Detail of the Jurassic ammonite *Angulaticeras greenoughi* from Lyme Regis, Dorset. Paisley Museum.
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Review of Fossil Collections in Scotland

Glasgow and Strathclyde

National Museums Scotland

John Ellerman Foundation

Glasgow and Strathclyde

Dick Institute (East Ayrshire Leisure)
John Pollock Collection Centre (South Ayrshire Council Museums and Galleries Service)
McKechnie Institute (South Ayrshire Council Museums and Galleries Service)
Isle of Arran Heritage Museum (Isle of Arran Museum Trust)
Low Parks Museum (South Lanarkshire Leisure and Culture)
Biggar and Upper Clydesdale Museum (Biggar Museum Trust)
McLean Museum and Art Gallery (Inverclyde Council)
Paisley Museum (Renfrewshire Leisure)
Zoology Museum (University of Glasgow)
The Hunterian (University of Glasgow)
Glasgow Museums Resource Centre (Glasgow Life)
Kelvingrove Art Gallery and Museum (Glasgow Life)

Dick Institute (East Ayrshire Leisure)

Collection type: Local authority (East Ayrshire Leisure)
Accreditation: 2017

Elmbank Avenue, Kilmarnock, Ayrshire, KA1 3BU
Contact: info@eastayrshireleisure.com

Location of collections
In the late 1800s James Thomson, a local fossil collector, offered the town council his collection on condition that a museum was created to store and display it. Elmbank House, built as the Sheriff Hall in 1792 and later used as the Free Library, was considered too small and demolished, with the new building on the site funded by James Dick (1823-1902) and designed by architect Robert Ingram, both born locally. The Dick Institute opened in 1901 and other collectors began donating their objects; many acquisitions came from the Glenfield Ramblers, notably archaeological specimens linked to member Archibald Fairbairn (1867-1945). The building was badly damaged by fire in 1908 and much of the collection lost. The Institute re-opened in 1911.

Size of collections
2,100 fossils.

Onsite records
Information is in an Access CMS with entries also on a CARDBOX catalogue on DOS. The natural science collection underwent a 'rapid inventory' in the last 10 years; red dots on the front of drawers and individual boxes/bags for each specimen indicate inclusion.

Collection highlights
1. Carboniferous fossils including corals, linked to John Hunter-Selkirk (1835-1898) and James Thomson (1823-1900).
2. Eurypterid fossils from the Silurian of Lesmahagow and other Midland Valley localities.
3. Type and figured material.

Published information
Dunlop, R. (1910). III. The Fossil Amphibia in the Kilmarnock Museum, previous to the Fire of 1909. *Transactions of the Geological Society of Glasgow*. 14:60-64.
Gregory, J.W. (1917). XII. Thomson's Genera of Scottish Carboniferous Corals. *Transactions of the Geological Society of Glasgow*. 16:220-243.
Hunter, J.R. (1865). XXV. Exhibition of Brachiopoda and *Gyrolepis Rankinii* from Braidwood Limestone. *Transactions of the Geological Society of Glasgow*. 2:54.
Lomax, D.R., J.C. Lamsdell, and S.J. Ciurca. (2011). A collection of eurypterids from the Silurian of Lesmahagow collected pre-1900. *Geological Curator*. 9:331-348.
Ross, A.J. (2010). A review of the Carboniferous fossil insects from Scotland. *Scottish Journal of Geology*. 46:157-168.
Ross, A.J. (2017). Insect evolution: the origin of wings. *Current Biology.* 27:113-115.
Trewin, N.H. (2013). *Scottish Fossils*. Edinburgh: Dunedin Academic Press.

Collection overview
The collection includes molluscs (cephalopods, bivalves, gastropods), arthropods (trilobites, crustaceans, arachnids, myriapods, insects), echinoderms (echinoids, brittle stars), corals (many linked to James Thomson), brachiopods, graptolites, bryozoans, chitons, porifera (*Chaetetes*), vertebrates (amphibians, reptiles, fish), microfossils (foraminifera) and plants (Fig. 45). Within each group there is a broad distribution in terms of geographic and stratigraphic origin, although many are from the Carboniferous, reflecting the local geology and interest of local collectors. Carboniferous corals are highly numerous with origins noted as Ayrshire, Fife, Lanarkshire, Lothian, Eifel,

Germany, Canada, Estonia and Sweden; samples from Worcestershire (the Much Wenlock Limestone Formation, specifically from Dudley) are Silurian. A collection of corals, brachiopods, bivalves and nautiloids from the nearby Deans Park Quarry is also present. Carboniferous plants include various leaves, seeds and cones, with fish collected in Ayrshire (Muirkirk, Lugton, the River Avon at Stenhouse near Cumnock and Crosshouse), Edinburgh (Gilmerton, Burdiehouse) and Lanarkshire (Hamilton) among others. *Rhizodus* teeth are from Gilmerton with large *Gyracanthus* spines and shark teeth from Ayrshire and Lanarkshire; some of the shark teeth are from the Cenozoic of America (*Carcharodon*, etc). Noted fossils are the oversize, proportionally complete but fragmentary remains of two *Megalichthys* fish from Crosshouse, and specimens of the early jawless fish *Lasanius problematicus* (Late Silurian) and *Birkenia elegans/*sp. (Middle Silurian) from Muirkirk. A fossil of the Carboniferous insect nymph *Idoptilus peachii* (Woodward, 1887) is a holotype, re-described by Ross (2010) and figured by Trewin (2013) and Ross (2017). Fossils from other stratigraphic levels include eurypterids from Silurian Inliers of the Midland Valley (notably two large examples of *Slimonia*), ostracods from Ayrshire and Lanarkshire, graptolites from Dob's Linn, Dumfries and Galloway, and fragments of Triassic rhynchosaurian vertebrates from Cheshire.

Figure 45: A drawer of invertebrate fossils from various geological periods (Dick Institute)

Post-Mesozoic material tends to be from outside Scotland, for example, echinoids from the south of England or the European continent. Additional gastropods, bivalves and ammonites are labelled Weymouth, Leicester, Northamptonshire, Folkestone, Sheppey, etc, where mostly Mesozoic (Liassic, Oolite) and Cenozoic (London Clay) rocks are found. Two boxes labelled 'Earth Sciences' contain similarly disparate fossils: (1) Carboniferous corals, plants, brachiopods, orthoconic nautiloids, shark teeth, ammonites, Jurassic brachiopod, conularid worm tubes, Cenozoic gastropod *Turritella* and a distorted *Euomphalus* gastropod from the Carboniferous and (2) Carboniferous bivalves, brachiopods, shark teeth, corals and *Bellerophon* gastropods, Jurassic ammonites (*Dactylioceras*) and belemnites, claws labelled as *Velociraptor*, hippo teeth, an echinoid and a large acanthodian spine.

Research/collection links

Fish fossils of *Birkenia* were recently examined by a student at the University of Manchester for research.

John Pollock Collection Centre (South Ayrshire Council Museums and Galleries Service)

Collection type: Local authority

Mainholm Crescent, Ayr, South Ayrshire, KA8 0QD
Contact: rozelle.house@south-ayrshire.gov.uk

Location of collections
The South Ayrshire geological collection was initiated by Alexander Sharpe Alexander (1860-1940), who accumulated objects for a short-lived museum at Bellisle House, south of Ayr, from 1926 to 1933. When this closed the collection was transferred to the Carnegie Library in Ayr alongside other geological collections; what is now the South Ayrshire fossil collection therefore comprises material from various sources. For the past five years the collections have been housed at the John Pollock Collection Centre with additional material relocated from rooms in the County Building basement and Rozelle House; the collection is due to move again to a new facility in Ayr. The Collection Centre is for storage only and while the collections are available for display, there is no established museum in South Ayrshire for exhibitions; Rozelle House and the McKechnie Institute can accommodate small/temporary displays.

Size of collections
1,000-1,500 fossils.

Onsite records
Information for the collection is in an Access CMS with details for the fossils in the process of being added. Prior to this all fossils were given a Dewey number which is still in use for those not yet added to the electronic database. Other records are on a paper card system. The collection was reviewed by John Faithfull from The Hunterian (University of Glasgow) in 2004 with the provision of a report listing geological specimens.

Collection highlights
1. Fossils from the local area, notably Girvan.
2. Fossils linked to Alexander S Alexander (1860-1940).

Published information
Alexander, A.S. (1935). The Alexander Collection, Ayr. Glasgow: John Smith and Son Ltd.
Howells, Y. (1975). Alexander Sharpe Alexander and his collection. *Newsletter of the Geological Curators Group*. 5:231-235.

Collection overview
Fossil material has a notable focus on Ordovician and Silurian rocks in South Ayrshire with a good number from the Girvan area. A box containing Llandovery (Silurian) shelly limestone with *Nidulites*, *Petraia* and *Pinacopora* fossils is from Rough Neuk Quarry, and a gastropod and separate orthid brachiopod in red matrix is from Mulloch Hill. Other specimens are described as fossiliferous limestone from Craighead Quarry, Girvan, one containing fossils of '*Ptilodictyum* and brachiopod' among others. Other specimens are described as Coralline Limestone from the Girvan area, with localities including 'Penkill below castle' and a rock labelled as '*Halysites*, *Favosites* and *Hainopora*' (all corals) from Shalloch shore, dated 1897. Numerous rocks containing complete and fragmentary orthid brachiopod shells, gastropod, trilobites and tentaculitids represent the Silurian of the Girvan area. A trilobite pygidium labelled as *Trinucleus* from Lady Burn, Ayrshire, is Ordovician.

Another large portion of the collection is from the Carboniferous. Plant fossils are *Neuropteris, Lepidodendron, Stigmaria, Sphenopteris, Sigillaria* (including West Calder), *Calamites* (Grangemouth), *Lithodendron* from Corrie Burn, Campsie near Glasgow, and indeterminate

specimens described as fragments and leaves, including one from Stevenston Shore, Ayrshire. Brachiopods include a *Lingula* from Paisley in addition to specimens of the large *Gigantoproductus* (one with reddish colour typical of examples from Arran) and other productids, spiriferids, etc. Fish are represented by *Gyracanthus* spines, many large but in variable condition, with examples of *Rhizodus* teeth, *Megalichthys* teeth, scales and possibly vertebrae, and *Cynopodius* teeth from Burdiehouse. Remains from Blackston, Renfrewshire, have the initials 'K.B.' with other labels in the same writing mentioning Patna, East Ayrshire; these might be from the area around the Blackstoun Mineral Oil and brickworks near Paisley. A fossil from Muirkirk has been identified as *Pinna* although this seems to be a *Rhizodus* tooth or the spine of a similar fish. A partial fish with an articulated fin is preserved with plant branches and is presumably also Carboniferous. Less numerous are the bivalves from a non-marine mussel band, orthoconic nautiloids preserved as internal moulds, and coral (*Zaphrentis*; *Lithostrotion* from Muirkirk). Interesting specimens include three fossils labelled as 'spores in coal. Juniper Green', a locality on the outskirts of Edinburgh. Several large fossils have recently been moved from the basement, notably a cross section of tree trunk and long segment of *Stigmaria*.

Other stratigraphic levels are represented by a limited number of fossils. A sample labelled as *Rastrites*, a graptolite, is from the Lower Silurian of Dob's Linn, Dumfries and Galloway. A *Lanarkia spinosa* is from the Silurian of Muirkirk. There are several Devonian fish, almost entirely from localities in Caithness. One fossil is labelled as the 'head of a fully grown *Dipteris valencienessi* found at Achanarras, Caithness in 1946 by Alex G. McLeod M.A., F.S.A. Scot'. Several boxes contain orthoconic nautiloids, *Gryphaea* and other bivalves, and ammonites. A large (40cm) and robust bone is potentially a mammal skull from the Siwalik Hills, India.

Research/collection links

The mammal bone should be investigated further to determine if it is from the Siwalik Hills, an important locality historically and scientifically, which could lead to research in collaboration with museums in Scotland (Falconer Museum) and across the UK (Natural History Museum, London, and Oxford University Museum of Natural History) where there are larger collections. The Ordovician and Silurian localities in the Girvan area are historically and scientifically important, with many studies focusing on various aspects of the fossil assemblages in the past. The stratigraphic units exposed at each locality perhaps need to be clarified.

McKechnie Institute (South Ayrshire Council Museums and Galleries Service)

Collection type: Local authority

Dalrymple Street, Girvan, KA26 9AE
Contact: keir.Murray@south-ayrshire.gov.uk

Location of collections
The McKechnie Institute was built using funds provided by Thomas McKechnie, a local businessman, and designed by McKissack & Rowan of Glasgow. It opened in 1889 and is still used today as a local museum, art gallery and venue for community groups. Fossils are housed in a display case with some storage in use onsite for the limited number of specimens not on display.

Size of collections
30-40 fossils.

Onsite records
Information for the majority of fossils has been entered on an inventory.

Collection highlights
1. Fossils from the Girvan area potentially linked to Alexander McCallum (1802-1845).
2. Fossils on display linked to Hew McCallum (1935-2016).

Figure 46: A fossil echinoid displayed with modern counterparts (McKechnie Institute)

Collection overview
The collection comprises 30-40 fossil specimens from nearby Upper Ordovician strata, either the Caradoc Series (Ordovician) in the Ardwell Bay area to the south of Girvan or the Ashgill Series

(Ordovician) from Lady Burn to the north. Specimens tend to include fragmentary remains of trilobites, brachiopods, bivalves, orthoconic nautiloids and graptolites. The remaining fossils were collected by Hew McCallum (1935-2016): Several ammonites (Jurassic), coral (probably Carboniferous), echinoid (*Clypeus*, Fig. 46) and plants (fossil wood and *Sigillaria*).

Research/collection links

The Girvan fossils represent an exceptionally preserved Ordovician fauna with some rare species, exposed at localities across the Girvan area now designated SSSIs. Fossils from the same localities in other collections have been studied and documented in numerous scientific publications, notably as part of a PhD project by Dr Sarah Stewart at the University of Glasgow (now in the Natural Sciences Department, National Museums Scotland). Publications on fossils from Girvan suggest historic links with the University of Glasgow. Material from the area continues to be of interest with species new to science still being found. There is therefore the possibility for re-examination of material in collections to reveal further new species and assist in revision of others.

Isle of Arran Heritage Museum (Isle of Arran Museum Trust)

Collection type: Independent
Accreditation: 2019

Rosaburn, Brodick, Isle of Arran, KA27 8DP
Contact: info@arranmuseum.co.uk

Location of collections
The late Miss Bess MacMillan MBE, Chairman of the Island Tourist Association, formed the Isle of Arran Museum Association and the Isle of Arran Museum Trust in 1976**.** Founded in 1979, the Museum is located in several former estate buildings dating from the 1700s. Fossils are displayed in the geology room set up by professional geologist Gordon Macleod who also wrote the text for the short introductory video on Arran's geology.

Size of collections
7 fossils.

Onsite records
Not known.

Collection highlights
1. Fossils from the Isle of Arran, including casts of arthropod and vertebrate trackways.

Publications
Briggs, D.E.G., W.D.I. Rolfe, and J. Brannan. (1979). A giant myriapod trail from the Namurian of Arran, Scotland. *Palaeontology*. 22:273-291.
Clark, N.D.L., P. Aspen, and H. Corrance. (2002). *Chirotherium barthii* Kaup 1835 from the Triassic of the Isle of Arran, Scotland. *Scottish Journal of Geology*. 38:83-92.
Clark, N. (2011). The hand-beast of Blackwaterfoot. *Deposits*. 25:6-9.

Figure 47: The Carboniferous brachiopod *Productus* from Corrie (Isle of Arran Heritage Museum)

Collection overview
Fossils all relate to the geology of Arran. Most are Carboniferous in age: Spaghetti rock from Corrie packed with the colonial coral *Lithostrotion*, shale with fossils from Laggan, *Gigantoproductus* brachiopods as isolated fossils or in limestone (one a distinct reddish colour) from Corrie (Fig. 47), and a *Lepidodendron* impression in sandstone from Corrie. Other fossils are worm casts without location or age information and a piece of fossil wood found in tuff from the Jurassic of north east Arran. Trace fossils include a silicon mould of a *Cheirotherium* track found near Blackwaterfoot, cast by researchers at the University of Glasgow, and an isolated, three-toed footprint representing an infilled track in a fine-grained, grey-green rock. Other information in the displays refers to the *Arthropleura* tracks found in Carboniferous rocks at the north end of the island.

Research/collection links
The cast of the reptile trackway was provided by the University of Glasgow following studies of the original.

Low Parks Museum (South Lanarkshire Leisure and Culture)

Collection type: Local authority (South Lanarkshire Leisure and Culture)
Accreditation: 2018

129 Muir Street, Hamilton, ML3 6BJ
Contact: museumresearch@southlanarkshireleisure.co.uk

Location of collections
Low Parks Museum is situated in part of the Duke of Hamilton's former estate. Most of the buildings have been demolished, notably Hamilton Palace, leaving only the Hamilton Mausoleum and the Portland building and Hamilton Palace Riding School which house the Museum. The collections include specimens transferred from Rutherglen and Hamilton in 1996. Fossils are not in use in Low Parks Museum, although specimens from the collection were on display in the Visitor Centre Gallery at Chatelherault Country Park. The collection is housed in two offsite storage rooms several miles from the Museum.

Size of collections
106 fossils.

Onsite records
Information is in a Vernon CMS with a paper catalogue onsite and documentation/entry forms held in the Museum. Notes with the collection suggest fossils were examined and partly inventoried as recently as 2015.

Collection highlights
1. Fossils collected through the local coal mining industry.
2. Fossils from Lesmahagow.

Collection overview
Most of the fossils are from the local Carboniferous, recovered through coal mining. Plants include *Stigmaria*, *Calamites* (a large, curved specimen was recently donated, Fig. 48), *Lepidodendron*, *Lepidostrobus*, a large tree trunk and other fragments, typically preserved as carbon films, moulds and casts, and impressions in black mudstone, although one is a more unusual sample preserved as two-dimensional pyrite fronds in black mudstone. Other fossils include productid brachiopods found as isolated fossils or in limestone, a fish, acanthodian spine, corals, orthoconic (straight) and coiled nautiloids including a polished section, and crinoidal limestone. Bivalves are present as isolated fossils, in an ironstone mussel band (labelled as an important marker horizon in the search for coal), in limestone or a layer known locally as Cambuslang Marble. Specimens from other stratigraphic levels are the piece of fossil wood accompanied by a note reading ‘found in the Sahara Desert in 1945’, and invertebrates, notably the eurypterids *Slimonia* and *Pterygotus* and arthropod *Ceratiocaris* from the Silurian of Lesmahagow.

Research/collection links
The collection has the potential to provide fossils for study although thorough examination of content is necessary to determine this.

Figure 48: Fragmentary remains of the Carboniferous plant *Calamites* (Low Parks Museum)

Figure 49: Carboniferous plants *Sphenopteris* from Forth (left) and *Stigmaria* from Wilsontown (back) and *Dibunophyllum* coral in an erratic from Biggar (right) (Biggar and Upper Clydesdale Museum)

Biggar and Upper Clydesdale Museum (Biggar Museum Trust)

Collection type: Independent
Accreditation: 2019 (Provisional)

156 High Street, Biggar, ML12 6DH
Contact: info@biggarmuseumtrust.co.uk

Location of collections
The Museum is located on the main street following relocation in 2015 from another building in Biggar. Collections are on display with storage upstairs and in a building nearby.

Size of collections
27 fossils on display with an additional undetermined number in storage.

Onsite records
Documentation is in the form of a paper catalogue and an Excel spreadsheet with ongoing work to enter fossils on the latter. Fossil specimens also appear in an entry book for the year they were acquired. All fossils have a reference number prefixed with a letter noting the taxonomic group.

Collection highlights
1. Locally collected fossils.

Collection overview
Fossils are part of a display on local/Scottish geology (Fig. 49). Most are plants from the Carboniferous: *Lepidodendron aculeatum, Stigmaria ficoides* (one with rootlets), *Calamites suckowi* and *Cordaites anglosostri* from localities including Wilsontown, Lanarkshire, *Sphenopteris, Stigmaria ficoides* and fern foliage (Forth, Lanarkshire), and plant cellular structure preserved in ironstone (Medwin, Lanarkshire). There are fossils of the phyllocarid arthropod *Ceratiocaris stygia* from Lesmahagow and a marine bivalve from Wilsontown. The corals *Lithostrotion* junceaum and *Dibunophyllum bipartium* found at Whitecleuch and Crawfordjohn are labelled as erratics – material transported by ice – found in Biggar. Specimens of limestone with brachiopod, coral and other invertebrate fossils are also likely to be Carboniferous. Not from the Carboniferous are specimens of *Gryphaea* (Jurassic) and mudstones with graptolites (probably Ordovician); the onsite catalogue suggests various graptolites (*Climacograptus*, *Dicranograptus*, *Orthograptus*) from Wanlockhead and Dob's Linn. A handling box contains fossils of the plants *Calamites*, *Stigmaria* and *Neuropteris*, *Lithostrotion* and other corals, crinoids from Lugton, Ayrshire, brachiopods and bivalves.

McLean Museum and Art Gallery (Inverclyde Council)

Collection type: Local authority
Accreditation: 2019 (Provisional)

Watt Institution, Kelly Street, Greenock, Inverclyde, PA16 8JX
Contact: wattinstitution@inverclyde.gov.uk

Location of collections
The origins of the collection are linked to the Greenock Philosophical Society whose branch at the Greenock Library was filled with artificial and natural curiosities, leading to designation of the building as a museum in 1816. The collection moved to the Watt Library, named after James Watt (1736-1819), and, as objects continued to accumulate, work began on a museum and lecture hall in 1863. It was funded by local timber merchant James McLean (1802-1877), a member of the Philosophical Society. It was completed in 1876 and Thomas Struthers, a geologist and naturalist from Glasgow, was appointed as the first curator; part of his collection is still onsite. The Museum and library closed in 2016 for a £2 million refurbishment.

Size of collections
800-1,000 fossils.

Onsite records
Information is in a Past Perfect CMS with various paper catalogues, including MDA cards. An online catalogue available at https://mcleanmuseum.pastperfectonline.com/webobject includes some of the fossil specimens.

Collection highlights
1. Fossils from well-known localities worldwide and a notable range of vertebrate fossils.
2. Fossils linked to Thomas Struthers and James Dairon (1811-1891).
3. Post-glacial fossils linked to Thomas L Scott (1849-1929) and Thomas Steel (1858-1925).
4. Labels attributed to fossil dealers Robert Ferris Damon (1845-1929) and LH Pegler MD.
5. Quaternary cave deposits linked to William Pengelly (1812-1894).
6. Fossils from Canada.

Published information
Robertson, D. (1883). I. On the Post-Tertiary Beds of Garvel Park, Greenock. *Transactions of the Geological Society of Glasgow*. 7:1-37.
Scott, T., and J. Steel. (1885). XXXI. Notes on the occurrence of *Leda Arctica* (Gray); *Lyonsia arenosa* (Möller); and other Organic Remains, in the Post-pliocene Clays of Garvel Park, Greenock. *Transactions of the Geological Society of Glasgow*. *7*:279-283.

Collection overview
Fossils are wide-ranging in terms of stratigraphic and geographic origin, with several acquired from dealers. For example, fossils labelled as RF Damon, Weymouth, include an *Omphyma* from the Much Wenlock Limestone Formation, a fish in a split nodule labelled '*Osteolepis* major, Lethen N.B. Old Red Sstone', *Cardinia* from the Lower Lias of Frodingham and a *Harpoceras* ammonite from the Upper Lias of Boll, Germany (Fig. 50). Vertebrate fossils are mostly fish from the Devonian (a *Pterichthyodes* in a nodule, cast of a *Cephalaspis* from Forfarshire in the British Museum, and an *Osteolepis* from Thurso with many other specimens present but not visibly labelled), Carboniferous (*Rhizodus* teeth and other fragments, notably a jaw from Loanhead, Edinburgh, and an acanthodian spine), Permian ('*Palaeoniscus comptus'*, a misspelling of *Palaeoniscum comtus*, from Ferry Hill and *Palaeoniscum freieslebeni*, labelled as '*Palaeoniscus*' from the Kupferschiefer Formation of Rothenburg, Bavaria), Jurassic (*Dapedius*, *Hybodus* and *Heterolepidotus,* and a tooth plate of *Acrodus anningae* from Lyme Regis) and Eocene (shark teeth from the London Clay). Additional

shark teeth are from North America (*Carcharodon*) with specimens more specifically from the River Coosaw (miss-spelt as 'Cossaw'), Beaufort County, South Carolina (where Miocene-Pliocene phosphate deposits were mined), attributed to Captain Black 1886.

Cretaceous fossils of *Beryx lewesiensis* and *B. superbus* from the Chalk at Lewes, and teeth of *Lepidotus mantelli* from the Wealden of Brook Bay, Isle of Wight, have been linked to Gideon Mantell (1790-1852) in the past although this connection is now less certain. The Mantell attribution was written on labels printed 'Mus M & M'. This indicated that they came from the Museum of Mantua & Montferrat, a collection put together by the self-styled 'Prince of Mantua and Montferrat'. His real name was Mr Charles Ottley Groom (1839-1894), described in *The Oxford Dictionary of National Biography* as an 'imposter' with an extensive collection much of which was 'bogus'. The attribution of these specimens to Mantell therefore requires further investigation. A fossil fish described as an impression in limestone from Norfolk could potentially be from the Eocene Green River Formation of Wyoming or similar fish-bearing deposits.

Reptiles are represented by a series of 4-5 vertebrae with possible neural spines/arches from the Jurassic, an *Ichthyosaurus* head from the Jurassic of Lyme Regis, and numerous isolated fish and reptile vertebrae. Mammals are represented by the teeth of a *Hippopotamus bivensis* from the Eocene London Clay of the Isle of Wight, a partial humerus of the giant kangaroo *Diprotodon australis* from Queensland and mammal bones (badger) from Happaway Cave, Devon, presented by E Newton of the Geological Museum, London, with a further note 'Quaternary/Pleistocene ossiferous caves Pengelly Collection'. There are plaster casts of various reptiles including the partial skeleton of a *Mosasaurus tenuidens* with the locality given as Albania, South Africa (Albania referring to a district), a complete Triassic *Lariosaurus* from Perledo, Lombardy, a third skeleton not identifiable due to a damaged label, the skull of the placodont *Cyamodus* showing dentition, a *Scaphognathus* pterosaur from the Solnhofen Limestone, the London specimen of *Archaeopteryx* and the 'largest' *Bothriolepis canadensis* fish held in the British Museum (according to the label).

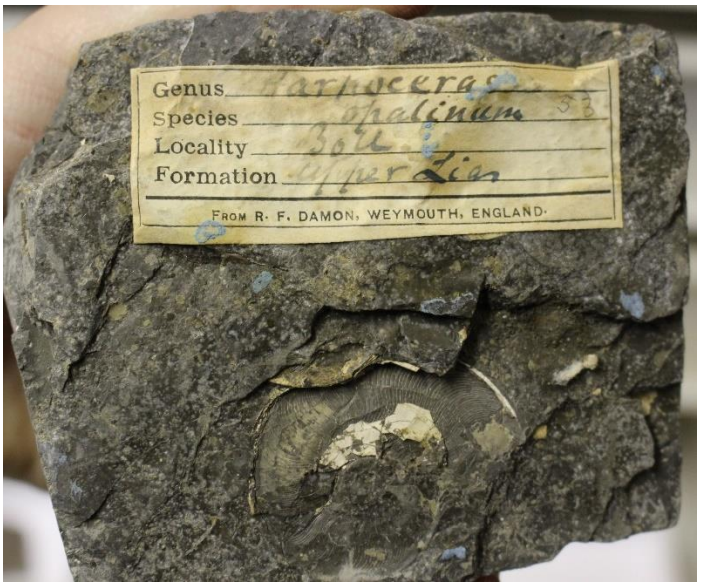

Figure 50: Upper Liassic (Jurassic) ammonite *Harpoceras opalinum* from Boll, Germany, with an RF Damon label (McLean Museum and Art Gallery)

Invertebrate fossils are from every period of the Palaeozoic. The Cambrian is represented by the trilobites *Angellina* from Porthmadoc and an *Asaphus* from Shineton, Shropshire. The Ordovician is represented by brachiopods from Wales and the trilobites *Ogygia* from Builth, an *Asaphus* from County Tyrone, Northern Ireland, labelled as Silurian but probably Ordovician, and a cast of the

trilobite *Asaphus tyrannus* from Llandeilo, Wales; several graptolites are attributed to James Dairon and dated to around 1896. There are additional graptolites from Dob's Linn, Dumfries and Galloway, some of which could be Silurian. Tentaculitids are from the Caradoc of Shropshire. Silurian fossils include the gastropod *Poleumita* and brachiopods from the Pentland Hills (*Strophomena*, *Rhynchonella*, *Leptaena*), *Nidulites* from Mulloch Hill, Girvan, and eurypterids labelled as *Eurypterus* from Gotland and a cast of *Stylonurus*. Fossils from the Welsh Borders (brachiopods *Spirifer*, *Leptaena*, *Atrypa*, '*Orthis*'), Dudley, West Midlands (coral *Favosites,* trilobites *Phacops*, *Proetus* and *Acidaspis*), Buildwas, Shropshire (*Cheirurus*) and without locality information (near fully articulated *Periechocrinus* head) are all likely to be from the Much Wenlock Limestone/Shale.

Interesting specimens are the Middle Silurian bivalves *Ambonychia* and *Hodiolopsis* from Western Ontario, Canada, and a *Stromatopora* and *Amplexus* coral from the Silurian of Elora, Ontario, Canada. Devonian invertebrates include a coral *Aulapora* from Eifel and *Favosites* without information. Carboniferous brachiopods are from Beith, Ayrshire (*Productus*), Fife (*Spirifer*, *Productus*), Little Island (*Aviculopecten*, *Pecten*), Arran (*Gigantoproductus*), Yorkshire (*Spirifer*) and Ireland (*Spirifer*) among other localities. A fossil from Ireland shows a *Cardiomorpha* bivalve and *Fenestella*, another specimen has a label reading 'Fossil mussels from Hemmington coalpit at Newton, Lanarkshire. Found over 200 fathoms under the surface. July 1892'. Trace fossils include Lower Silurian *Crossopodia scotia* from Penwhapple Glen, Girvan, two fragments of *Arenicolites* from the Huronian of St Johns, Newfoundland, and arthropod tracks that could be assigned to *Cruziana*.

Mesozoic invertebrates are almost entirely molluscan; none were observed from the Triassic. Fossils from the Jurassic include relatively numerous specimens of *Gryphaea*, with a set from Morvern, Argyllshire, dated 1943, a set from Broadford, Isle of Skye, and another from the Kimmeridge Clay of Shotover near Headington, Oxford. Bivalves include *Pecten* and *Cardium* from the Upper Oolite Portland Stone Formation of Portland, *Clypeus* from the Inferior Oolite of Birdlip, *Ostrea* from the Great Oolite of Cirencester and a bivalve from the Kimmeridge Clay. Ammonites are relatively numerous with labels for Folkestone, *Hildoceras* from Whitby, *Dactylioceras* from Kittleness, *Stephanoceras* from Sherbourne and specimens that appear to be from the Jurassic of Eathie (Cromarty). Nautiloids include a large partial orthocone and second complete specimen. Non-molluscan fossils include echinoid tests and disarticulated spines from the Coral Rag, Middle Oolite of Oxfordshire and Weymouth, and a specimen labelled as the isopod *Archaeoniscus* from the Upper Oolite of Weymouth, which might be *A. brodiei* from the Purbeck Limestone Group of the Isle of Portland. The Alistair Cowden Geology Collection contains mixed geological material including fossils from the Liassic of Lyme Regis, bivalves from the Upper Jurassic Portland Beds and orthoconic nautiloids in mudstone.

Cretaceous fossils are similarly dominated by molluscs with examples of the bivalve *Exogyra* and cephalopod *Belemnites* from the Speeton Clay of Yorkshire, the unusual bivalve *Gervillia* from the Lower Greensand of Atherfield, Isle of Wight, *Belemnites* from the Upper Greensand, *Hammites* from the Gault of Kent, the bivalve *Inoceramus* from the Gault of Folkestone and *Nucula* from the Chalk of Folkestone. Non-molluscan fossils are the echinoid *Anchytes*, *Terebratula* brachiopods from the Upper Greensand, the echinoids *Micraster*, *Echinoconus* and *Ananchytes* from the Chalk of Kent, the brachiopod *Kingena* from Cheltenham and coral *Holocytes* from the Lower Greensand of the Isle of Wight.

Cenozoic fossils are limited to a few well-known levels. The Eocene is represented by fossils from the London Clay (bivalves *Modiola* from Holloway and *Cytherea* from Fareham, brachiopods *Lingula* from Bognor and *Terebratulina* from Belsize Tunnel, with vertebrates including shark teeth among bivalves from other localities and a hippo jaw fragment from the Isle of Wight), Barton Beds (numerous bivalves, such as *Pectunculus*, and gastropods), Woolwich Beds (*Cyrena* from Charlton) with Paleocene fossils from the Thanet Sands (*Pholadomya*). Several drawers are noted as Pleistocene and/or Quaternary. Among the fossils from the Red Crag locality of Walton on the Naze, Essex, are the gastropods *Natica*, *Trivia*, *Emarginula*, and bivalves *Pectunclus*, *Lucina*, *Cardium*,

Cardita and *Nassa*. The Thomas L Scott collection focuses on material from Quaternary/Pleistocene raised beaches: *Rissoa, Montacuta*, *Lepton* and *Axinus* from Largs, *Mactra* from Innellan, *Lucina* and *Littorina* from Millport, and crustacean remains from Garvel Park, Greenock, a locality described in publications, such as Scott and (James) Steel (1885). Additional drawers of Quaternary/Pleistocene and boulder clay fossils are attributed to Thomas Steel and contain mostly gastropods (*Pleurotoma*, *Buccinum*, *Trophon*, *Fusus*, *Purpura*), algae (*Melobesia*), crustacean fragments and fish remains. A collection of fossils identified by diamond-shaped labels with a blue outline in two compartmentalised boxes is assumed to be from a specific collector. It includes further molluscs (gastropods and bivalves) that appear to be Cenozoic if not Recent, and plants, ammonites, echinoids, crustaceans and belemnites from a range of geological ages. The boxes were found with a list of taxonomic names (mostly bivalve and gastropod) giving origins of Germany, France and Bohemia among other countries, which might be relevant.

Plant fossils are mostly from the coal mining industry in the Central Belt (*Alethopteris*, Sigillaria, *Plecopteris*, *Pecopteris*, *Neuropteris*, *Sphenopteris* including from Burdiehouse, *Stigmaria* from Dunfermline, *Calamites*), Ayrshire (*Lepidodendron* from Dalmellington) and Derbyshire (*Neuropteris*, *Sphenopteris*, *Pecopteris, Lepidodendron*). Among the specimens is one with a label ‘Fragments of a *Lycopsidiaceous* (?) plant Fm *Coccosteus* beds at Navity Cromarty’ and a second with a label *Alethopteris* from the Carboniferous of Derbyshire mentioning LH Pegler at Gloucester Square, perhaps acquired as part of donation in 1892 (Stace *et al.* 1987). Two fronds have notes mentioning Robert Dykes and an origin of the beach south of Prestwick in 1898 (Fig. 51). A single specimen was noted as Permian: the ostracod *Kirkbyia permiana* from the Lower Zechstein of Saxony, Germany. A rock with a plant frond is etched with ‘Barony Pit, Auchinleck, Ayrshire, 300 fathoms 1953, Bob McCallum Park Keeper’. Tertiary plants include a broad leaf fossil labelled ‘from the leaf beds of Ardtun, Loch Scriden [sic], Mull. The leaves are embedded in volcanic ash, and the deposit is believed to be the only representative of Miocene strata in Britain’; the deposit is now dated to the Paleocene.

Figure 51: Frond of a Carboniferous fern from Prestwick dated 1898 (McLean Museum and Art Gallery)

Research/collection links

Potentially important scientific material is the collection of mammal bones from Happaway Cave, Devon. The origin of the fossils from Canada would be interesting to research. A drawer of invertebrate fossils affixed to pieces of black card are potentially from Eathie although they are attributed to many collectors with a range of collection dates (Lyle, 1868; Pattinson ‘89) that could be investigated for context. This collection has the potential for a number of small, focused research projects.

Paisley Museum (Renfrewshire Leisure)

Collection type: Local authority (Renfrewshire Leisure)
Accreditation: 2019 (Provisional)

The Secret Collection, High Street, Paisley, PA1 2BA
Contact: tours@renfrewshireleisure.com

Location of collections
The origins of Paisley Museum lie in the Paisley Philosophical Institute, founded in 1808, whose collection of scientific apparatus, objects, and books needed a permanent home. Fundraising began in 1864, allowing construction of a building to begin in 1869 with the finished Free Public Library and Museum opening in 1871. Several extensions have since been added and the building closed recently for extensive refurbishment, due for completion in 2023. The collections have been relocated to a new storage facility on the main street following demolition of the 1950s store to make way for gallery space.

Size of collections
c4,000 fossils.

Onsite records
Information is currently being transcribed from a card index and catalogues to a Microsoft Excel document which will be transferred to an Adlib CMS. Many specimens have temporary numbers.

Collection highlights
1. Collection of Carboniferous invertebrate, vertebrate and plant fossils.
2. Fossils linked to Hugh Miller (1802-1856), Reverend John Anderson (1796-1864) and Reverend Hugh Mitchell (1822-1894).
3. Several invertebrate and vertebrate fossils from North America.

Published information
Andrews, S.M., and T.S. Westoll. (1970). The postcranial skeleton of Rhipidistian fishes excluding *Eusthenopteron*. *Transactions of the Royal Society of Edinburgh*. 68:207-329.
Jeffrey, J.E. (2001). Pectoral fins of rhizodontids and the evolution of pectoral appendages in the tetrapod stem-group. *Biological Journal of the Linnean Society*. 74:217-236

Collection overview
Although the collection includes casts of the Precambrian Ediacaran *Cyclomedusa* from Leicestershire, the oldest fossils are the burrows in Cambrian Pipe Rock from Wester Ross and the pseudo-fossil *Eozoon canadensis* from Montreal. Trilobites represent the Cambrian, Ordovician and Silurian, with examples of *Ptychagnostus* from Utah, *Olenus* from Pennsylvania, *Conocoryphe* from Bohemia, species from Norway and a rare detrital *Homolonotus* in the Devonian Budleigh Salterton pebble bed from Exmouth. Ordovician and Silurian fossils are mostly graptolites from Glentrool, Girvan, Dob's Linn (Dumfries and Galloway), Pentland Hills and north Wales, with specimens from as far afield as New York State (*Didymograptus* from the Deepkill Shale) and Canada; there are Silurian corals including a *Synaptoyllum* from the Guelph Limestone of Ohio. Silurian specimens from England include a variety of brachiopods, bivalves, gastropods and ostracods from the Much Wenlock Limestone Formation. Scottish fossils include several fragments of eurypterids from Lesmahagow, such as a *Pterygotus* without locality information, a large section of 3-4 articulated segments and another smaller but more complete fossil with the outline of the tergites drawn on in white.

Devonian fossils include early plants (*Hostimella*, *Psilophyton* and *Arthrostigma* from Tarr Burn, Callander), but are predominantly fish: Lower Devonian *Ischnacanthus* and other acanthodians from

Turin Hill; Middle Devonian *Pteraspis* from Cradley, Worcestershire, *Coccosteus* and *Osteolepis* from Edderton, *Mesacanthus* from Tynet Burn, *Pterichthyodes*, *Osteolepis* and *Cheirocanthus* from Cromarty, *Cheirocanthus* from Lethen [Bar]; Upper Devonian *Holoptychius* in sandstone from Dura Den. Several specimens have links to Hugh Miller, Reverend John Anderson or Reverend Hugh Mitchell. An *Osteolepis* from the 'Burn of Tynet' has a label reading 'bought by order of committee'. Another fossil is labelled as *Entonus tuberosa* from Deerhope, a species for which there is little information but may be an ostracod from the Deerhope Formation of the Pentlands.

Figure 52: Carboniferous shrimp *Tealliocaris* from the Gullane Shrimp Bed, East Lothian (from Renfrewshire Council's collection, held by Renfrewshire Leisure Limited)

The largest part of the collection comprises fossils from the Carboniferous. Corals, such as *Lithostrotion,* are from the local region and Scotland generally (Beith, Paisley, Lugton, Bathgate, Kellhead, Arbigland, Fife, Dunbar, Muirkirk, Campsie; a named rock unit is the Petershill Limestone (Brigantian) from the Lower Limestone Formation), England (Avon Gorge, Bristol) and beyond (Ohio, Illinois, Canada). Bivalves include *Carbonicola* and *Cypricardium* from Douglas Water and Lanarkshire, with samples of a mussel band. Cephalopods are represented by orthoconic nautiloids (Carluke) and goniatites. Gastropods are limited to a few species, notably *Bellerophon* of which there are many examples. Brachiopods include various sizes of recognisable productids and other taxa from Barrhead, Beith, Kilmarnock, Dalry, Weston-super-Mare and localities in Derbyshire. There are smaller numbers of conulariids and arthropods (*Tealliocaris* shrimp from the Gullane Shrimp Beds, Fig. 52). Fish include fragments of *Megalichthys* (Airdrie, Lanarkshire, Kilbarchan), *Rhizodus* (Dalry, Nitshill), *Strepsodus* (Gilmerton), *Acrolepis* (Hurlet, East Renfrewshire), *Palaeoniscum* (Blackstone, Kilbarchan), *Sphenocanthus* (Annick Lodge) and *Pleurocanthus* (Annick Lodge). There is a noted collection of *Rhizodus* fragments from Todhills Pit including teeth, isolated or embedded in jaws, with rarer shoulder and other large skeletal elements. Coprolites attributed to fish include a specimen from Kilbarchan (Johnstone, Renfrewshire), Hurlet and Dalry (Ayrshire). A specimen labelled as amphibian from Cardowan, Stepps, Lanarkshire, seems to be a three-toed footprint in dark mudstone.

Carboniferous plant fossils include typical and rare types from around the world: *Pecopteris* (Radstock, Somerset; Whinhill Quarry, Alloa), *Sphenopteris* (Bothwell), *Telangium*, *Asterophyllites* (Foxley, Glasgow; Nova Scotia), *Annularia*, *Alethopteris*, *Calymmatotheca*, *Trigonocarpus*,

Lepidodendron, *Mariopteris*, *Neuropteris* (one might be *Cyclopteris*), *Calamites* (Dunbar, Lanarkshire), *Sigillaria* (Edinburgh, Randwood Colliery, Springhill Colliery), *Stigmaria* (Gateshead), *Urnatopteris*, *Carlopteris*, *Cordaites*, *Seftenbergia*, *Halonia*, *Lepidostrobus*, *Ulodendron*, *Diplotmena* (Whinhill Quarry, Alloa) and other indeterminate fragments; several are oversize. Many plant fossils are attributed to David Beveridge, a former coal worker and janitor at the Museum, whose collection was purchased by the Coats family and donated to the Museum.

Permian fossils are mostly traces: various *Chelichnus* and *Herpetichnus robustus* from Locharbriggs. A *Palaeoniscum* fish from Germany is probably from the Permian Kupferschiefer Formation. Triassic fossils are limited but include samples of the Rhaetic Bone Bed from Aust Cliff, Gloucestershire, a *Cheirotherium* from the Triassic of Storeton, Cheshire, and oversize slabs showing various footprints and a trackway of small, rounded depressions in two rows.

Jurassic fossils originate from Scotland, England and worldwide. Cephalopods include ammonites from Eathie, Tiree (Argyllshire), Robin Hood's Bay, Redcar, Cleveland, Portland, Lyme Regis (Fig. 53) and Blockley (Gloucestershire), a handful of ammonites from the Callovian Clynelish Limestone (Sutherland), *Nautilus* from Brora, and a belemnite from the Jurassic Solnhofen Limestone labelled Krantz of Berlin. A set of ammonites in small boxes is labelled to zone and possibly subzone level. Bivalves are numerous with *Gryphaea*, *Pholadomya* and many other species from Broadford and Brora in Scotland, the south of England including Blockley, and worldwide. Also present are numerous crinoid fragments, examples of the brittle star *Ophioderma* from Lyme Regis, various Jurassic echinoids (*Acroselenia*, *Nucleolites*) and a dragonfly labelled as *Petalia* from the Solnhofen Limestone (now *Cymatophlebia longialata* (Gerner 1839)). Jurassic vertebrates are represented by the fish *Lepidotus* from Thuringia, pterosaur *Scaphognathus* from the Solnhofen Limestone, 'crocodile' *Steneosaurus* and casts of an ichthyosaur limb (the original from Holzmaden in Kelvingrove Art Gallery and Museum).

Oversize specimens include a set of large blocks with part of a rib cage and several near articulated vertebrae assigned to the ichthyosaur *Macroptychius* from the Oxford Clay, a second set of rib and vertebrae fragments, some articulated, assigned to the same taxa but without locality information, and a third comprising crushed ribs from an ichthyosaur collected at Peterborough. There are further large vertebrae without age or locality information, a *Plesiosaurus* fossil from the Kimmeridge Clay of Brora, a marine reptile humerus and an ichthyosaur skull from Peterborough. From further afield is a dinosaur limb bone from Wyoming and a polished dinosaur bone from Colorado. Trace fossils include 'an iguanodontid… poss. Purbeck Stone Quarry', a footprint identified as Jurassic from Swanage and a slab of rock approximately a metre across mounted as a display piece showing two dinosaur footprints. Invertebrates from the Cretaceous comprise terebratulid and rhynchonellid brachiopods, sponges, corals (some from Tampa, Florida), flint echinoids and belemnites from Kent and Lyme Regis, many in chalk. Vertebrates include vertebrae of the marine reptile *Plesiosaurus* and fish, specifically the head of *Saurodon* from the Chalk of Sussex showing high surface detail, a group of small fish from the Cretaceous of Lebanon, and *Tharrhias* in nodules from the Cretaceous Santana Formation. A fossil in chalk is labelled as an infilled worm burrow, perhaps due to its overall long, thin shape, although the fossil seems to be a complete but slightly disarticulated fish; the shape of the specimen follows the outline of the fish. The Cretaceous Ulster White Limestone is represented by fossils from Glenarm and other localities in Northern Ireland.

Cenozoic fossils are mostly from the Eocene. Invertebrates include *Clypeaster* from Egypt, crustaceans (*Xanthopsis* (also spelt *Zanthopsis*) from the Isle of Sheppey; *Thalassina* from eastern Australia), foraminifera (*Nummulites*) and a selection of gastropods (*Pleurotoma*, *Turricula*, *Sconsia*, *Clavilithes*, *Voluta*, *Hippochrenes*, etc) most likely from the Barton Beds or similar. Unusual specimens include larvae from the dragonfly *Libellula* from Piedmont, Italy. Vertebrates are represented by shark teeth (*Lamna*, *Oxyrina*, *Carcharodon*), fish from Monte Bolca, Italy, and Green River Formation (*Knightia*, *Priscacara*), the fish *Smerdis* from France, and the fish *Clupea* and *Leptaucherin* from northern Germany. Cenozoic mammals include teeth and bone fragments of the Miocene *Diceratherium* from Agate Springs, Nebraska, skull and jaw of the Oligocene oreodont

Merycoidodon from North Dakota, and *Mesohippus* from North America. Plant material includes remains from Brora, Sutherland and Eigg, leaves from the Ardtun leaf bed at Bunessan, Mull, and Florissant, Colorado, various species (*Platanus*, *Salix*, *Tilia*, *Acer*) from the Oligocene of Germany, *Metasequoia* from British Columbia and fossil wood from Norwich.

Quaternary fossils include the bivalves (*Cyprina*, *Pecten*) and gastropods (*Trophon*, *Aporrhais*) from the Pleistocene Clyde Beds (Clyde Clay Formation) of Paisley, Largs and Greenock; material can be attributed to Peder Aspen, who collected extensively from the Clyde Beds while working at Paisley Museum. Other fossils are of *Serpula* and barnacles from Linwood (bypass cutting) and Largs; several specimens are labelled as Yorkshire. Vertebrate fossils from Scotland are limited to the jaw of an ox from Seedhill, Paisley, with the majority from outside Scotland: Deer horn from Norfolk, a *Mastodon* tooth from North Carolina, *Equus* jaw and teeth, mammoth teeth from several localities such as Tampa, Florida, an *Elephas* tooth from the Engineer gravels of Alaska, and several bison teeth and a separate jaw from Cripple Creek, Alaska. Fossil wood from Zeltam and Lough Neagh are present.

Miscellaneous fossils are the gastropods from Kansas, a ‘deposit of silica or phosphate containing fossil remains of shells, corals, worm burrows’ from Erskine (East Craigend, Renfrewshire), ostracods, brachiopods (from Houston, Renfrewshire), a fish or reptile head, fossils from Johnstone, Renfrewshire (crinoids and bivalves, etc, perhaps from the Carboniferous), Jurassic fossil oysters and echinoids that could be associated with a label reading ‘roadside – Cotswold Limestone’, a large orthoconic nautiloid that might be from the Carboniferous of Bishop Hill, Kinross, other nautiloids, bivalves and plants (*Endogenites* from Hastings Sand), an indeterminate fossil potentially fucoid (seaweed) and the left shoulder bone of an Irish elk from Paisley. Boxes also contain various brass models of Devonian fish (*Cheirolepis*, *Cephalaspis* and *Bothriolepis*) and Ice Age animals (sabre tooth tiger and mammoth).

Figure 53: Jurassic ammonite *Angulaticeras greenoughi* from Lyme Regis (Paisley Museum). Image copyright of Renfrewshire Leisure Ltd

Research/collection links

Fragments of the Carboniferous fish *Rhizodus* from the Todhills Pit are numerous and could represent a relatively complete individual, providing a focus for a project that could investigate larger elements assigned to *Rhizodus* in other museum collections. Material is certainly held in collections at Glasgow Museums Resource Centre, Cockburn Museum, The Hunterian and University of Aberdeen Museums, with other specimens in smaller collections, such as The Discovery Centre (Mintlaw), Tweeddale Museum, McLean Museum and Art Gallery, and John Pollock Collection Centre. The two specimens from the Beveridge Collection, mentioned by Andrews and Westoll (1970), and Jeffrey (2001), are part of a recent joint Cambridge University/Natural History Museum project which undertook a new study of rhizodont humeri and other material found recently in the Tournaisian of the Borders Region (not yet published).

Additional studies could investigate the identity and origin of several other fossils in the Paisley Museum collection, notably the specimen labelled *Entonus tuberosa* from Deerhope, the set of fossils from Lethen Bar and/or Tynet Burn labelled as eurypterid and Devonian placoderm fish more likely to be a Carboniferous *Megalichthys*. A possible footprint of an amphibian from Cardowan, Lanarkshire, which might be Carboniferous, could provide the basis for a research project on Scottish vertebrate trace fossils. The Mesozoic marine reptile material is also interesting and could be studied, or at the very least documented, as part of an investigation of such material and its context in collections across Scotland. The fossils from the Clyde Beds are important as a record of climatic and habitat changes in late glacial to post-glacial times. It is not clear if the specific fossils from either the Clyde Beds (Firth of Clyde) and Errol Clay (Tayside) in the Paisley collection were part of such studies, which could be investigated. The material collected historically and more recently is still present and available for study.

Zoology Museum (University of Glasgow)

Collection type: University
Recognised Collection: 2007

Graham Kerr Building, University of Glasgow, Glasgow, G12 8QQ
Contact: on website https://www.gla.ac.uk/hunterian/visit/ourvenues/hunterianzoologymuseum/

Location of collections
The project of constructing a building for the Department of Zoology at Glasgow University was undertaken by John Graham Kerr (1869-1957), Regius professor of Zoology 1904-1935. The building was designed by the Glasgow architect Sir John James Burnet and opened in 1923. Displays and stores have been onsite since then and are still used for exhibitions, research and teaching. Material in the Zoology Museum is part of The Hunterian Collections, Recognised under the Museums Galleries Scotland Recognition Scheme as a Nationally Significant Collection. Fossils are included in the displays; further specimens might be in storage, which was not investigated at the time of the visit.

Size of collections
Less than 10 fossils.

Onsite records
Not known. The website has an online collection at: http://collections.gla.ac.uk/#/advancedsearch.

Collection overview
Fossils are limited to a trilobite (labelled *Ogygiopsis klotzi*) and eurypterid for comparison to modern arthropods. There are several fish: Silurian *Lasanius* and *Birkenia* models (Fig. 54), Devonian *Cephalaspis*, *Pteraspis*, *Pterichthyodes*, *Gemuendina* and *Climatius* displayed with modern fish. A *Hesperornis* skull and two casts of *Archaeopteryx* are in a case themed on birds.

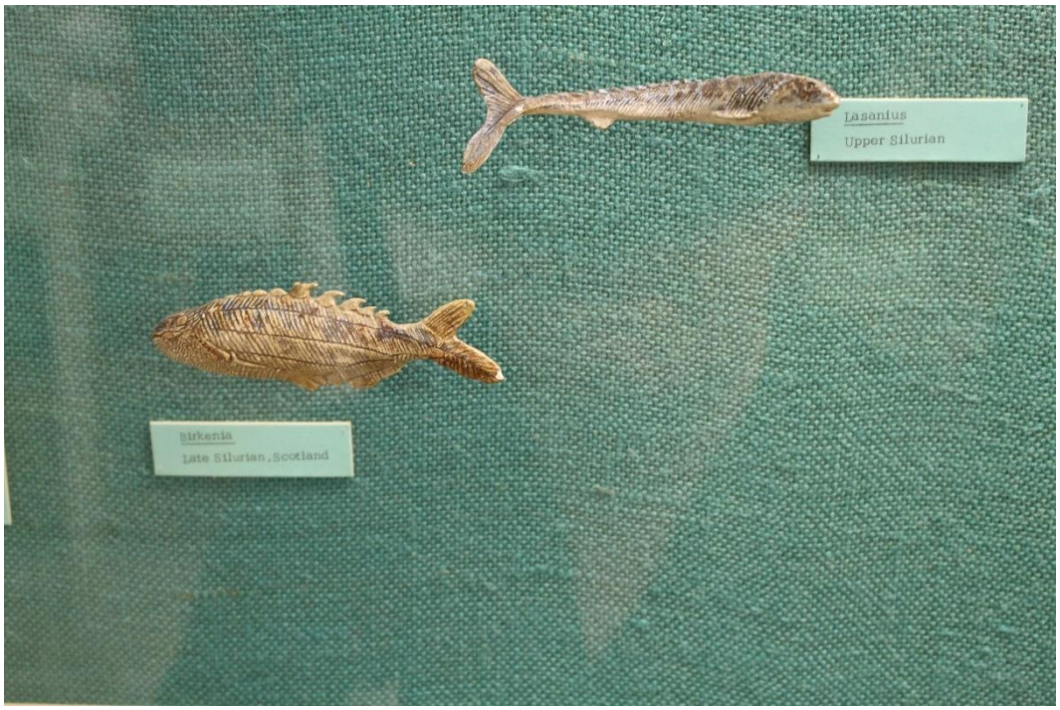

Figure 54: Reconstructions of the jawless Silurian fish *Lasanius* and *Birkenia* from the areas around Lesmahagow and the Hagshaw Hills (Zoology Museum, University of Glasgow)

The Hunterian (University of Glasgow)

Collection type: University
Accreditation: 2017
Recognised Collection: 2007

Gilbert Scott Building, University of Glasgow, Glasgow, G12 8QQ
Contact: hunterian-enquiries@glasgow.ac.uk; hunterian-collections@glasgow.ac.uk

Location of collections
The collection and Museum building are the legacy of Dr William Hunter (1718-1783) who was born locally, attended the University of Glasgow and became a pioneering obstetrician and teacher. Hunter built his first museum, part of an anatomy school, at 16 Great Windmill Street, London. The collection was bequeathed to the University along with funds to create a museum, which opened in the east end of Glasgow in 1807. In 1870 the University moved to its current site and the Museum was relocated to the Gilbert Scott building where it is today. As the collection included everything from paintings to coins and medals, medieval manuscripts, etc, parts have since dispersed to relevant departments. The entire collection of The Hunterian is Recognised under the Museums Galleries Scotland Recognition Scheme as a Nationally Significant Collection. Fossils are onsite in displays with extensive fossil material in offsite storage, which is in the process of being relocated to Kelvin Hall; due to the Covid-19 lockdown it was not possible to investigate the latter.

Size of collections
Approximately 100 fossils on display, with more than 30,000 specimens in storage.

Onsite records
Information for the collection is on a Ke EMu CMS database, with the majority of fossils now added, notably those on display, with ongoing work to include the remainder. Information for the fossils is also documented in various ledgers, MDA card, entry forms, etc. The website lists 5,000 graptolites, 10,000 vertebrates and 10,000 plants; an online collection includes entries for 17,319 fossils at: http://collections.gla.ac.uk/#/advancedsearch.

Collection highlights
1. Fossils illustrating the geological history of Scotland and key points in the evolution of life.
2. Fossils linked to Gideon Mantell (1790-1852) and William Buckland (1704-1856).
3. Fossil collections of Emily Dix (1904-1972), Alfred Nicholson Leeds (1847-1917), Thomas Brown of Lanfine (1774-1853), and James ‘Paraffin’ Young (1811-1883).
4. David Ure (1749-1798) collection of Carboniferous fossils, subject of an extensive publication.
5. Strong collection of c.6,000 trilobite fossils attributed to George Rae (1927-1998).
6. Several thousand type and figured fossils in the collection.

Published information
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Collection overview

The displays in The Hunterian focus on well-known fossil localities from Scotland, the UK and worldwide where assemblages have been excavated and studied both historically and recently. The oldest specimens are Cambrian Pipe Rock from Ullapool, representing infilled burrows in sand. Fossils from the Ordovician of the Girvan area, 460 million years ago, include the worm tubes of *Serpulites*, orthoconic nautiloids, conularids, starfish (*Drepanaster*, *Stenaster*, *Urasterella*, *Euzosoma* and *Mastigactis*), carpoids (*Dendrocystoides* and *Cothurnocystis*), cystoids (*Pleurocystites* and *Dendrocystoides*), floating sponges *Receptaculites*, brachiopods (*Plaesiomys*, *Dinorthis*, *Schizophorella* and *Leptaena*), echinoids (*Ectinechinus*), crinoids (*Protaxocrinus*) gastropods (*Tropidodiscus*), coral (*Grenwingkia*) and trilobites (*Stenoparia*, *Pseudospharexochus*, *Calymene*, *Erratencrinus*, *Sphaerocoryphe*, *Remopleurides*, *Phillipsinella*, *Decoroproetus*, *Flexicalymene*, *Dindymene*, *Lochodomas*, *Cybeloides*, *Paraproetus*, *Stygina*, *Tretaspis*, *Nankinolithus*, *Toxochasmops* and *Erratencrinurus*). In addition, an 18cm long *Hadromerus keisleyensis*, dated to 435 million years ago from Girvan is highlighted as Scotland's largest trilobite. The collection also includes Ordovician graptolites, such as *Diplograptus*.

Figure 55: Jaw with teeth of the Carboniferous fish *Rhizodus hibberti* from Edinburgh (The Hunterian)

Silurian fossils are from the Lesmahagow and Hagshaw Hills inliers in Ayrshire and Lanarkshire, specifically the localities discovered by James Fallow in the 1840s and subsequently excavated by Dr Robert Slimon (1808-1882), and the Geological Society of Glasgow under the name 'Camp Siluria'. Fossils include the fish *Jamoytius*, the eurypterids *Hughmilleria*, *Pterygotus* (juvenile and adult specimens) and larger *Paracarcinosoma*, a *Pterygotus* claw, the enigmatic shrimp-like

arthropod *Ainiktozoon* (assigned previously to many groups including sea squirts) and the jawless fish *Loganellia*, *Lasanius* and *Birkenia*. A millipede from the Silurian of the island of Kerrera (Argyll and Bute), dated to 425 million years ago, is described as the earliest known land animal, although older terrestrial arthropod fossils have since been found. Devonian fossils are limited to *Cephalaspis* and other fish from Dura Den, Fife.

Carboniferous fossils are from the 330 million-year-old rocks exposed at Bearsden and Bathgate. The Bearsden locality was discovered by Stan Wood (1939-2012) and excavated by The Hunterian in 1982. Fossils include the 'Bearsden shark' *Akmonistion*, the rat-fish *Deltoptychius*, an iniopterygian 'flying shark' (one of a rare few found outside America), smaller shark *Denaea*, the fish *Chirodus* and *Rhizodus*, a coprolite from a large fish, a species of the fish *Mesopoma carriki* known only from Bearsden, the shrimps *Palaemysis* and *Tealliocaris*, with an additional fossil of *Palaemysis* showing preservation of blood vessels and muscles. Fossils from East Kirkton, near Bathgate, are as varied as the hind part and head of the amphibian *Balanerpeton*, two scorpion fossils, the harvestman spider *Brigantibunum listoni*, and carbonate encrusted wood resulting from deposition in hot springs saturated with lime. Additional Carboniferous fossils are of the corals *Aulophyllum* and *Lithostrotion*, brachiopods (*Gigantoproductus, Productus*, *Spirifera* and *Echinoconchus*), coprolites, bivalve *Carbonicola*, crinoid *Parazeacrinus* and bryozoan *Fenestella* (some linked to David Ure), *Tealliocaris* shrimps from Gullane, East Lothian, shark teeth (*Gyracanthus* (Cowdenbeath, Fife), *Gonotodus* (Edinburgh) and other large specimens), *Rhizodus* from Edinburgh (Fig. 55), and the *Arthropleura* track from Laggan, Isle of Arran, with a full-sized model and part of an *Arthropleura* body segment in an ironstone nodule. There is the fossil of the 345 million-year-old amphibian *Pederpes finneyae* (Fig. 56), discovered in the Ballagan Formation at Dumbartonshire in 1973 and named after the finder Peder Aspen and preparator Sarah Finney.

The Permian is represented by the three-dimensional resin cast of a dicynodont skull, produced from an MRI scan of a void in Hopeman Sandstone from the Moray Coast. Fossils from the Mesozoic of Scotland are from the Jurassic of the Isle of Skye: The bivalve *Gryphaea* and ammonites, casts of trackways and footprints (originals in Staffin Dinosaur Museum or still *in situ*), and a dinosaur caudal (tail) vertebra. A footprint found on the Isle of Skye by the curator of vertebrate fossils at The Hunterian, recognised by Guinness (2006) as the smallest footprint in the World, is also on display. This footprint is interesting because it occurs within a second, only moderately larger print.

Early vertebrate fossils are the teeth of the conodont *Jumodontus* from the Lower Ordovician of Perthshire and examples of the complete animals from the Lower Carboniferous of Edinburgh. Early tetrapods are represented by the cast of *Acanthostega* from the Upper Devonian of Greenland, a tail of *Eusthenopteron* from Quebec with a model and cast of the pectoral fin to show the bones, the lower jaw of a baphetid amphibian from the Carboniferous of Larkhall, Lanarkshire, *Eoherpeton* from the Lower Carboniferous of East Kirkton, cast of a *Diplocaulus* skull from the Early Permian of Texas, a fossil showing the rear of the skull, thorax and shoulder girdle of *Discosauriscus* from the Early Permian of the Czech Republic, *Archegosaurus* from the Lower Permian of Germany, lower jaw of *Cyclotosaurus* from the Early Triassic of Germany, and *Thoosuchus* from the Early Triassic of Russia. Fish fossils include *Coturus* and *Ophiopsis* (Upper Jurassic, Eichstatt), *Pachycormus* (Early Jurassic, Holzmaden), *Mene, Myripristis* and *Sparnodus* from the Eocene Monte Bolca, *Diplomystus* (Eocene Green River Formation, Wyoming), *Amia* (Eocene, Darmstadt, Germany), *Dapedius* (Lower Jurassic, no location), *Mallotus* (Quaternery, Ontario), *Diplomystius* (Upper Cretaceous, Mt Lebanon, Lebanon) and *Pholidophorus* (Jurassic, Dorset). A tooth found in 1821 by Mary Mantell in a Sussex Quarry was compared by Gideon Mantell (1790-1852) in a 1925 publication to the tooth of the carnivore *Megalosaurus* that William Buckland (1704-1856) had published on in 1824. Flying vertebrates are represented by the casts of *Archaeopteryx lithographica* (the Berlin specimen showing feather outlines and the Eichstatt specimen found in 1951), a model of *Proavis* in flight (Frank Munro, 1960s), a *Pterodactylus* cast from the Jurassic Solnhofen Limestone, and the bat *Palaeochiropteryx* from the Eocene of Messel, Germany. A dinosaur nest with several eggs from the Upper Cretaceous of China, a large articulated cast of a sauropod dinosaur leg, and a comparison

of a dinosaur limb bone to a section of the 300 million-year-old club moss *Lepidodendron* are present.

Dinosaur fossils are the lower and upper jaws of the Cretaceous *Juxartosaurus* showing the tooth plates and wear, a Cretaceous *Tyrannosaur* jaw with a broken and erupting tooth, a Cretaceous dinosaur 'hand', Cretaceous hadrosaur skin impression cut by a rib and 150 million-year-old (Jurassic) dinosaur dung with plant fragments. A separate display shows the skulls of an *Archaeopteryx* from Germany, *Velociraptor* from Asia, *Diplodocus* from North America and an *Allosaurus* skull from North America. Marine reptiles are represented by a large, wall-mounted Jurassic ichthyosaur and an articulated skeleton of a *Cryptoclidus*. An elephant tooth from Norwich and a mastodon tooth from North America represent mammals. Brittle stars in Arctic clay from Dunbar, East Lothian, are the youngest fossils on display.

Figure 56: The Carboniferous amphibian *Pederpes finnayae* from the Ballagan Formation, Dumbarton (The Hunterian)

Several cases give information on specific collectors and examples of their work, some of which contain fossils. The collection of Emily Dix (1904-1972) comprises Upper Carboniferous (300 million-year-old) plant fossils from France, Germany, Wales and England, used to correlate the respective stratigraphic sections among these regions. Representative specimens on display are of *Acitheca*, *Archaeosigillaria*, *Neuropteris*, *Diplotmema*, *Sphenophyllum*, *Senfteribergia*, *Lepidodendron*, *Asterotheca*, *Callipteridium*, *Alethopteris*, *Annularia*, *Polymorphopteris* and *Odontopteris*. The specimens in The Hunterian are those that survived bombing in London during the Second World War. Many specimens and most of the paperwork and research notes produced by Dix were destroyed; the event led to the remaining material being donated to The Hunterian at the end of the war. Fossils from the collection of George Rae (1927-1998) have a wide range, both geographically and stratigraphically: a Silurian gastropod *Platystoma* from Indiana, Jurassic ammonite *Caloceras* from Somerset, *Diplomystius* and *Knightia* from the Eocene Green River Formation of Wyoming, Ordovician *Ectillaenus* and Devonian *Lioharpes* from the Czech Republic, Ordovician *Asaphus* and *Neoasaphus* from Russia, plants from the Carboniferous of Illinois, the Middle Cambrian trilobite *Acadoparadoxides*, Ordovician trilobite *Onnia* and Devonian trilobites *Ceratarges*, *Morocconites*, *Odontochile* and *Konoprusia* from Morocco, Jurassic belemnite *Megateuthis* from the Isle of Skye and *Microdoceras* from Charmouth, and Cretaceous

Venezoliceras. Material attributed to Rae includes a notable collection of fossils from Girvan, particularly trilobites.

The collection of Alfred Nicholson Leeds (1847-1917) comprises 160 million-year-old vertebrate fossils collected from brick pits around Peterborough to form the largest collection of Jurassic marine reptiles (approximately 600) accumulated by a single family. On display is a front paddle and two dorsal vertebrae of the long-necked plesiosaur *Muraenosaurus*, tail rays and gill rakes from *Leedichthys*, skull and lower jaws of the aquatic crocodile *Metriorhynchus*, skull and isolated tooth from the 'land' crocodile *Steneosaurus* and 4 tooth plates from the chimaerid shark or rat fish *Plichymylus*. The Thomas Brown of Lanfine (1774-1853) collection includes a specimen of limestone showing coral reef debris with a prominent, complete *Encrinurus* calyx (head and arms) and part of the stem from Brunswick, Germany. A second specimen is a *Megalosaurus* tooth and bone fragment from Tilgate, Sussex, with a link to Buckland, and is perhaps the specimen mentioned by Mantell. The James 'Paraffin' Young (1811-1883) collection includes a wooden compartmentalised case of fossils (brachiopod, bivalve, crinoid, coral, gastropod) from the Carluke area, Lanarkshire, with labels providing a genus and species name, locality, and number (there is a total of 98). Most specimens are cut in some way, usually as squares, and polished, the orientation of the cut being given in the information provided by the collector.

Examination of material in storage was not possible due to Covid-19 restrictions; the material on display is assumed to be representative of the fossil specimens in the Hunterian Collection. A summary of the 'Dinosaurs and Fossils' collection is available at https://www.gla.ac.uk/hunterian/collections/collectionssummaries/dinosaursandfossils/. Information from the database and literature highlights various type and figured specimens, including a specimen of the Carboniferous nymph *Idoptilus peachii* figured by Prokop et al (2018).

Research/collection links

Fossils showing the diversity of life in the Girvan area during the Ordovician have been studied through various research projects. Work to find, collect and study vertebrate, invertebrate and trace fossils from the Middle Jurassic of the Isle of Skye is ongoing with the fossils recovered studied in a collaboration of staff and researchers at the University of Glasgow, University of Edinburgh and National Museums Scotland.

Glasgow Museums Resource Centre (Glasgow Life)

Collection type: Local authority (Glasgow Life)
Accreditation: 2017
Recognised Collection: 2009

200 Woodland Road, South Nitshill Industrial Estate, Glasgow, G53 7NN
Contact: museums@glasgowlife.org.uk

Location of collections
The Glasgow Museums Resource Centre (GMRC) is the main store for collections managed by Glasgow Life. The building is divided into large rooms known as 'pods', one of which is reserved for the storage of fossils. There are no displays onsite, although the collections are available for use across Glasgow Life venues (see report for Kelvingrove Art Gallery and Museum below) and for loan to other organisations. Under normal circumstances, the collections are open and accessible 7 days a week with GMRC offering tours, school visits and family activities. The entire collection of Glasgow Museums is Recognised under the Museums Galleries Scotland Recognition Scheme as a Nationally Significant Collection.

Size of collections
c.50,000 fossils.

Onsite records
Information is in Mimsy (Multimimsy), the CMS database used by Glasgow Life, with the majority of fossils entered and work ongoing to add and update others. Additional details are in accession registers, Natural History Department daybooks and object files. An online database is available at: http://collections.glasgowmuseums.com/mwebcgi/mweb?request=home.

Collection highlights
1. Fossil collection 'representative of Scottish palaeontology'.
2. Silurian fossils from Lesmahagow collected by Dr Robert Slimon (1808-1882) and donated in 1909, with other material excavated by Camp Siluria.
3. Extensive collection of Devonian fish from Scotland.
4. Carboniferous fossils from East Kirkton.
5. The John Young (1823-1900) Collection of Carboniferous invertebrates (brachiopods, crinoids, ostracods, corals, bivalves, etc) donated by James Tullis in 1901, the basis for the *Catalogue of Western Scottish Fossils*.
6. Carboniferous corals collected by James Thomson (1823-1900).
7. Plant fossils from the Palaeocene Ardtun leaf beds of Mull.
8. Arctic clay fossils collected by David Robertson (1806-1896) and James Coutts (1810-1886).
9. Fossils are attributed to Dr Robert Gregory Absalom (1902-1975), David Nimmo, James Neilson (1820-1901, the Robert Craig (1822-1901) collection), James Dairon (1811-1891) and David Corse Glen (1824-1892).
10. Approximately 650 type and figured specimens.

Published information
Armstrong, J. (1876). *Catalogue of the western Scottish fossils*. Glasgow: Blackie & Sons.
Black, R.M. (1970). *The elements of palaeontology*. Cambridge University Press.
Brady, G.S., H.W. Crosskey, and D. Robertson. (1874). A Monograph of the Post-tertiary Entomostraca of Scotland. *Monograph of the Palaeontographical Society.* 28:1-232.
Campbell, G. D. (1851). On Tertiary leaf-beds in the Isle of Mull. *Quarterly Journal of the Geological Society of London.* 7:89-103.
Crosskey, H. W., and D. Robertson. (1868). VIII. The post-tertiary fossiliferous beds of Scotland. *Transactions of the Geological Society of Glasgow.* 3:113-129.

Forbes, E. (1851). Note on the Fossil Leaves represented in Plates II. III. and IV. *Quarterly Journal of the Geological Society.* 7:103-103.
Hill, D. (1938). A Monograph on the Carboniferous Rugose Corals of Scotland. *Monographs of the Palaeontographical Society.* 91:1-78.
Hill, D. (1939). A Monograph on the Carboniferous Rugose Corals of Scotland. *Monographs of the Palaeontographical Society.* 92:79-114.
Hill, D. (1940). A Monograph on the Carboniferous Rugose Corals of Scotland. *Monographs of the Palaeontographical Society.* 94:115-204.
Johnson, T. (1937), Notes on the Tertiary flora of Scotland. In *Transactions of the Botanical Society of Edinburgh.* 32:291-340.
Young, J., and J. Armstrong. (1874). XXIV. The Fossils of the Carboniferous Strata of the West of Scotland. *Transactions of the Geological Society of Glasgow.* 4:267-281.

Collection overview

The collection includes material focused on several stratigraphic levels and important localities. Silurian fossils include *Birkenia*, *Lanarkia*, *Logania*, and other agnathans (jawless fish) from the Lesmahagow, and Hagshaw Hills, Inliers. The Devonian is represented by fish: *Cephalaspis* (Ayrshire), *Coccosteus* (Thurso, Achanarras), *Psammosteus*, *Homostius* (Caithness), *Bothriolepis* (Scat Craig, Tynet Burn), *Pterichthyodes* (Caithness), *Osteolepis*, *Glyptolepis*, *Mesacanthus*, *Oracanthus*, *Cheirolepis*, *Dipterus* (Caithness), *Diplacanthus* and *Acanthodes* (Tynet Burn) and *Cheiracanthus* (Cromarty and Caithness); several of these localities are no longer accessible. Upper Devonian Dura Den fossils are also present as large, oversize slabs. Carboniferous fish include *Rhizodus* (Airdrie), *Eurynotus*, *Amblypterus*, *Gyracanthus*, *Nematoptychius*, *Ctenocanthus* (Carluke), *Gonatodus*, *Ctenodus* (Annich Lodge), *Rhabdoderma* and *Elonichthys* (from a blackband ironstone), and many other fragments. Other Scottish vertebrate material includes the scute impressions and bones of the reptile *Stagonolepis robertsoni* in Triassic sandstone. Fish fossils from outwith Scotland are a Jurassic *Dapedius*, isolated teeth in Jurassic Stonesfield Slate (*Hybodus*), several isolated shark teeth from East Anglia and *Carcharodon megalodon* (probably from East Anglia and America), and near complete fossils of *Odotus* (Cretaceous of Dover), *Lepidotes* (Wealden, Isle of Wight) and *Belinostomus* (Santana Formation of Brazil), among others.

A range of vertebrate material from outwith Scotland includes fragments of dinosaur bone, Jurassic plesiosaur femora and marine reptile vertebrae from the Jurassic Oxford Clay, ichthyosaur ribs, a crocodile scute and teeth, whale bones from the Red Crag of Felixstowe and a mammoth tooth, among others. Fragmentary artiodactyl mammal fossils (notably skull and teeth) from the Eocene-Oligocene of North America include *Eporeodon* (specimens from the Oligocene Chamberlain Pass, South Dakota), *Hyracotherium*, *Agriochoerus*, *Systemodon* and *Merycoidodon* (better known as *Oreodon*), among others. There is a complete skeleton of a Moa (*Dinornis*), with several additional limb bones and an articulated foot from New Zealand. There are casts of an *Archaeopteryx* and two ichthyosaurs.

Invertebrate fossils from the Palaeozoic (Cambrian to Permian) tend to be from rocks locally and within Scotland; younger (Mesozoic and especially Cenozoic) fossils are usually from further afield. Invertebrate specimens include examples of sponges, annelids in coal from Ayrshire and foraminifera from numerous stratigraphic levels. The Cambrian is represented by trilobites and trace fossils not examined on this visit. Fossils from the Ordovician include an assemblage from the Ardmillan Series (Caradoc-Ashgill, now Upper Sandbian-Upper Katian) of Girvan, notably trilobites (*Cyclopyge*, raphiophorids) and brachiopods (*Lingullela*, *Leptellina*, *Foliomena*, and *Glyptomena*). Examples of the Ordovician graptolite *Climacograptus* from the Glenkiln Shale (Rein Gill, Abington, Lanarkshire), Ardwell Shale (Girvan), Llandeilo Series (Llandrindod Wells) and the Hartfell Shale (Dob's Linn) were examined although many other taxa are present from these and additional localities. A further Ordovician fossil is *Nidulites* from Drummock, Ayrshire. Silurian fossils are of arthropods from Lesmahagow in Lanarkshire: The eurypterids *Slimonia* and *Carcinosoma* (labelled with the former name, *Eusarcana obesa*) and examples of the phyllocarid *Ceratiocaris* part of a

fauna including early fish (mentioned above), and brachiopods from the Silurian of the Pentland Hills and Much Wenlock Limestone Formation of the Welsh Borderlands (Shropshire and Wales).

A large part of the collection comprises invertebrate fossils from the Carboniferous: Corals (*Dibunophyllum*, *Clisiophyllum*, *Lonsdaleia*, *Carcinophyllum* among many others), crinoids (mostly fragments), bryozoan (*Fenestella*), brachiopods (most notably productids (*Productus*, *Gigantoproductus*) and several other groups), gastropods, goniatites, bivalves (*Aviculopecten*) and ostracods (*Bythocypris*, *Leperditia*, *Cypridinella*, *Healdia* and polycope burrows), many attributed to specific collectors and from localities focused in the southwest of Scotland: Kilmarnock, Dykehead, Blantyre, Beith, Roscobie (Fife), Campsie, Kirktonholm, East Kilbride, Bathgate, Hamilton and Bankhead (Lesmahagow). The corals are often cut to show internal morphology, and there are examples of productid brachiopods showing (rare) long external spines that stabilised them on the seabed during life. Many fossils are attributed to historic workers, such as John Young (1823-1900), James Thomson (1823-1900) and Robert Craig (1822-1901). The corals collected by James Thomson were used as the basis for a monograph of Scottish rugose corals by Dorothy Hill (published 1938-1940).

Figure 57: Eocene gastropod molluscs from England (Barton) and France (Grignon) (Glasgow Museums Resource Centre). Published with permission of Culture and Sport Glasgow (Glasgow Museums)

Mesozoic fossils include bryozoans (Herault, France), ammonites (*Aegoceras*, *Harpoceras* preserved adjacent to an ichthyosaur), brachiopods (terebratulids and rhynchonellids), echinoids (*Clypeus*), crinoids (*Seirocrinus*, *Apiocrinus*) and Jurassic arthropods (*Eryon* from the Inferior Oolite). From the Cenozoic, the Eocene is represented by bivalves and gastropods (*Voluta*, *Mitra*, *Terebra*, *Buccinum* and *Plurotoma*) from the Barton Beds of Barton in Northamptonshire, Turin and France (Fig. 57). A giant gastropod, measuring 50 centimetres, is probably from the Eocene of the Paris Basin. The Pliocene Coralline and Pleistocene Norwich crags are represented by mollusc fossils. There is material labelled as Post-Tertiary, representing Arctic (Pleistocene) glacial marine clays deposited between 13,500 and 12,000 years ago. Labels indicate Gourock and the Firth of Clyde among other localities, where the Clyde Beds (now the Clyde Clay Formation) are exposed.

These contain bivalves, gastropods, brittle stars (*Ophiopholis aculeata*), foraminifera and ostracods, often presented in fully labelled, glass-topped slides.

The taxonomic and geographic diversity of the plant fossils is indicated by drawer labels: Jurassic of Scotland, Miocene of Switzerland, Paleocene of Mull, Pleistocene mainly from Scotland, Silurian plants, Lower Old Red Sandstone from Forfarshire, Lower Old Red Sandstone from Perth and Stirling, and Lower Old Red Sandstone from Callendar, among others. Carboniferous plant fossils are the most numerous and diverse with specimens of *Cordaites*, *Sphenopteris*, *Zeilleria*, *Cordaicarpus* and *Lyginopteris* observed among many others. Fossils from the Paleocene Leaf Beds at Ardtun on Mull are labelled as *Betula cuspridens*, *Hamamelis orbicularis*, *Viburnum coryloides* and *Platanus hebridicus*, *Quercus*, *Gingko* and other deciduous trees; a specimen with fragments of several taxa is figured by Johnson (1937). The leaf bed locality was discovered in 1850 by George Campbell the 8th Duke of Argyll (1823-1900) with fossils donated to numerous museums by his son Lord Archibald Campbell (1846-1912). A drawer of Silurian plants includes *Amphiospongia* (perhaps an unusual hexactinellid sponge) from the Pentland Hills, which has not been observed in other collections to date and is perhaps a rarity. Approximately 1,000 Carboniferous plant fossils from the Scottish coalfields, attributed to Robert Gregory Absalom (1902-1975), were donated in 1946.

Research/collection links

Past research includes work on the Arctic clay fossils attributed to David Robertson, donated in 1902, and James Coutts Collection, donated in 1914, used to show a change in climate and the transition in the Clyde Beds (Clyde Clay Formation) from deep marine to shallow water and rivers. In addition, the molluscs and ostracods infer temperatures in the Clyde area 12,000 years ago that are comparable to cooler climates at higher latitudes today. Fossils from the Ardtun leaf bed are diverse and could be studied to at least document the occurrence of material in this and other collections.

Kelvingrove Art Gallery and Museum (Glasgow Life)

Collection type: Local authority (Glasgow Life)
Accreditation: 2017
Recognised Collection: 2009

Argyle Street, Glasgow, G3 8AG
Contact: museums@glasgowlife.ac.uk

Location of collections
The Museum was purpose-built as the Palace of Fine Arts for the Glasgow International Exhibition in 1901. Following closure for major refurbishment and restoration, the Museum reopened in 2006. The objects at Kelvingrove Art Gallery and Museum are part of the Glasgow Museums Collection which is Recognised under the Museums Galleries Scotland Recognition Scheme as a Nationally Significant Collection. Fossils are onsite in the Museum displays with extensive collections in storage at the Glasgow Museums Resource Centre (see separate report above).

Size of collections
80-100 fossils on display (see GMRC entry above for details of stored collections).

Onsite records
Information is in Mimsy (Multimimsy), the CMS database used by Glasgow Life, with the majority of fossils entered and work ongoing to add and update others. Additional details are in accession registers, Natural History Department daybooks and object files. An online database is available at: http://collections.glasgowmuseums.com/mwebcgi/mweb?request=home

Collection highlights
1. Fossils representing well-known localities across Scotland.
2. Carboniferous amphibian *Balanerpeton* from East Kirkton, found by Stan Wood (1939-2012).
3. Carboniferous plant fossils linked to Dr Robert Gregory Absalom (1902-1975).
4. Fossils attributed to Charles Darwin (1809-1882).
5. Type and figured specimens

Published information
Hibbert, S. (1836). On the freshwater limestone of Burdiehouse in the neighbourhood of Edinburgh, belonging to the Carboniferous group of rocks. With supplementary notes on other freshwater limestones. *Transactions of the Royal Society of Edinburgh.* 13:169-282.
Jeram, A.J., and P.A. Selden. (1993). Eurypterids from the Viséan of East Kirkton, West Lothian, Scotland. *Earth and Environmental Science Transactions of The Royal Society of Edinburgh.* 84:301-308.

Collection overview
Fossils are found in the *Creatures of the Past* gallery in displays focused on several stratigraphic levels. Fossils from the Devonian include the Lower Devonian *Cephalaspis* from Ayrshire, and Middle Devonian *Osteolepis* from Thurso and Orkney, *Gyroptychius* from Quoyloo, *Dipterus* from Caithness, *Palaeospondylus* from Achanarras, and *Cheirolepis*, *Cheirocanthus, Pterichthyodes*, *Coccosteus* and *Homostius* from Caithness, each with a model reconstruction. Two further reconstructions of Coelacanths are suspended from the ceiling. Upper Devonian fossils are of the fish *Holoptychius* in variably sized pieces of sandstone from Dura Den and other Scottish localities. Photographs of the scales of *Holoptychius* and *Osteolepis* placed adjacent to each other allow comparison of the scale ornament.

Carboniferous fossils are mainly plants, such as the giant club moss *Lepidodendron* (trunks, twigs and seed cones from Lanark among other localities), *Lepidostrobus* from Muirkirk and *Stigmaria*.

Horsetails include *Annularia* from Merrystone, *Calamites* from New Cumnock, *Asterophyllites* twig with leaves from Lesmahagow and a *Palaostachya* cone from Foxley, Glasgow. Fern-like plants are *Alethopteris* from Whinhill Pit, Alloa (also labelled as Absalom Collection), *Neuropteris* from Carluke, *Sphenopteris* from Grange Pit, Kilmarnock, and an *Alethopteris* with the seed cone *Trigonocarpus* from Foxley, Glasgow. Fish are represented by *Rhizodus*, *Megalichthys*, a species of *Mesopoma*, *M. carriki*, known only from Bearsden and *Eurynotus* (Broxburn), amphibian *Anthracosaurus* from Lanarkshire, and various coprolites, one macerated to reveal *Acanthodes* fish scales (labelled as 'J. T. Tullis, Young Collection', material collected by Dr John Young (1823-1900) and donated by James Tullis). Invertebrates include a range of corals (*Aulaphyllum*, *Lithostrotian*, *Zaphrentis* and *Lonsdaleia*), crinoids (*Poteriocrinus* showing the arms, cup and stems separately), bryozoa (*Penniretipora* with *Fenestella*), bivalves (*Anthracomya* and other bored shells), brachiopods (*Gigantoproductus*, *Spirifer*, *Antiquatonia*, *Schellwienella*, *Echinoconchus*, *Eomarginifera*, *Rugosochonetes*, *Leptagonia*, '*Lingula'* and *Krotovia*), cephalopods (*Rayonnoceras*, *Tylonautilus*, *Orthoceras*, *Beyrichthioceratoides*), bivalves (*Anculapecten*, *Lithophaga*, *Sanquinolites*, *Polidevcia*), arthropods (*Palaemys dunlopi*, *Paladin cuspidatus*) and gastropods (*Palaeostylus*, *Pleurotomaria*, *Straparollus*). Noted specimens are the large head of the eurypterid *Hibbertopterus* (a figured lectotype) and part of the skeleton of the amphibian *Balanerpeton woodi* from East Kirkton, found by Stan Wood in 1985 (figured).

Figure 58: Triassic *Cheirotherium* footprints from England (Kelvingrove Art Gallery and Museum). Published with permission of Culture and Sport Glasgow (Glasgow Museums)

The Triassic is represented by bones and the impression of bones from the reptile *Stagonolepis robertsoni* collected from Lossiemouth, near Elgin, Moray, and displayed with a life-size reconstruction. The Jurassic is represented by a complete ichthyosaur *Stenopterygius* from the Liassic of Holzmaden, Germany, several dinosaur gastroliths and invertebrate fossils including belemnites, gastropods, ammonites of regular and irregular type and examples of aptychii (the two-part lid used to close the shell with the living animal inside for protection) from the Isle of Skye, Scotland, England and Germany (displayed in a spiral), orthconic nautiloids, sponges, brachiopods, echinoids, corals, a crinoid from Germany, arthropods (lobster) and worm cast. Bivalves include the Jurassic *Gryphaea*, *Trigonia*, *Plagiostoma, Pholadomya* and oysters among other Jurassic and

Cretaceous specimens, such as the echinoid with club spines still attached and preserved in chalk. A bivalve is possibly from a Devensian Arctic clay. Vertebrates are represented by a fish with an old label reading *Caturus* from the Solnhofen Limestone, a second fish that is perhaps Permian, and a turtle. The table also shows a cast of a *Cetiosaurus* limb bone and cast of a *Ceratosaur* tibia, from the Middle Jurassic of the Isle of Skye. On top of the case is an articulated cast of a *Ceratosaur* skeleton from the Jurassic of Wyoming.

Trace fossils originate from several stratigraphic levels: Carboniferous *Eione montiforme* worm traces, Silurian *Crossopodia* snail tracks, Devonian *Helminthites* worm traces, Jurassic *Labricanus* worm casts (possibly from the Solnhofen Limestone), U-shaped *Corophiodes* worm burrows, *Oldhamia* invertebrate tracks, two specimens described as Carboniferous worm burrows and tracks, and more than one Triassic *Cheirotherium* track (labelled as England but probably from Cheshire, Fig. 58) including a cast. Further casts are of a Cretaceous *Protoceratops* nest with eggs and the pterosaurs *Scaphognathus*, *Pterodactylus* and *Rhamphorhynchus*, and an *Archaeopteryx* with a *Pterandon* model suspended from the ceiling.

A box of fossils in a themed display is attributed to Charles Darwin: The bivalve *Spondylus*, a crinoid, echinoid *Cyphosoma*, gastropod *Pleurotomaria*, coral, bivalve *Gryphaea*, belemnite, ammonite, second echinoid, a vertebra from the ichthyosaur *Macropterygius*, bivalve, ammonite and *Ptychodus* shark tooth. In another case related to Darwin is a slab of Much Wenlock Limestone Formation representing coral reef debris and showing fragments of numerous invertebrate fossils.

Research/collection links
Some of the trace fossil species are represented in other collections, notably University of Aberdeen Museums where many specimens are type and figured. A project could investigate whether the fossils displayed at Kelvingrove Art Gallery and Museum are of the ichnospecies studied by workers at Aberdeen with the potential to focus research on those that are ‘new’ or in need of revision.