vanderbeckei (Queenslie) Marine Band; AS = Aegiranum (Skipsey's) Marine Band.

	No6 (lower)	**No6 (upper)**		**BCM**		**VQ**		**AS**
	PB(D)	**Gh(S)**	**AB(D)**	**LS(S)**	**HB(D)**	**(S)**	**(D)**	**(D)**
FORAMINIFERIDA								
Ammonemas sp.							/	
foraminifera			/			/		
PORIFERA								
sponge spicules					?			
ANNELIDA								
Serpuloides sp.	/	/	/		/			/
Spirorbis sp.						/		
BRACHIOPODA								
Buxtonia sp.		/						
Cancrinella? craigmarkensis (Muir-Wood, 1937)								/
chonetid (indeterminate)								/
Lachrymula pringlei (Currie, 1937)								/
Lingula mytilloides (J. Sowerby, 1812)	/	/	/	/	/	/	/	/
L. squamiformis Phillips, 1836					/			
Orbiculoidea sp.		/			/			/
orthotetid		/						
Tornquistia diminuta Demanet, 1949								?
GASTROPODA								
Donaldina sp.			?		/			
Euphemites sp.					/			
high spired gastropod (indeterminate)				/				/
murchisoniid			?					
Retispira sp.					?			
SCAPHOPODA								
Dentalium sp.					?			
BIVALVIA								
Dunbarella sp.								/
Modiolus sp.	?		/					
Palaeolima sp.		?						
Pernopecten carboniferus (Hind, 1903)								?
Posidonia sp.								?
Sanguinolites sp.					?			
CEPHALOPODA								
nautiloid (indeterminate)					/			
Metacoceras sp.								?
Homoceratoides jacksoni Bisat, 1930								/
ARTHROPODA								
ostracods				/				
crinoid columnal								/
PISCES								
fish fragments (indeterminate)		/	/			/		/
INSERTAE SEDIS								
conodont elements						/		/
Planolites ophthalmoides Jessen, 1949					cf			
burrow traces						/		

Appendix 5. Sources of Information: palaeontological.

Type	Lithostratigraphical Group	Approx. No. of samples	Location
Macrofossils	Strathclyde	1790	BGS Edinburgh
Palynomorphs	Strathclyde	3 (slides)	BGS Keyworth
Macrofossils	Clackmannan	12680	BGS Edinburgh
Microfossils	Clackmannan	6 (slides)	BGS Edinburgh
Macrofossils	Coal Measures	3010	BGS Edinburgh

For further information on and access to the fossil collections contact should first be made with:

The Curator
Palaeontology Collections
British Geological Survey
Murchison House
West Mains Road
Edinburgh
EH9 3LA.

Tel: 0131 650 0354
Fax: 0131 668 2683
Email: PalaeoEnquiriesNorth@bgs.ac.uk

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Mark T Dean
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