Detail of the Lower Devonian jawless, armoured fish *Cephalaspis* from Balruddery Den.

Review of Fossil Collections in Scotland

Tayside, Central and Fife

National Museums Scotland

John Ellerman Foundation

Tayside, Central and Fife

Stirling Smith Art Gallery and Museum
Perth Museum and Art Gallery (Culture Perth and Kinross)
The McManus: Dundee's Art Gallery and Museum (Leisure and Culture Dundee)
Broughty Castle (Leisure and Culture Dundee)
D'Arcy Thompson Zoology Museum and University Herbarium (University of Dundee Museum Collections)
Montrose Museum (Angus Alive)
Museums of the University of St Andrews
Fife Collections Centre (Fife Cultural Trust)
St Andrews Museum (Fife Cultural Trust)
Kirkcaldy Galleries (Fife Cultural Trust)
Falkirk Collections Centre (Falkirk Community Trust)

Stirling Smith Art Gallery and Museum

Collection type: Independent
Accreditation: 2016

Dumbarton Road, Stirling, FK8 2KR
Contact: museum@smithartgalleryandmuseums.co.uk

Location of collections
The Smith Art Gallery and Museum, formerly known as the Smith Institute, was established at the bequest of artist Thomas Stuart Smith (1815-1869) on land supplied by the Burgh of Stirling. The Institute opened in 1874. Fossils are housed onsite in one of several storerooms.

Size of collections
700 fossils.

Onsite records
The CMS has recently been updated to Adlib (Axiel Collection); all fossils have a basic entry with additional details on MDA cards.

Collection highlights
1. Fossils linked to Robert Kidston (1852-1924).
2. Silurian graptolite fossils linked to Professor Henry Alleyne Nicholson (1844-1899).
3. Dura Den fossils linked to Reverend John Anderson (1796-1864).

Published information
Traquair, R.H. (1900). XXXII.—Report on Fossil Fishes collected by the Geological Survey of Scotland in the Silurian Rocks of the South of Scotland. *Earth and Environmental Science Transactions of The Royal Society of Edinburgh*. 39:827-864.
Woodward, A.S. (1900). Reviews - Dr. Traquair on Silurian fishes. Report on fossil fishes collected by the geological survey of Scotland in the Silurian rocks of the south of Scotland. By Ramsay H. Traquair, MD (Doctoral dissertation, LL. D., FRS). Earth and Environmental Science Transactions of the Royal Society of Edinburgh. 39:827-864. *Geological Magazine* 7(2):66-72.

Collection overview
Fossils are mixed in with geological specimens with a good proportion reflecting local geology, notably the Carboniferous rocks around Stirling (Sauchie, Bannockburn, Dollar, Dunblane, Ballengeich), the border with Perth and Kinross (Blairingone) and Fife (Roscobie, St Andrews); labels also refer to Midlothian localities such as Calder Hall. Carboniferous specimens include plants (*Lepidodendron*, *Equisetum, Alethopteris, Neuropteris, Calamites, Pinnularia, Stigmaria, Asterophyllites*), corals, various fish elements (notably teeth of *Rhizodus,* either isolated or in rock, and a possible rib), brachiopods (productids and spiriferids), bivalves, crinoids and gastropods (*Euomphalus*); many have the further stratigraphic detail 'Calciferous Sandstone Series' (Lower Carboniferous). Additional fossils include a *Cyathophyllum* coral from Bristol and limestone with shell fragments from Columbia County, New York.

Other stratigraphic levels are represented. Graptolites are from the Ordovician (with labels for Dumfriesshire (Dumfries and Galloway) suggesting Dob's Linn), Garple (East Ayrshire) and the Rocky Mountains, Canada; a graptolite specimen is attributed to Professor Henry Alleyne Nicholson. A label highlights *Eozoon canadensis,* describing it as one of the oldest forms of life, now considered a pseudofossil. The Devonian is represented by the fish *Dipterus* and *Palaeospondylus* from Achanarras, scales of *Holoptychius* from the Upper Devonian of Dura Den (handwritten label mentioning John Anderson), a fish labelled '*L. spinosa* Traq D.S.M. Ayrshire' (*Lanarkia spinosa* perhaps mentioned in a publication by AS Woodward) (Fig. 24), and Devonian worm tubes from

Pendreich. A *Holoptychius* in a dark-coloured matrix has an origin of Gilmerton (Carboniferous). Other fossils include bone, potentially fragments of fish jaw, rib or shoulder. Jurassic fossils are represented by ammonites from the Liassic (*Phylloceras* and *Hildoceras* from Whitby), Inferior Oolite, Oxford Clay and other unspecified levels, such as a *Dactylioceras*, with examples of bivalves (*Gryphaea*, inoceramids), brachiopods (rhynchonellids from the Oolite of Gloucestershire) and belemnites. One belemnite from the Middle Oolite of Whitby shows preservation of an ink sac. There is also a large coprolite in dark mudstone labelled 'Wealdon Oolite S England', with the Cretaceous age confirmed in a label on a second specimen. Cretaceous fossils are mostly echinoids (*Micraster* and *Diodema*), brachiopods, ammonites (*Hoplites* from the Gault), *Turritella* gastropod from the 'Aptian Malta', fossils from the Chalk and shark teeth from the Gault (Dover, Cambridge).

Cenozoic fossils include a bivalve from the 'Tertiary Malta', *Nummulites* from the Eocene at Southampton, Eocene gastropods and bivalves from the London Clay, and shark teeth from the Coral Rag. Material labelled 'Post Glacial Fossils' comprises bivalves (*Ostrea*, *Cardium*), gastropods (*Puroura*, *Belenus*) and trace fossils (*Teredo* bivalve burrows) from Bridge of Allan, distinct in their storage in old, white cardboard trays and/or affixed to wooden boards; some labels refer to the Brick Clay. There are Quaternary fossils from the Devensian loess of Guernsey (dated 1869) and a Moa limb bone from New Zealand. Other geological periods are represented by orthoconic nautiloids, trilobites, ophiuroids, a reptile tooth and fossil wood, etc.

Research/collection links

Vertebrate fossils in black muds from the Carboniferous could be investigated to determine/confirm their identity and context. Fossils in the post-glacial/brick clay sediments from Bridge of Allan and fossils from the Carboniferous are attributed to Robert Kidston and have found use both at the time of collection and, more recently, in climatic studies.

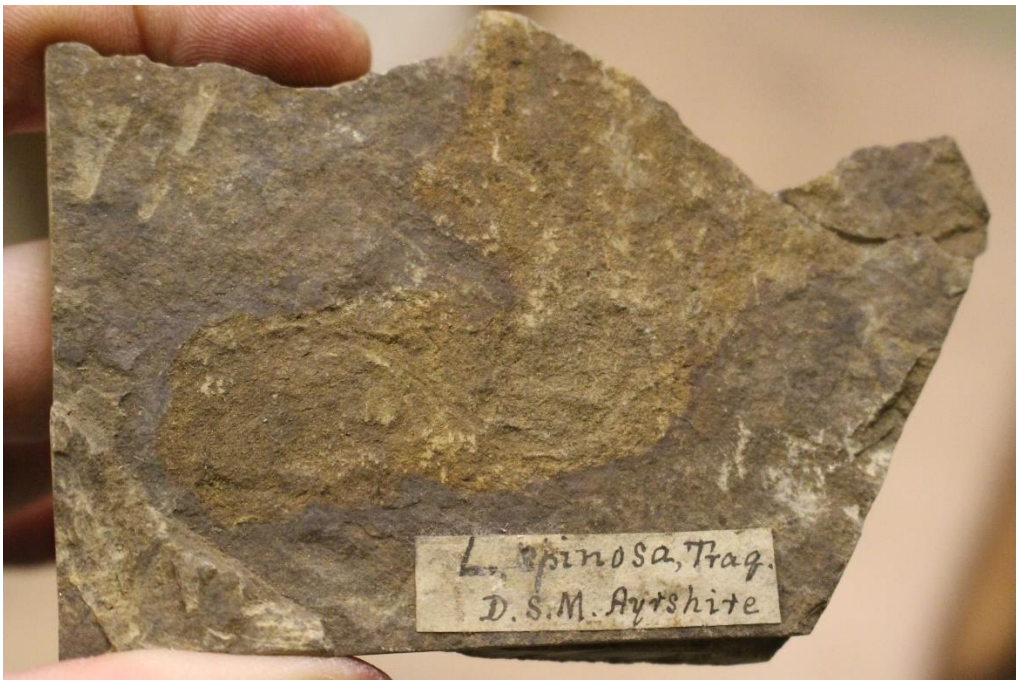

Figure 24: The Devonian jawless thelodont fish *Lanarkia spinosa* from Ayrshire (Stirling Smith Art Gallery and Museum)

Perth Museum and Art Gallery (Culture Perth and Kinross)

Collection type: Local authority (Culture Perth and Kinross)
Accreditation: 2019
Recognised Collection: 2007

78 George St, Perth, PH1 5LB
Contact: museum@culturepk.org.uk

Location of collections
The collection was initiated by the Perthshire Society for Natural Science (PSNS) and housed in a museum on Tay Street, from 1881. It was moved to the present-day Perth Museum and Art Gallery in 1935. The Museum holds the Glenalmond Collection, transferred from Trinity College in 1987 and 2010, and the collection of the Marshall Museum, Kinross, transferred in the 1980s. Both collections include fossils among other geological and natural science specimens. The entire collection of Culture Perth and Kinross is Recognised under the Museums Galleries Scotland Recognition Scheme as a Nationally Significant Collection. The collection includes fossils located onsite in displays and stored in dedicated storage areas.

Size of collections
1,890-2,000 fossils.

Onsite records
Information is in an Adlib CMS, which includes entries for all fossils. Recent labels associated with mainly fish fossils suggest review and identification by SM Andrews (National Museums Scotland) and others. An online collection database also includes fossils: https://www.culturepk.org.uk/museums-galleries/collections/.

Collection highlights
1. Lower Devonian fossils from Fife and Tayside.
2. Fossils from Balruddery Den.
3. Fossils linked to Reverend Hugh Mitchell (1822-1894), Walter McNicoll (1827-1908), Robert Dunlop (1848-1921), Robert Kidston (1852-1924), James B Corr (1855-1931), Peter MacNair (1868-1929) and William Graham-Smith (c1912-2002).
4. Pleistocene invertebrate and vertebrate fossils from the Errol Clay Formation from Tayside.
5. Type specimens of the Devonian fish *Securiaspis waterstoni* and *S. caledonica*.

Published information
Batchelor, R.A., and R.E. Garton. (2013). An occurrence of *Palaeohelcura tridactyla* in the Arbuthnott–Garvock Group, Lower Devonian, at Friarton Quarry, Perth. *Scottish Journal of Geology*. 49:149-152.
Davidson, C.F. (1932). The Arctic clay of Errol, Perthshire. *Transactions and Proceedings of the Perthshire Society of Natural Science*. 9:55-68.
Dawson, J.W.M. (1890). On Certain Devonian Plants from Scotland. *Nature*. 41:537.
Graham, D.K., and D.M. Gregory. (1981). A revision of CF Davidson's Arctic fauna from Inchcoonans Claypit, Errol, held by the Museum and Art Gallery, Perth. *Scottish Journal of Geology*. 17:215-222.
MacNair, P. (1908). *The Geology and Scenery of the Grampians and the Valley of Strathmore (Vol. 2)*. Glasgow: James MacLehose and Sons.
Macgregor, M. (1916). A Jurassic Shore Line. *Transactions of the Geological Society of Glasgow*. 16:75-85.
Kidston, R. (1893). On the Occurrence of Arthostigma Gracile, Dawson, in the Lower Old Red Sandstone of Perthshire. *Proceedings of the Royal Physical Society of Edinburgh*. 12:102-111.

Reid, J., W. Graham, and P. Macnair. (1898). VII. *Parka decipiens*, its Origin, Affinities, and Distribution. *Transactions of the Geological Society of Glasgow*. 11:105-121.
White, E.I. (1963). Notes on *Pteraspis mitchelli* and its associated fauna. *Transactions of the Edinburgh Geological Society*. 19:306-322.

Figure 25: The lobe-finned Upper Devonian fish *Holoptychius* from Dura Den, Fife (Perth Museum and Art Gallery) © Courtesy of Perth Museum & Art Gallery, Perth & Kinross Council

Collection overview

The fossil collection includes 350 specimens of plants, eurypterids, fish and mammals from the Devonian, Carboniferous and Pleistocene of Angus, Perthshire and Fife, a collection considered to be important by palaeontologists studying the localities and fossils following numerous loans for research purposes. For example, Lower Devonian fossils include the rare *Homostius*, *Pteraspis mitchelli* and the type and figured specimens of two species of *Securiaspis* from Bridge of Allan (White 1963). Material from the Lower Devonian of Balruddery Den, preserving a range of invertebrate, vertebrate and plant fossils, is extensive and otherwise present only in the National Museums Scotland and The McManus: Dundee's Art Gallery and Museum collections. The fish are especially important for their diversity and range with examples of *Cephalaspis*, *Mesacanthus* and *Parexus*; a fossil labelled as *Homocanthus arcatus,* now known to be *Vermicomacanthus,* is perhaps from the same locality.

Localities such as Farnell, Turin Hill and Tealing are the source of numerous acanthodians, such as *Climatius*, *Mesacanthus*, *Acanthodes*, *Ichnacanthus* and *Brachyacanthus*. Eurypterids from the Lower Devonian are labelled as *Pterygotus anglicus* (one with the date 1890 collected by James B Corr) and *Erretopterus*, with examples from Tealing attributed to Walter McNicoll (1827-1908) and from Lesmahagow (Silurian) to Peter MacNair (1868-1929); a further name is W Graham-Smith, probably William Graham-Smith (c1912-2002), a researcher at the University Museum of Zoology Cambridge. There is a trace fossil of the Devonian scorpion *Palaeohelcura tridactyla* from Friarton Quarry (Batchelor and Garton, 2013). Plants include *Rhynia* from the Rhynie Chert (with 'Ex Glenalmond Coll' labels and dates of 1926), primitive plants *Zoosterophyllum* and *Psilophyton* from

Myreton, Callander, Hill of Fass (Caithness) and Canada (dated 1898) and the alga *Parka decipiens* from Farnell, some of which are figured (MacNair 1908). Indeterminate plant fragments were collected on several PSNS excursions, dated to 1894 and 1900, with localities including Millhaugh. Fossils are also attributed to Reverend Hugh Mitchell (fossils from Farnell), Robert Kidston (*Psilophyton* from Earn Quarry, Callander, with a date of 1898), James Reid (House of Allan, Blairgowrie, whose fossils were studied by Dawson and Geikie) and William Baird (Lower Devonian plants from Little Glenshee, donated 1991).

The Middle Devonian is represented almost entirely by fish including *Dipterus*, *Mesacanthus*, *Dickosteu*s and *Coccosteus* from Thurso, some donated by Mr McKillop or labelled Ex Glenalmond Collection. Specimens of *Osteolepis* are from the Sandwick Fish Bed and Cruaday Hill, Orkney, *Glyptolepis*, *Pterichthyodes*, *Dipterus* and *Coccosteus* are from Achanarras and a *Thursius* is from Skennet (Caithness). Labels for *Gyroptychius* from Orkney show the names Mrs Christie and Reverend V Slater-Stone with *Dipterus* from the Eday Flags of Deerness, Orkney, labelled J Coates and dated 1906; examples of *Pentlandia*, *Osteolepis* and *Tristichopterus* are from the same locality. There are examples of the conchostracan brachiopod '*Estheria' membranacea* from Thurso. Several fish from Achanarras and examples of '*Estheria'* are attributed to James Reid with dates of around 1895. The identification of some fish fossils has been revised/updated relatively recently by Michael Newman and SM Andrews. Labels highlight information added by Michael A Taylor, former Senior Curator of Natural Sciences at Perth Museum and Art Gallery; further identification, review and documentation was undertaken by Anne Abernethy (former Assistant Keeper of Natural Sciences). Upper Devonian fossils are mainly *Holoptychius* from Dura Den (Fig. 25), many linked to Robert Dunlop and the British Association excavation at the locality in 1915, and a quarry at Glenearn, Perthshire.

Carboniferous fossils are primarily plants: *Neuropteris*, *Alethopteris* (including Calderbrook dated 1886), *Pecopteris* (several from Baillieston), *Annularia*, *Calamites*, *Sphenopteri*s (Burdiehouse), *Lepidostrobus*, *Lepidodendron* frond, *Lepidodendron* bark and *Stigmaria*, several of which are attributed to Robert Kidston. Invertebrate fossils include brachiopods (*Gigantoproductus* from Renfrewshire), bivalves (*Mytilus*, *Nucula*, *Pinna*, *Ctenodonta*), trilobites (*Phillipsia* from Pitscottie, Fife), gastropods (*Bellerophon* and *Pleurotomaria* from Dunfermline and Roscobie, *Loxonema*), crinoid fragments, *Dentalium* from Dunfermline and *Tealliocaris* shrimps from Cheese Bay, Gullane. Invertebrate fossils, notably from Woodmill and Dunfermline, are attributed to Robert Dunlop (1848-1921). Vertebrates include *Megalichthys* from Burdiehouse (one specimen without locality is attributed to Col Ogilvie of Rarmaguzion), *Rhizodus* from Gilmerton, spines from the acanthodian *Gyracanthus* (Hamilton, Lanarkshire) and various shark teeth from localities including Campsie. Two drawers contain 'Carboniferous fossils from Dron. Rev D. Hugh Mitchell'; most fossils are indeterminate although one is labelled as the bivalve *Modiolus*.

Devensian (Pleistocene) fossils from the Errol Clay were collected entirely by Professor CF Davidson. The material includes the bivalves *Hiatella*, *Musculus*, *Pecten*, *Palliolum*, *Portlandia* and *Saxicava*, the gastropod *Lunatia* and brittle star *Ophiolepis*. Most of the collection is cited and/or figured by Graham and Gregory (1981) with a very rare bone of the seal *Phoca vitulina* figured by Davidson (1932). The Clyde beds (Clyde Clay Formation) are represented by the bivalves *Chlamys* and *Arctica*, barnacles and gastropods from localities such as Balnakailly Bay, Bute.

The remaining collection is primarily from localities outwith Scotland. Graptolites are from the Cambrian of Pembrokeshire and Shropshire (Shineton Shales) and Ordovician of Westmorland, Wales and the Welsh Borderlands (notably the Onny Valley). Also represented are trilobites (*Calymene* from Cumberland, trinucleid trilobites), tentaculitids, the trilobite trackway *Cruziana* and brachiopods (*Lingula* and *Lingullela* from North Wales). Hand specimens of Silurian Much Wenlock Limestone from the Welsh Borders and Wren's Nest, Dudley, show fragmentary corals (*Halysites*), brachiopods (*Salopina*, *Leptaena*, *Athyris*, *Atrypa*, *Strophonella*, pentamerids), trilobites (*Calymene*, *Encrinurus*) and gastropods (*Poleumita*). The Carboniferous is represented by corals (solitary and colonial types in limestone, such as *Lithostrotion* from Shropshire, *Zaphrentis* and *Dibunophyllum*

from Ribblesdale), brachiopods (*Chonetes*, *Productus* and *Rhynchonella* from Staffordshire among other localities), plants and bivalves (*Anthracosia* and *Dunbarella* from Fenton near Stoke-on-Trent). More unusual is the fusilinid foraminifera from Nassfield Pass, Karnisch Alps, Austria.

Triassic fossils are limited but include a large *Ceratodus* (lungfish) tooth from the Rhaetian (Fig. 26), a phylloceratid cephalopod from the Halstatt Limestone of Austria and the cast of a Triassic *Cheirotherium* trackway from the Wirral. Fossils from several stages of the Jurassic (Lias, Inferior Oolite from Oxfordshire and Gloucestershire, Oxford Clay, etc) are mostly invertebrate with examples of belemnites, nautiloids, ammonites (many from Whitby and Dorset), bivalves (*Pholaydomya*, *Plagiostoma*, *Gryphaea*, *Modiola, Myacites*, *Trigonia*), brachiopods (*Terebratula*, *Rhynchonella*, *Goniathyris*) and smaller numbers of corals (*Montlivaltia* from the Jurassic of Cheltenham), echinoids (*Clypeus*) and gastropods (*Nerinea*), crinoids and trace fossils. Vertebrate specimens include several isolated vertebrae, an ichthyosaur humerus from Dorset, part of a marine reptile rostrum (snout) from Whitby, a specimen of 3-4 articulated *Plesiosaurus* vertebra (noted as figured, perhaps by MacGregor), *Plesiosaurus* vertebrae from Whitby, two examples of teeth from the shark *Acrodus*, and a ganoid fish from Robin Hood's Bay. Several drawers contain the associated fragments of rib and shoulder bones of a vertebrate from the Oxford Clay near Peterborough dated 1902. A complete *Stenopterygius quadriscissus* ichthyosaur is a cast of a specimen in the Glasgow Museums collection. The Greensand (Cretaceous) is represented by sponges from Blackdown, Devon, and Faringdon Sponge Gravels, echinoids (*Salenia*), brachiopods (*Rhynchonella*), bivalves (*Girvillia*), the crab *Palaeocorystes*, isolated vertebra, teeth of *Saurocephalus* (sword-eel fish) and conical teeth described as ichthyosaur. Fossils from the Gault include well preserved ammonites (some irregularly coiled). Chalk fossils are mostly belemnite fragments, and echinoids (*Micraster*) from Cambridge, Kent, north of Dublin and France, with the fish *Beryx ornatus* from Lewes (label mentioning Brighton Museum) and a *Ptychodus* tooth from Kent.

Figure 26: Tooth-plate of the Triassic lungfish *Ceratodus latissimus* (Perth Museum and Art Gallery)

Eocene fossils are the well-preserved fish *Leptolepis* from Lebanon or Green River Formation, shark teeth, a fish from the Isle of Sheppey, a fish labelled as an ex-Beirut Museum specimen from the Tertiary (Cenozoic) of Syria and Tertiary fish teeth from Otago, New Zealand. A 19th century

cast is labelled as an Eocene bird by Fric (natural history dealer Vaclav Fric of Prague, 1839-1916). Red Crag fossils (assigned to the Pleistocene and Pliocene on labels) are the gastropods *Purpura*, *Trophon*, *Turritella*, *Murex*, *Natica*, *Tellin*, *Artemis* and *Buccinum*, and bivalves *Littorina*, *Unio*, *Cardium* from Suffolk, *Bithynia* from Cambridgeshire. Vertebrates from the Pleistocene are represented by teeth of the sharks *Lamna* and *Oxyrhina*, tooth of a woolly rhinoceros from Kent, several smoothed vertebrae and antlers, and lower jaw of a red deer. Another large tooth transferred from the osteological collection is likely to be a mastodon tooth. Two large vertebrae, found in Cambridgeshire in 1892, are labelled as *Ichthyosaurus* reworked from the Greensand into the Red Crag.

Research/collection links

Investigation of Lower Devonian fossils (fish, eurypterids, plants, etc) from localities in the Forfar area (Turin Hill, Tillywhandland, Farnell, etc) is suggested, mainly to clarify their origin - Turin Hill is used to describe several localities in the area - and study the palaeoecosystem, with the potential for collaboration with other collections holding material from the same area (The McManus: Dundee's Art Gallery and Museum, for example).

The McManus: Dundee's Art Gallery and Museum (Leisure and Culture Dundee)

Collection type: Local authority (Leisure and Culture Dundee)
Accreditation: 2017

Albert Square, Meadowside, Dundee, DD1 1DA
Contact: themcmanus@leisureandculturedundee.com

Location of collections
The Museum is located in the Albert Hall, designed by Sir George Gilbert Scott and commissioned in honour of Prince Albert. It opened in 1867 as the Albert Institute with the Victoria Galleries added in 1889. Extensive renovation took place between 2006 and 2009 and the Museum re-opened in February 2010. Stored collections are located in The McManus Collections Unit in Barrack Street.

Size of collections
2,500 fossils.

Onsite records
Information is present electronically in a KE EMu CMS and on paper in MDA and other card indexes, accession registers, daybook, object entry forms and annual reports. Drives to document information occurred in the 1800s and 1970s; specimens collected before the former date are listed as "ex-collections" or "old Museum Collections".

Collection highlights
1. Fossils from important Devonian localities: Rhynie Chert, Turin Hill, Clashbenny, Balruddery Den and Whitehouse Den.
2. Fossils forming the Kinnaird Collection, obtained from land belonging to Lord Kinnaird (George Kinnaird the 9th Lord Kinnaird, 1807-1878) in the 1800s.
3. Collections attributed to George Stewart Graham-Smith (1875-1950) and William Graham-Smith (c1912-2002).
4. Fossils linked to Reverend John Anderson (1796-1864), Walter McNicoll (1827-1908), James B Corr (1855-1931) and David S Henderson (-2005).
5. A series of bronze models (upright *Iguanodon*, sauropod with tail on ground, *Glyptodont*, elephant, ice age mammal, etc) likely to have scientific and/or historic importance.

Published information
Agassiz, L. (1844–1845). *Monographie de poissons fossiles des Vieux Gres Rouges ou Systeme Dévonien (Old Red Sandstone) des Îles Britanniques et de Russie.* Neuchâtel: Soleure, chez Jent and Gassmann.
Graham-Smith, W. (1938). *The environment, growth and evolution of some Old Red Sandstone fishes.* Unpublished Doctoral dissertation, University of Cambridge.
Huxley, T.H. and J.W. Salter. (1859). On the anatomy and affinities of the genus *Pterygotus* (by Huxley) and description of new species of *Pterygotus* (by Salter). *Memoirs of the Geological Survey of the United Kingdom Monograph.* 1:1-105.
Powrie, J. (1864). On the fossiliferous rocks of Forfarshire and their contents. *Quarterly Journal of the Geological Society*. 20:413-429.
Selden, P.A. (1984). Autecology of Silurian eurypterids. *Special Papers in Palaeontology*. 32:39-54.

Collection overview
The collections have an apparent focus on several stratigraphic levels exposed locally, although fossils representing the Devonian are noticeably numerous. Samples of the Aberdeenshire Rhynie Chert contain the early plants *Psilophyton* and *Rhynia*. Lower Devonian fossils from Turin Hill, Angus, illustrate another ecosystem deposited within the Forfar Basin. These are primarily

arthropods, such as the millipede *Kampecaris forfarensis* and eurypterids including *Pterygotus* and *Tarsopterella* with additional indeterminate fragments. Labels for the latter reference the Arbuthnott Group of Blairgavies Quarry. A specimen of *Erretopterus bilobus*, part of the Kinnaird Collection, has additional notes mentioning William Baird (formerly National Museums Scotland) and research by Paul Selden, formerly at the University of Manchester. Large fragments of the eurypterid *Pterygotus* from Turin Hill and Balruddery Den are shown in displays with a life-size reconstruction. Turin Hill, Balruddery Den and Whitehouse Den are also known for acanthodian fish (*Ischnacanthus*, *Euthacanthus*, *Diplacanthus*, *Brachyacanthus* and *Parexus*) and trace fossils. Specimens of *Euthacanthus* and *Climatius scutiger* are among the fish donated by Miss McNicoll (also spelt 'McNicol' in labels) in 1939. The collection includes specimens and casts of cephalaspids (*Cephalspis lyelli* collected by Mr F Gray without locality) with a specimen of the osteolepid fish *Glyptolamus kinnairdi*. Early plants are represented by *Psilophyton* (Pitairlie Quarry, Monikie) and the alga *Parka decipiens* (Turin Hill, Carmyllie and Tealing; a specimen from Tealing is also attributed to Miss McNicol). Most of this material is part of the Kinnaird Collection, which has been the subject of research. Fossils are attributed to George Stewart Graham-Smith (1875-1950, University of Cambridge); labels also indicate specimens collected by W Graham-Smith, his son William (c1912-2002), a researcher at the University Museum of Zoology, Cambridge. One or both Graham-Smiths excavated and published details of fossils from Fithie Burn, Duntrune, which was at the time a new locality.

Figure 27: A large bone from the Carboniferous fish *Rhizodus* from Gilmerton
(The McManus: Dundee's Art Gallery and Museum)

Fish fossils from the Middle Devonian originate from localities across north east Scotland in what is referred to as the Orcadian Basin: *Cheiracanthus*, and *Glyptolepis* from Tynet Burn, Moray, *Diplacanthus*, *Coccosteus*, *Cheirolepis* from Lethen Bar, Moray, *Pterichthyodes* and *Pterichthys* from Cromarty, *Dipterus*, *Pterichthyodes*, *Osteolepis*, *Coccosteus*, *Millerosteus* and *Brachypycopterus* from Caithness (some linked to David Henderson and dated to the 20th century) with *Dipterus* and *Pterichthyodes* specifically from Achanarras, and *Diplacanthus* from Stromness; additional fossils without obvious locality information are likely to be from the above. Middle Devonian corals *Pachypora* and *Favosites* illustrate differences in palaeoenvironment between Scotland (rivers and lakes) and the southern part of England (shallow marine water). The Upper Devonian is represented by scales of *Holoptychius* from Clashbenny showing detailed ornament

and slabs of Dura Den sandstone with *Holoptychius* and *Osteolepis* among other fish, some attributed to Rev John Anderson. Additional Devonian fish include *Phaneropleuron* and *Bothriolepis* (Ferniehurst, Jedburgh). Several rocks noted as erratics (transported by glaciers) contain Devonian fish scales.

Carboniferous fossils include the typical plants *Stigmaria* and *Lepidodendron*, with *Calamites* (one labelled as Cape Breton, Sydney), *Lepidostrobus* (Burdiehouse), the fern *Adiantites hibernicus* and numerous other fragments (one noted as Rotherham). Brachiopods are represented by *Productus* and other productids (*Gigantoproductus*), *Spirifera* and *Rhynchonella*, the bryozoan *Fenestella* from Halkyn Mountain (North Wales) and fragments of the stem and calyx of crinoids. Fish fossils show teeth, complete jaws and a shoulder girdle of *Rhizodus* (Fig. 27), and fragments labelled as *Holoptychius* from Burdiehouse and Gilmerton in Edinburgh among others. Some of these fossils are linked to James B Corr. Another tooth from Airdrie shows distinct curvature and is probably *Strepsodus*. Labels with invertebrates give origins as widely dispersed as Devon (bivalve *Posidonia*), Yorkshire (Settle, Bowland in Lancashire), Derbyshire and Durham.

Ice age fossils are a mammoth tooth from St Fort gravel quarry with molluscs and an eroded bone from the Devensian (Pleistocene) Errol Clay Formation. Additional invertebrate specimens (bivalves *Saxicava* and *Modiolaris*, etc) are part of the Kinnaird Collection.

Fossils from other stratigraphic levels are broader in their origin. The Ordovician is represented by trilobites from the Hartfell Shale (Dumfries), *Phacops* from Horderley (Shropshire) and a complete *Ogygia guettardi* (now *Ogygites guettardi*) from the transition clay slate of the Netherlands (Fig. 28), graptolites from the Drygill Shale of the Lake District and a coral from Michigan, USA. The Silurian is represented by eurypterids, notably *Slimonia* and *Erettopterus* from the Lesmahagow Inlier, associated with notes suggesting they have been studied. Mesozoic specimens are not generally local and include ammonites (mostly labelled as '*Ammonites*', from the Liassic, Greensand and other levels), belemnites, nautiloids, bivalves (*Trigonia*, *Gryphaea*), brachiopods, echinoids (*Clypeaus*), sponges (*Siphonia* from the Cretaceous of Blackdown), gastropods (*Pleurotomaria*) and scaphopods (*Dentalium* from Cambridge), with the occasional fish (*Mesodon* from the Great Oolite; James B Corr bequest 1937) and reptile remains. Representing the Triassic are several partial specimens of the reptile *Stagonolepis* from Elgin showing scutes and disarticulated bones, linked to Reverend John Anderson. There are numerous isolated marine reptile vertebrae, perhaps Jurassic, a block with 10 or more partly articulated ichthyosaur vertebrae and arches, a second specimen of slightly larger centra piled together and a possible cast of an *Ichthyosaurus* front paddle. Another specimen is labelled as a ribcage but a sclerotic ring from the eye is visible suggesting it might be a skull or contain skull elements. Fish include a Liassic (Jurassic) *Aechinodus, Pholidophorus* from Lyme Regis and *Beryx* from the Chalk. There is a sample of tuff containing bones from Bustchaafs, South Africa, and a set of approximately 10 smoothed agate-like pebbles labelled as dinosaur gastroliths from Wyoming.

Cenozoic fossils from Scotland are limited to two specimens of tufa with leaf impressions, potentially from Mull, each associated with notes mentioning Mr Duncan, one dated 1927. Most of the Cenozoic fossils are from outwith Scotland. For example, the Eocene is represented by fossils from the London Clay (molluscs and crustaceans), Barton Beds, Headon Hill Formation (*Erodona*), Bracklesham Beds of Bracklesham Bay (*Fusinus*) representing the London and Hampshire basins, and other unknown localities (bivalves and gastropods (*Buccinum*, *Turritella*, *Voluta*)). Examples of the Eocene foraminifera *Nummulites* are present, either isolated or in limestone matrix, with France given as the origin of some. The gastropods *Voluta* and *Natica* are from the Eocene of the Paris Basin with a specimen of *Hinia* labelled as the same area but from the Pliocene. Many of these were collected by Dr A Dalgetty, James B Corr or workers from the Geological Survey. Further Eocene fossils are shrimps and fish labelled as from Lebanon, fish and plant fossils from Monte Bolca, Italy, and fish from the Eocene Green River Formation of America. The Pleistocene Red Crag from East Anglia (Felixstowe, etc) is represented by numerous bivalves (*Nassa*), gastropods (*Neptunea*, *Turritella*, *Natica*, *Venus*) and shark teeth (*Otodus*), with some linked to Lady Kinnaird. A

box of 40 fish bone fragments is from the Norwich Crag (Pleistocene) at Easton Bavents, Southwold, Suffolk.

Vertebrate fossils include several mammoth, horse and deer teeth, a cave bear mandible, an antler fragment, various tusks and horns, shark teeth (many worn, perhaps by water), the end of a vertebrate limb bone with a label ‘Dr Blair Tayport’ and a modern bird’s nest with five eggs preserved in cave deposits from Jamaica. Miscellaneous specimens without age or locality details are a dragonfly on a rock covered with red crystalline growth, possibly a cave deposit, and fossil wood from Antigua, Hobart (Tasmania) and other localities.

Figure 28: An Ordovician trilobite *Ogygites guettardi* from the Netherlands (The McManus: Dundee’s Art Gallery and Museum)

Research/collection links

A collection of Lower Devonian fossils from Fithie Burn, Duntrune, is attributed to George Stewart Graham-Smith (1875-1950, University of Cambridge) and/or his son William (c1912-2002), a researcher at the University Museum of Zoology, Cambridge. The specimen labelled *Adiantites hibernicus*, a fern, could be from the Devonian of Dura Den or Carboniferous and it would be worth investigating. Fish from the Carboniferous could be studied as part of a collaborative project, with the aim of documenting material in more detail. The origin of the ichthyosaur fossils could also be studied, as some specimens include enough diagnostic elements to look at their taxonomy.

Broughty Castle (Leisure and Culture Dundee)

Collection type: Local authority (Leisure and Culture Dundee)
Accreditation: 2017

Castle Approach, Broughty Ferry, Dundee, DD5 2TF
Contact: broughty@leisureandculturedundee.com

Location of collections
The Museum is located in a castle built on the River Tay in the 1490s and in ruins by the 1800s. In 1860 it was converted into an artillery defence in case of French invasion with its use continuing through both World Wars. The museum moved into the castle in 1969. The collections at the site are managed by Leisure and Culture Dundee on behalf of Dundee City Council. Fossils are on display; all stored specimens are in The McManus Collections Unit.

Size of collections
11 fossils.

Onsite records
Fossils are included in documentation at The McManus: Dundee's Art Gallery and Museum.

Collection highlights
1. Fossils from the local area.

Collection overview
The collection includes Devonian fish, such as the Lower Devonian *Cephalapis* found near Broughty Ferry and acanthodians *Acanthodes* and *Parexus*, and *Holoptychius* in a slab of Upper Devonian sandstone from Dura Den, Fife. Plant fossils are of *Parka decipiens* described as the spores of an early (Devonian) land plant preserved with other fragments (now considered an alga), an example of the Devonian *Psilophyton* and the 400 million-year-old Carboniferous plant *Sigillaria*. The youngest fossils on display are a fragment of mammoth tusk and femur, and a sample of Pleistocene Arctic clay with the bivalve *Hiatella arctica* from Errol, Perthshire.

D’Arcy Thompson Zoology Museum and University Herbarium (University of Dundee Museum Collections)

Collection type: University
Accreditation: 2016

University of Dundee, Dundee, DD1 4HN
Contact: museum@dundee.ac.uk

Location of collections
The University of Dundee holds two fossil collections. The first is linked to Professor D’Arcy Wentworth Thompson (1860-1948) who built up a large Museum of Zoology from 1885. Thompson moved to the University of St Andrews in 1917 after which the museum was cared for by his successor Alexander Peacock (1886-1976). On his retirement in 1956 the building housing the museum and the Natural History department was demolished and the collection dispersed, with only parts being retained in Dundee – these have been redisplayed in the new D’Arcy Thompson Zoology Museum which opened in 2008. The second collection is that of the former Botany department, originally founded by Patrick Geddes (1854-1932). This is housed in the University Herbarium in the museum stores in Hawkhill House.

Size of collections
159 fossils.

Onsite records
Information is in a KE Emu CMS and a system called ‘Inca’, created by John Faithfull at the University of Glasgow. A small number of fossils are included in an online collection database at: https://www.dundee.ac.uk/museum/collections/zoology/collections/.

Collection highlights
1. Cast linked to Richard Owen (1804-1892).
2. Range of vertebrate fossils, many from well-known localities.

Published information
Edwards, D. (1972). A *Zosterophyllum* fructification from the Lower Old Red Sandstone of Scotland. *Review of Palaeobotany and Palynology*. 14:77-83.
Walton, J. (1964). On the morphology of *Zosterophyllum* and some other early Devonian plants. *Phytomorphology*. 14:155-160.
Edwards, D. (1970). Fertile *Rhyniophyta* from the Lower Devonian of Britain. *Palaeontology*. 13:451-461.
Thompson, D.W. (1879). Some Bones of a Fossil Seal from the Post-Tertiary Clay at Dunbar. *Journal of Anatomy and Physiology*. 13:318-321.
Owen, R. (1884). On the skull and dentition of a Triassic mammal (*Tritylodon longævus*, Owen) from South Africa. *Quarterly Journal of the Geological Society*. 40:146-152.

Collection overview
The collection includes material from well-known/important localities with a wide geographic and stratigraphic range, indicating that specimens were probably acquired randomly with zoological specimens, by donation and through specialist excursions. Vertebrates are numerous and include examples of the fish *Dipterus* in Devonian sandstone from Caithness, two *Palaeospondylus* from Achanarras linked to Prof Thomas Stanley Westoll (1912-1995), Kings College, Newcastle upon Tyne, a poorly preserved placoderm *Pterichthyodes*, *Rhizodus* jaw fragment with several teeth, indeterminate pieces of a crossopterygian fish that might be Carboniferous *Megalichthys* or similar, a complete *Dapedium* fish from the Jurassic and a part and counterpart fish fossil in light-coloured rock, perhaps from the Solnhofen Limestone of Germany. Casts include a Devonian placoderm

head shield, painted and marked to show the outlines of various plates and other features, a model of *Pterichthys* with detail of the scales, plates and movable front fins, and a cast of a Devonian *Cephalaspis*.

Reptile fossils include a scute impression from the Triassic *Stagonolepis*, a bone from the Triassic cynodont *Diademodon*, a three-dimensionally preserved Upper Liassic (Jurassic) *Ichthyosaurus* skull from Whitby with sclerotic rings but missing most of the rostrum, disarticulated bones from the front limb and ribcage of an ichthyosaur (humerus, radius, ulna, ribs, gastralia), a framed *Ichthyosaurus quadriscissus* (now *Stenopterygius quadriscissus*) labelled as 'B. Hauff, Holzmaden, Germany' (Fig. 29), two near-complete tortoise shells in light-coloured rock, a neural arch from an indeterminate mammal or reptile and a crocodile vertebra. Casts include a half-size cast of the marine reptile *Thalassiodracon* (acquired by D'Arcy Thompson for the Zoology Museum in 1898; the original, found in Street in the 1830s, is now in the Natural History Museum, London), an *Archaeopteryx* (Berlin specimen), a partly painted skeleton of a dinosaur similar to *Compsognathus*, and a black model in a wooden frame showing a skull viewed from above with labels reading: 'The model was made from a drawing of a specimen in the Hancock Museum, Newcastle upon Tyne, where it is named *Loxomma allmanni* Huxley. The specimen was found in the Low Main, Newsham, Northumberland, shortly before 1870', 'The *Stegocephalia* were mostly giant amphibia which flourished in the Carboniferous period. They comprised forms which were the earliest vertebrates to adapt themselves to a terrestrial life', and 'Amphibia. Model of a skull, dorsal aspect, of the embolomerous stegocephalian *Orthosaurus pachycephalus* Barkas. Actual size. A.M. Black'. A similar model/cast was observed in the Bell Pettigrew Museum (Museums of the University of St Andrews), although this was painted black.

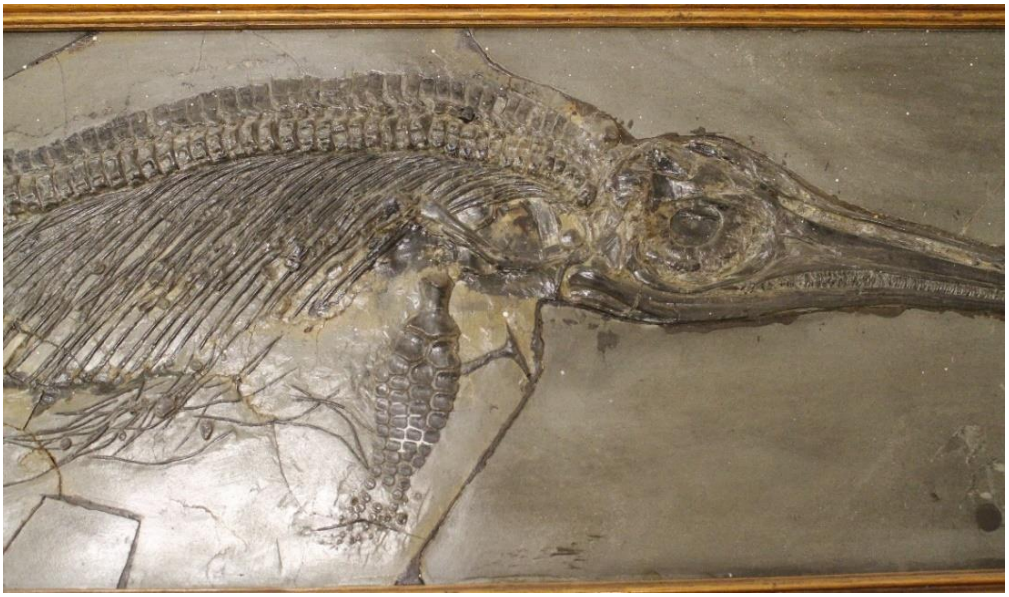

Figure 29: Jurassic ichthyosaur *Stenopterygius quadriscissus* from Holzmaden, Germany (D'Arcy Thompson Zoology Museum)

Mammals include a mastodon tooth, mammoth tooth, a tooth-like fossil labelled *Rhytiua* with another similar specimen noted as 'Not *Rhytiua*? (Stellar's Sea Cow)', several skull and jaw fragments of the oreodon *Merycoidodon*, and a set of rhinoceros, fox, horse, deer, bear (Fig. 30) and hyaena teeth, bear claws and phalanges with other indeterminate bone fragments collected from a bone breccia. Several large jaw fragments and a tooth labelled 'Mammalia Pterissodactyla' are perhaps associated with additional bags of similar material. One jaw fragment is labelled as *Palaeotherium crassum*, an Upper Eocene ancestor of the horse from Vaucluse, France. A further interesting cast is of a Triassic dicynodont skull that was difficult to orientate at first (the label

identifies it as snake due to the large fang-like teeth); the original specimen is linked to Richard Owen.

Invertebrate fossils include examples of echinoderms (heads of the blastoid *Pentremites*, an articulated stem and head of a Liassic crinoid in a black frame, a *Uintacrinus* in chalk and articulated crinoid stems that might be a trace fossil), brachiopods (lingulid brachiopod and a box with *Dinorthis* from the Ordovician of Kentucky, *Spirifera* from the Devonian of Canada and *Platystrophia* from Cincinnati, Ohio, dated 1868), arthropods (the Cambrian trilobite *Elrathia*, cast of the Silurian trilobite *Calymene*, fossils of the crab *Xanthopsis* (also spelt *Zanthopsis*) and a lobster from the Eocene London Clay), cephalopods (various including ammonites, such as a *Hamites* from the Gault Clay at Folkestone), corals (fragment of the coral *Donacosmilea whigatii* with the mention of it being a 'new one' in the label), bryozoans (*Schizoporella* from Port Phillip Head, Victoria, *Proboscinna*, *Microporella* (Tasmania), *Diastopora* (with a note to see monograph), *Alveolania* (foraminifera), a sponge from the Red Crag of Suffolk and a fossil from the Coralline Crag, among others. Six additional boxes have similar content: *Entalophora*, *Lophorlepsis* (from Faringdon and likely to be Sponge Gravel), [*Hebroflora comfera*], [*Menifis angulate*] (Faringdon), [*Cillelp globularia*] (from near Vienna) and *Reticulopora*.

Plants in the collection are limited to a large '*Sigillaria* or *Stigmaria* root' from the Carboniferous and a *Cyclopteris* described in an associated letter (Jason Hilton, National Museums Scotland, 2002) as being nodular and therefore possibly from the Mazon Creek Flora of Illinois. Additional fossils are in the botany building: several *Parka decipiens* from the Devonian of Westhall Terrace (near Tealing, Angus), lycopsids from the Devonian Rhynie Chert, and fragments of the early psilopsid plants *Cooksonia* and *Zoosterophyllum* from the Devonian of Angus; various notes suggest some of these are figured, for example, in Edwards (1972). The Carboniferous is represented by *Calamites*, *Stigmaria*, several *Lepidodendron, Sigillaria* and *Pteropsida.*

A cardboard tray contains casts of a variety of fossils: brittle star, Carboniferous arachnid *Eophrynus* from Coseley, West Midlands, irregular ammonite, a regular echinoid, millipede provided by the Open University, Milton Keynes, *Lepidodendron* or similar and small round tree trunk, an ammonite fossil, Carboniferous brachiopod and crinoid showing articulated stem and head.

Research/collection links
Fossils of marine reptiles and Cenozoic mammals (*Merycoidodon* and *Palaeotherium*) could be investigated further, with the potential for studies of material across several collections, including the Glasgow Museums Resource Centre. The preservation of the three-dimensional ichthyosaur skull is unusual and the context, taphonomy and taxonomy could be studied.

Figure 30: Bear teeth from cave deposits (D’Arcy Thompson Zoology Museum)

Montrose Museum (ANGUSalive)

Collection type: Local authority (ANGUSalive)
Accreditation: 2018

Panmure Place, Montrose, DD10 8HF
Contact: MontroseMuseum@angusalive.scot

Location of collections
The collection and the Museum are both linked to the Montrose Natural History and Antiquarian Society, formed in 1836 through the Montrose Chess Club and led by William Beattie. The original building housing the collection was an Old English School, replaced with a new building on the same site designed by Edinburgh Architect John Henderson. It opened in October 1843, on the birthday of Lord Panmure who provided funds; a rear gallery was added in 1889 with refurbishment in the late 1970s. In 1962 the museum and collection formally passed to Montrose Town Council and subsequently Angus Council, with management since 2015 through ANGUSalive Culture, Sport and Leisure Trust. Fossils are on display and in storage onsite.

Size of collections
800-1,000 fossils.

Onsite records
The Museum collections are documented on an Adlib CMS although information on fossils, currently on index cards, has not yet been entered. The Society has an accession book started after the Second World War.

Collection highlights
1. Lower Devonian fossils, linked to Reverend Hugh Mitchell (1822-1894).
2. Fossils from localities on land owned by Lord Kinnaird (9th Lord, George Kinnaird, 1807-1878).
3. Arctic clay fossils collected by James Cunningham Howden (1830-1897) and Robert Boog Watson (1823-1910).
4. Fossils of the Munich Collection.
5. Fish fossils from the Devonian of Abergavenny, Wales.

Published information
Mitchell, H. (1861). On the Position of the Beds of the Old Red Sandstone developed in the Counties of Forfar and Kincardine, Scotland. *Quarterly Journal of the Geological Society*. 17:145-151.
Trewin, N.H. (2013). *Scottish Fossils*. Edinburgh: Dunedin Academic Press.

Collection overview
Fossils can be divided into specimens of the Mitchell and Munich collections with material from additional or unspecified collectors forming the remainder. The Mitchell collection is almost exclusively from Angus and the Devonian: acanthodian fish labelled as *Ischnacanthus*, *Mesacanthus*, *Euthacanthus* (one specimen a sheet of rock in a wooden frame with an old label describing it as the spines and scales of *Euthacanthus* from Farnell), *Climatius* and *Parexus* from Turin Hill, Eggerton, Kinnell and Tillywhandland, and ostracoderms from West Drum Quarry (*Cephalaspis* cf. *pagei*), Kinnaird quarries (*C.* cf. *pagei,* Fig. 31), Turin Hill (*C.* cf. *powriei*), and Brechin Quarry (*C.* cf. *lyellii*). Arthropods include the eurypterids *Pterygotus* (one a large section of *Pterygotus anglicus* body segments from Carmyllie Quarry on display, on loan from National Museums Scotland) and *Hughmilleria* (Turin Hill, Tealing, Canterland Den, Carmyllie). Crustaceans are represented by *Dictyocaris* from Canterland Den, and arthropod cuticle fragment from the same locality, each with notes ‘L. I. Anderson 1994’ (Lyall Anderson, formerly National Museums

Scotland). Arthropod traces include myriapod trackways from the Ferryden foreshore, and *Diplichnites*, *Cochlichnus* with *Isopodichnus* from Canterland Den.

Lower Devonian plant fossils include *Nematophyton* and *Zoosterophylum* from Merton Quarry. Part of the Mitchell Collection is comprised of Carboniferous fossils, notably *Megalichthys*, *Rhizodus* and palaeoniscid fish, plant fragments and nodules from Burdiehouse and the Edinburgh Coalfield. A specimen showing fragments of the plants *Alethopteris*, *Lepidodendron*, *Pecopteris* and other leaves from Felling on Tyne Colliery, Northumberland, and a *Bothriodendron* from Northumberland are attributed to Alex - rather than Hugh - Mitchell. Two specimens from the Carboniferous of the Edinburgh Coalfield are each described as a 'cast of reptile footprint' on old labels and as sedimentary structures in notes added more recently.

Figure 31: The jawless Lower Devonian fish *Cephalaspis* cf. *pagei* from the Kinnaird Quarries, Angus (Montrose Museum)

The Munich Collection comprises fossils almost entirely from the Mesozoic and Cenozoic. The fossils were received as an exchange with Munich Museum for a specimen of *Pterygotus anglicus* from Carmyllie, Angus, around 1899 (Stace *et al*. 1987); information also suggests the *Pterygotus* specimen was destroyed by a bomb during the Second World War. The collection represents all major taxonomic groups. Bivalves include *Pecten*, *Cardium*, *Trigonia* (one preserved with a *Plesiosaurus* tooth from the Lower Jurassic and probably Stonesfield Slate), Jurassic *Gryphaea*, Cretaceous oysters and *Lopha*, wood encrusted by oysters, and Eocene *Pteriomorphia*. Gastropods are represented by disparate types from the Silurian, Carboniferous (including *Euomphalus*), Cretaceous Greensand, taxa typical of the Eocene Barton Beds, and Oligocene *Natica* and *Pleurotomaria*. Cephalopods are represented by ammonites (Jurassic and Cretaceous, several in 'black limestone'), belemnites and nautiloids of various types. Limited numbers of fossils represent brachiopods (Carboniferous *Brachythyris* and Spirifera), corals (*Heliolites*, *Syringopora*, *Thecosmilia*), echinoids (*Cidaris* spine from the Oolite, Upper Jurassic), graptolites (Ordovician graptolites from Dob's Linn) and trilobites (Devonian *Phacops* from Bohemia). A fossil labelled as a '*Buprestis'* beetle wing case from the Lower Oolite is re-identified as a flat, crushing tooth from a shark in Stonesfield Slate and a dragonfly labelled as '*Petalia'* from the Upper Malm (Jurassic) of Solnhofen, Germany, as *Cymatophlebia longialata.* Further investigation is needed to confirm the

identification of a crustacean with several labels, each varying in their spelling of the generic name in '*Panneus' speciosus*. The collection includes the Cambrian trace fossil *Oldhamia* from Bray Head, County Wicklow, Eocene *Dipthelia* from France, the foraminifera *Nummulites* from Italy and large disc-shaped *Orbicula*, and *Serpula* from the Oxford Clay. An interesting specimen is the *Eozoon canadensis* with an origin of Cote St Pierre, La Petit Nation, Seigniay donated by TS Weston of the Geological Survey of Canada in the 1870s. Vertebrate fossils include the Devonian fish *Pteraspis*, samples of bone breccia, Carboniferous acanthodian (*Gyracanthus*) spines, fish vertebra from Gilmerton, *Megalichthys* (including a complete *Megalichthys* from Burdiehouse presented by Robert Barclay Esq among several other fragments of body) and *Rhizodus* fragments (including a jaw with teeth and scapula), Jurassic *Leptolepis* from the Solnhofen Limestone, teeth of the sharks *megalodon* and *Ptychodus* among others (many in chalk), several indeterminate fish in Cretaceous Chalk from Dover, a Quaternary mammal tooth, and a modern bird skull and sacrum.

Several small collections of focused material are present. The Watson Collection (Reverend Robert Boog (misspelt Boag) Watson (1823-1910), whose publications include a report on molluscs collected during the HMS *Challenger* expeditions from 1872-1876) comprises sub-fossil bones from a bovine animal and two wild boar mandibles, and a fossil of the Devonian fish *Cephalaspis*. The James Cunningham Howden Collection comprises Pleistocene Arctic clay fossils from the 'Railway cutting' among other localities; samples of 'Dryleys Clay' are perhaps not Arctic clay in the strict sense, rather a brick clay from the Dryleys brick and tile works near Montrose. The Arctic clays contain mostly bivalves (*Saxicavella*, *Pecten*, *Artica*, *Mytilus*) and gastropods, with rarer brittle stars (*Ophiolepis*). There is also a collection of bones (skull, beak, trachea, sternum, clavicle and vertebrae in bags and limb and other long bones affixed to pieces of wood) from an eider duck discovered at Puppieston in 1891. Moderately sized samples of Arctic clay show similar mollusc fossils but are noted for the barnacle *Balanus*. The progression of the Ice Age is illustrated by fossils from the Arctic clay 10,000 years ago (Arctic clams *Artica islandica*, nut shells *Nucula tenuis* and others, Arctic starfish *Ophiolepis gracilis*, a rock borer *Saxicavella sulcate*, Arctic scallop *Pecten groenlandicus*, upper jaw and second bone from a common seal (*Phoca vitulina*), and replica bones of the eider duck *Somateria*), sub-estuarine peat from 8,000 years ago (branch from the alder *Alnus*, horsetail *Equisetum*, Scots pine cone *Pirius sylvestris* and a sample of 'fossilised' peat) and post-glacial Carse Clay Formation from 6,000 years ago (a common European oyster *Ostrea edulis*, peppery furrow shell *Scrobicularia plana*, common mussel *Mytilus edulis*, Baltic tellin *Macoma balthica* and common cockle *Cerastoderma edule*).

The remaining material might belong to any or none of the collections mentioned. There are numerous examples of *Parka decipiens* (from Watchkey, Carmyllie and Canterland Den, etc), a possible eurypterid trace from Leesmill Quarry, Ferryden, and trace fossils including an Upper Devonian specimen from Elgin presented by Henry Young in 1859. Fossil fish represent the Lower Devonian (*Pteraspis*), Middle Devonian (*Pterichthyodes* and *Osteolepis* with *Glyptolepis*, *Osteolepis* and *Dipterus* from localities in Caithness, such as Achanarras, Castle Hill and Holburn Head, and *Pterichthyodes* from Cromarty among other localities) and Upper Devonian (Cromarty, Dura Den and Gamrie); these are accompanied by various models. Specimens of *Pteraspis* (*P. crouchi* Lankester), *Cephalaspis* and indeterminate fossils are from the Lower Devonian of Abergavenny, Wales. These are accompanied by Carboniferous fossils: fish (scales of *Megalichthys*, one attributed to Dr Steele, Fife, spines and scales of *Rhizodus, Palaeoniscum* (labelled as *Palaeoniscus*) from Burdiehouse, *Gyracanthus* from Gilmerton and other fossils from the Edinburgh Coalfield), brachiopods (notably productids from Fife) and the plants *Calamites*, *Lepidostrobus* and *Lepidodendron*, including one in light-coloured rock from New Zealand. Fossils from other stratigraphic levels include samples of Silurian Much Wenlock Limestone Formation showing brachiopods among fragmentary coral reef debris, a Jurassic ichthyosaur from Lyme Regis, bivalves (oysters, many of large size), various cephalopods (nautiloids and ammonites representing the Jurassic (*Cardioceras*) and Cretaceous) and a mammoth tooth. Interesting specimens are those labelled as *Bourguettocrinus* from the Chalk of Petersbey, Maastricht, and several small round fossils labelled as seeds from the Great Oolite Series (Jurassic) almost certainly platy shark teeth from the Stonesfield Slate.

Fossils on display illustrate the fossilisation process: modern Mytilus with a second shown under sediment and a broken pebble revealing a bivalve cast, an internal mould of a Jurassic bivalve (described by quarrymen as ‘Osses ‘eds’ due to their horse-head shape), Cretaceous *Micraster* and Carboniferous plant frond. Another case shows Devonian trackways, mudcracks and ‘heat blisters’. A handling table includes a large ammonite whorl fragment, a 20cm section of the Carboniferous *Stigmaria* and fossil fern.

Research/collection links

The material attributed to named collectors often occurs mixed within the storage areas; organisation/separation would help to determine the actual size and contents of each and allow potential research projects to be identified. The Mitchell collection is already of interest with fossils of *Vernicomacanthus*, *Climatius* and *Brachycanthus* recently examined by a PhD student from Imperial College, London. Specimens that could be studied include the fish from the Lower Devonian of Abergavenny, a potentially important locality historically and/or scientifically, and the fossils labelled *Bourguettocrinus* from the Chalk (Maastrichtian, Cretaceous) of Petersbey which should be investigated to confirm their identity (as a crinoid), origin and context.

Museums of the University of St Andrews

Collection type: University
Accreditation: Wardlaw Museum 2019 (Provisional); Bell Pettigrew Museum 2017

Bell Pettigrew Museum, Bute Building, St Mary's Quad, University of St Andrews, KY16 9TS
Wardlaw Museum, 7a The Scores, St Andrews, KY16 9AR
Contact: museumenquiries@st-andrews.ac.uk

Location of collections
The University of St Andrews is Scotland's first university, founded between 1410 and 1413. The first University museum was established in 1838 jointly with the St Andrews Literary and Philosophical Society and its collections were displayed in rooms in the United College. From 1904 the University assumed sole responsibility for the remaining collections, which were moved to the new Bell Pettigrew Museum in 1912. In the 1950s the collections were dispersed among relevant academic schools (or to other museums) with only the Zoology Collections remaining at the Bell Pettigrew Museum. Fossils are displayed in the Bell Pettigrew Museum as part of the Zoology Collections (with additional onsite storage in the Bute building). The Geological Collection also includes material from the Literary & Philosophical collections and gathered by significant Scottish scientists, such as Robert Meldrum Craig (1882-1956). The collection has continued to grow through academic fieldwork and research and is used extensively in university teaching. The Geology Collection does not have its own museum, but specimens can be seen in the Wardlaw Museum and, by appointment, in storage.

Size of collections
46 fossils on display with approximately 6,000 geological specimens in storage.

Onsite records
Online database with information and images: https://www.st-andrews.ac.uk/collections/.

Figure 32: The Carboniferous fish *Amblypterus* from Denhead, Fife
(Museums of the University of St Andrews)

Collection highlights
1. Devonian fish fossils from Dura Den, Fife.
2. Fossils linked to James Bell Pettigrew (1834-1908), Reverend John Anderson (1796-1864), Louis Agassiz (1807-1873), Matthew Forster Heddle (1828-1897), Thomas Henry Huxley (1825-1895), Ramsey Heatley Traquair (1840-1912), Dr Thomas Stewart Traill (1781-1862), Reverend Dr John Fleming (1785-1857), Sir Arthur Smith Woodward (1864-1944) and possibly the journalist George Buist (1805-1860).
3. Scottish Carboniferous crinoids collected by Robert Meldrum Craig (1882-1956)

Published information
Pettigrew, J.B. (1908). *Design in Nature: Illustrated by Spiral and Other Arrangements in the Inorganic and Organic Kingdoms as Exemplified in Matter, Force, Life, Growth, Rhythms, &c., Especially in Crystals, Plants, and Animals* (Vol. 2). London: Longman, Green, and Company.
Anderson, J. (1859). *Dura Den. A monograph of the yellow sandstone, and its remarkable fossil remains... With illustrations*. Edinburgh: Constable.
Catalogue of Rocks and Minerals in the Museum of the Literary and Philosophical Society of St Andrews (1849). Dr. Edward Woodford's Press.

Collection overview
The fossils of the Palaeontological collection, forming part of the Geology collection, consist mainly of invertebrate macrofossils organised into taxonomic groups with the majority from UK locations. The collection includes published and type material of Scottish crinoids collected by Robert Craig Meldrum and slabs of the Upper Devonian Dura Den fish. Examples displayed at the Wardlaw Museum represent the teaching and research activity of the University. Fossils displayed in the Bell Pettigrew Museum illustrate the diversity of ancient life through time. Vertebrates include a plesiosaur vertebra from Lyme Regis, dinosaur tooth labelled as *Spinosaurus* from Morocco, coprolite from the Jurassic Morrison Formation of America, *Mioplosus* and *Knightia* from the Eocene Green River Formation, Wyoming, and a mammoth tooth. Fish are represented by *Bothriolepis*, *Glyptopomus*, *Phaneropleuron* and *Holoptychius* from nearby Dura Den, Fife, accompanied in displays by copies of historical text and illustrations. One historic illustration, labelled '*Pterichthys* Dura Den, drawn to scale by M Forster Heddle', and a more recent label reading '*Bothriolepis crestata* Traquair', looks to be of a specimen observed in the Fife Collections Centre. Other fish fossils on display are the smaller *Mesacanthus* and *Palaeospondylus gunni* from Achanarras, an unidentified fish with a label affixed reading 'Nr. Thurso, Caithness C. R. Stonor', dated 1941, *Phaneropleuron*, *Amblypterus* (Fig. 32) and platysomid fish in darker sandstone (Carboniferous) from Denhead, Fife, and *Pycnadus rhombus* and *Palaeoniscum freieslebeni* (labelled as '*Palaeoniscus*') from the Permian of Mansfeld in the Saxony-Anhalt region of Germany.

Casts of a placoderm, *Ceratodus* teeth from the Triassic of Bristol, and a series of modern and fossil shark teeth affixed to a board are displayed near modern fish. A picture-framed model of a skull has two labels reading 'Stegocephali *Orthosaurus pachycephalus* Barker Dorsal aspect of skull found in coal at Low Mains, Newsham, Eng' and 'This is an actual size model of a specimen in the Hancock Museum, Newcastle Upon Tyne'. The same model is also present, but painted white, in the University of Dundee Museum Collections. Two *Archaeopteryx* (casts of the London and Berlin specimens) and a cast of an *Archaeornithes* skull are in a case with bird skeletons themed on the mechanics of flight. Invertebrates are a Cambrian trilobite from Morocco (possibly a reproduction), Ordovician graptolites, 380 million-year-old orthoconic nautiloids from Morocco in polished slabs of rock, a slab with various bivalves from the Jurassic of Robin Hood's Bay, ammonite *Titanites giganticus* from Portland (Dorset), an ammonite cut to show crystal-filled chambers, the crinoid *Encrinus* from the Inferior Oolite (Jurassic), 120 million-year-old mayfly *Ephemeropsis* nymph from Liaoning (China), 100 million-year-old shrimp *Carpopenaeus* from Lebanon and a Quaternary termite in copal.

In many cases fossils are shown with modern equivalents for comparison. Such fossils are of echinoids (the complete and isolated spines of the Cretaceous echinoid *Cidaris*, Cretaceous *Echinocorys* preserved in flint and Miocene *Clypeaster*, including one from Bordeaux), crinoid fragments in limestone, brachiopods (from the Silurian, Carboniferous and Recent shown against the geological timescale), trilobites (*Ogyopsis*, *Ptychoparia* and *Neolenus* from the Cambrian of Mount Stephen, British Columbia, *Homalonotus* from the Silurian of Dudley and *Ogygiocarella* from the Cambrian of Wales), other arthropods (cast of the Xiphosuran *'Prestwichia'* (*Euproops*) from Manchester and an original from the Carboniferous of Barnsley) and corals (*Halysites*, *Syringopora*, *Favosites*, *Pachypora*, *Alveolites*, *Lithostrotion*, *Dibunophyllum*, *Cyathophyllum*, *Calceola* and *Lonsdalia*). Cephalopods are well-represented by fossils with many fragments of belemnites and the ammonites *Hildoceras* from the Lias at Whitby*, Dactylioceras*, *Ludwigella concava*, *Parkinsonia* from the Inferior Oolite at Burton Bradstock, *Teloceras* from the Inferior Oolite at Sherborne and *Hoplites* from the Gault at Folkestone. Displays of other molluscan groups (bivalves, gastropods) did not include any fossils. Microfossils are represented by large *Nummulites* from the Eocene of the Sahara, Egypt, and Mid Eocene (Lutetian) of Southampton. Plants are primarily Carboniferous with examples of *Glossopteris*, *Pecopteris*, *Calamites*, *Lepidodendron* of various sizes, *Sigillaria*, *Sphenopteris*, *Neuropteris* and *Sphenophyllum*, cycad from the Cretaceous of Australia, a lycopod (Fig.33) and 225 million-year-old wood from Madagascar.

Research/collection links

Fossils from localities across Fife could be the basis for a project on their context, and historical and scientific importance with potential for collaboration with other collections holding similar material, such as those managed by Fife Cultural Trust. A broader project could investigate fossils from localities across Scotland and the UK from the perspective of scientific importance, with potential for collaboration with numerous organisations holding similar material, including the Scottish University collections.

Figure 33: Fragments of a Carboniferous lycopod (Museums of the University of St Andrews)

Fife Collections Centre (Fife Cultural Trust)

Collection type: Local authority (Fife Cultural Trust)

Bankhead Park, Glenrothes, KY7 6GH
Contact: museums.enquiries@onfife.com

Location of collections
Several museums across Fife house collections although most of the stored material from the east, central and west local authority regions was centralised at the Fife Collections Centre in Glenrothes in 2017. The collections are managed by Fife Cultural Trust on behalf of Fife Council.

Size of collections
2,000 fossils.

Onsite records
Collection information is stored on a Ke EMu database; the majority of fossils have a basic entry and work is in progress to add additional details from MDA cards as part of a documentation plan.

Collection highlights
1. Fossils from the Fife area.
2. Fossils linked to Reverend John Anderson (1796-1864), Robert Dunlop (1848-1921), Reverend Dr John Fleming (1785-1857), James Wright (1876-1957), J Wood and D Nevey.
3. Fossils forming part of the Lauder Collection.

Published information
Woodward, A.S. (1915). Preliminary report on the fossil fishes from Dura Den. *Reports of the British Association for Advancement of Science, Australia*. 84:122-3.
Wright, J. (1950-1960). *A monograph on the British Carboniferous Crinoidea*. *Palaeontographical Society. London*. 1:1-190; 2:191-347.
Young, G.C. (2005). An articulated phyllolepid fish (Placodermi) from the Devonian of central Australia: implications for non-marine connections with the Old Red Sandstone continent. *Geological Magazine*. 142:173-186.

Collection overview
Fossils from Fife tend to be from the Carboniferous at Kinghorn, Woodmill, Charlestown, Roscobie, Dunfermline, Wemyss, Buckhaven, Bogie Mains, Inverteil and Seafield among other locations. The fossils include corals (*Lithostrotion*, *Favosites*, *Thysanophyllum*, *Lonsdaleia*, *Koninckophyllum*, *Dibunophyllum*), crinoids (many fragmentary specimens in limestone), gastropods (*Bellerophon*, *Platyostonella*, *Macrocheilus*), bivalves (*Nuculana* and others, and samples of mussel band), brachiopods (*Orthis*, *Productus*, *Athyris*, *Aviculopecten*, '*Lingula*', *Terebratula*), bryozoans (*Fenestella*), ostracods (*Cypricardella*, *Leperditia*), cephalopods (*Nautilus*), fish (*Rhizodus*) and plants (*Lepidodendron*, *Lepidostrobus*, *Pecopteris*, *Stigmaria*, *Calamites*, *Annularia*, *Sphenophyllum*, *Neuropteris*, *Sphenopteris*, one from the Coxtool bed, a large tree trunk and fossils described as bark and tree spores). In addition, there are examples of Carboniferous fossils from the Derbyshire, Yorkshire and Staffordshire coal measures and limestones.

Carboniferous fossils are attributed to specific collectors. The Robert Dunlop Collection is comprised of fossils from Woodmill, Dunfermline: gastropods (*Bellerophon*, *Euomphalus*, *Pleurotomaria*), scaphopod (*Dentalium*), brachiopods (*Productus*, *Chonetes*), cephalopods (*Cyrtoceras*, *Orthoceras*) and bivalves (*Nucula*, *Grammatodon*), and from Charlestown brachiopods ('*Orthis*', *Spirifera*), among other fossils from both localities. The James Wright Collection includes a variety of fossils, many without locality information: Corals (*Zaphrenoides*, *Cyathoxinia*, *Koninckophyllum*, *Dibunophyllum*, *Amplexizaphrentis*, *Rotiphyllum*, *Aulacophyllum*), crinoids (*Hydreionocrinus*,

Ulocrinus, *Eupachycrinus*, *Zeacrinus*, Platycrinus, *Poteriocrinus*, *Cocliacrinus*), gastropods (*Euomphalus*, *Mourkinia*, *Loxonema*, *Bellerophon*), sponges, bryozoans, arthropods (ostracod *Leperditia*, crustacean *Leaia*, phyllocarid *Dithyrocaris* and scorpion *Eoscorpius*) and echinoids (*Lepidesthes*). The Wright collection includes shark and fish fossils, for example, *Bothriolepis*, *Holoptychius*, *Eurynotus*, *Rhizodus* and *Petalodus*. Carboniferous fossils are also attributed to J Wood, D Nevey and Dr John Fleming (single *Aulophyllum* coral).

The Lauder Collection (assumed to be from the former Lauder College, Dunfermline) comprises fossils typical of well-known localities, mostly from outside Scotland and representing stratigraphic levels throughout geological time: Trace fossil *Oldhamia* from County Wicklow, Ordovician graptolite *Dictyonema* and trilobite *Angelina* from north Wales, bryozoan *Fenestella* from Halkyn Mountain (North Wales), Silurian Much Wenlock Limestone Formation (*Orthis*, *Cyathophyllum*, *Favosites*), Carboniferous Limestone from Derbyshire (with the crinoids *Actinocrinus* and *Encrinites*, and brachiopods *Productus* and *Rhynchonella*, etc), Jurassic ammonites *Aegoceras* from Whitby and *Quenstediceras* from Weymouth, *Pleurotomaria* from Dundry (Inferior Oolite), *Exogyra* and *Turritella* from Blackdown, *Ostrea*, *Raphidonema* and *Salenia* from the Faringdon Sponge Gravels (Lower Greensand, Cretaceous), Eocene Barton Beds (*Chama*, *Turritella*, *Volute*, *Murex*, *Typhis*, *Natica*, *Crassiatella*) and from Suffolk (molluscs *Mactra*, *Cardium*, *Lucina*, *Neptunea*, *Nassa*) among others. Fossils from Kent (*Terebratula*, *Belemnitella*, *Cidaris*, *Otodus*), Folkestone (*Acteon*, *Hoplites*, *Holaster*, *Natica*) and Isle of Wight (*Terebratula*) are probably Chalk.

Fossils from Fife are of the Upper Devonian fish *Holoptychius*, *Bothriolepis* and *Glyptopomus* in sandstone from Dura Den; some are figured due to excellent preservation. A specimen of the placoderm *Bothriolepis* shows a serrated leading edge on a front fin (Fig. 34) and seems to be the specimen drawn in mirror-image by Matthew Forster Heddle on display in the Bell Pettigrew Museum. The collection includes a painted cast of a placoderm fish, which matches an image in Young (2005, fig 2) described as the cast in the Australian National University Collection, Canberra, of the holotype of *Phyllolepis woodwardi*. The original was from Dura Den and described by Woodward (1915, fig 4). Another cast was observed in the Cockburn Museum (University of Edinburgh Collections).

Figure 34: Serrated front fin of an Upper Devonian placoderm fish *Bothriolepis* from Dura Den, Fife (Fife Collections Centre)

Other fossils stand out because they originate from further afield. Specimens from the Southern Hemisphere are *Phoulactus*, *Entellophylum* and *Mucophyllum* from the Middle Silurian Barrandella Shale Member of Yass, New South Wales, with a specimen of *Zenophyla* also likely to be from the same unit, *Thomnopora* from Tasmania, *Favosites* from the Middle Silurian Hume Limestone, *Disphyllum* from the *Receptaculites* Limestone, Middle Devonian of New South Wales, and a bryozoan from the Lower Marine Series of Harpers Hill, Hunter River Valley [Australia]. Specimens from the Palaeozoic of North America are *Tryplasma*, *Favosites* and *Quepora* (dated 1961?) from the Upper Ordovician Oakdale Formation of eastern Connecticut, *Tetroclium* from Ulrich, Trenton, Richmond, and *Homospisa* from Hartsville, Indiana. A fossil coral *Lambeophyllum* from Conrad Bridge Creek could be from Australia or North America.

There are specimens of silicified wood from Haifa desert, Egypt, petrified wood from Fort McMurry, Alberta, fossil wood from Arizona, copal from New Zealand, and Eocene leaf impressions from Bournemouth. A fossil of the trilobite *Ogygia* is from the Cambrian of Mount Stephen, British Columbia, however a *Spirifer* and *Encrinites* labelled with the same locality are more likely to be Carboniferous and their origin should be checked if possible. Other specimens to note are a *Clupea* (herring) from the Lagerstätte of Monte Bolca, Verona, Italy, the cast of an *Archaeopteryx* gifted when Glenrothes was twinned with Ingolstadt, the arthropod *Euproops*, *Carcharodon* shark teeth, an ichthyosaur fossil, coral *Phillipsastrea* from the Devonian of Torquay, a mammoth tooth from the River Medway and a petrified bird's nest from Knaresborough, Yorkshire.

Research/collection links
It would be interesting to know how the fossils from the southern Hemisphere and North America came to be in the collections, as well as further details of their origin.

St Andrews Museum (Fife Cultural Trust)

Collection type: Local authority (Fife Cultural Trust)
Accreditation: 2019

Kinburn Park, Doubledykes Road, St Andrews, KY16 9DP
Contact: standrews.museum@onfife.com (OnFifemuseums.enquiries@onfife.com)

Location of collections
St Andrews Museum is located in a nineteenth-century mansion house in the grounds of Kinburn Park. The collection was formerly part of the North East Fife District Museum Service and includes specimens from the Laing Museum in Newburgh. There is a single fossil on display with the remainder onsite in storage and at the Collections Centre in Glenrothes.

Size of collections
400-500 fossils.

Onsite records
Information is entered on a central KE Emu CMS for the Fife Cultural Trust venues. All the fossils onsite are included.

Collection highlights
1. Fossils from the Fife area.
2. Fossils linked to Robert Dunlop (1848-1921).

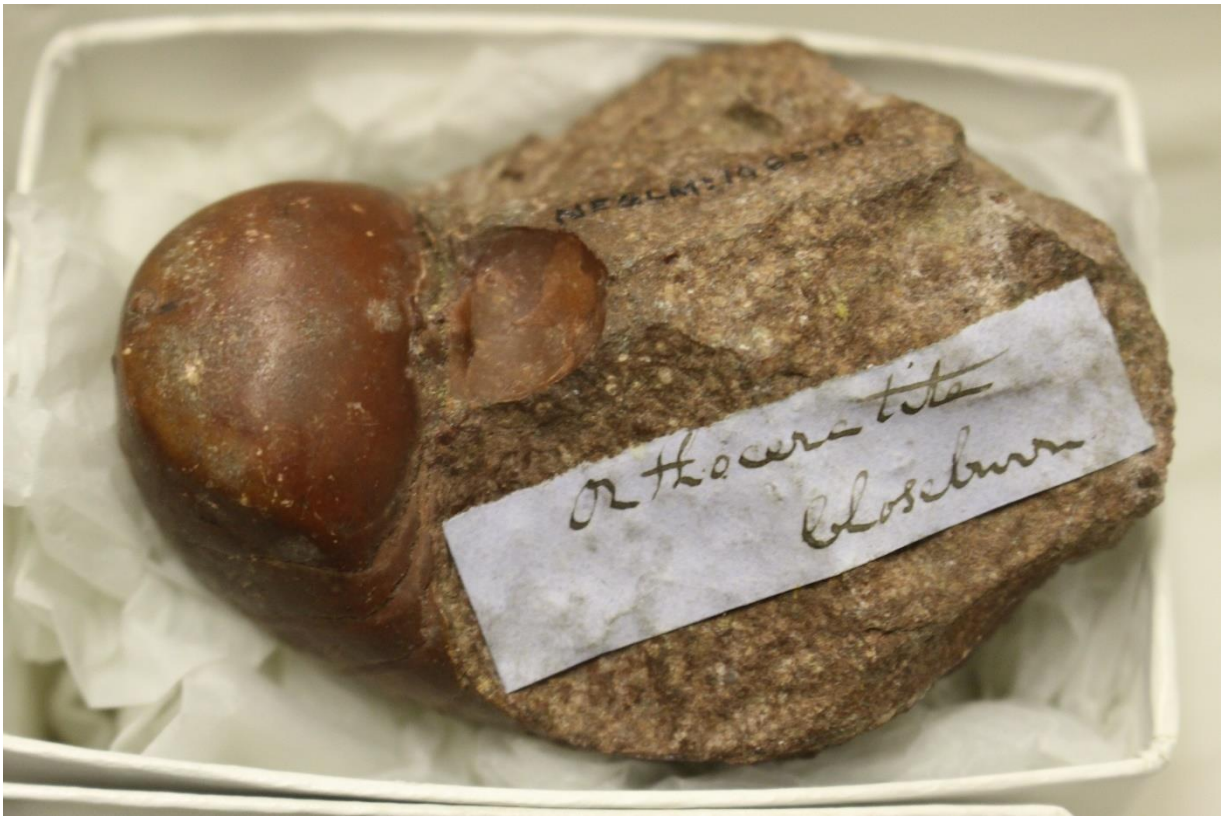

Figure 35: Carboniferous nautiloid *Orthoceratites* from Closeburn, Dumfries and Galloway (St Andrews Museum, ONFife)

Collection overview
The fossils in the collection are from two main stratigraphic levels: the Devonian and Carboniferous, although other levels are represented. Fossils from the Devonian are entirely fish, divided into those from the Middle Devonian, such as *Pterichthyodes* from Caithness, *Osteolepis* and *Glyptolepis*, and those from the Upper Devonian, represented by *Holoptychius*, *Bothriolepis* and *Glyptopomus* from Dura Den, *Pheneropleuron andersoni*, and a *Holoptychius* and indeterminate fish from Scaat Craig near Elgin, among other fragmentary fish remains.

The remaining fossils are almost entirely Carboniferous. A portion of the specimens labelled with origin are from Charlestown Quarry: Corals *Microcyathus*, *Dibunophyllum*, *Lithostrotion* and other rugose forms, spiriferid, productid and orthid brachiopods, crinoids including a set of fossils showing a calyx, arms and stems, bryozoans *Penniretipora* and *Fenestella*, bivalves, gastropods *Bellerophon*, *Palaeostylus* and indeterminate specimens, among others. Specimens also likely to be Carboniferous are of the bivalves *Wilkingia* (some from Duloch), *Lithophaga* (Isle of Man), *Carbonicola* and *Anthracospharium*, brachiopods identified mostly to order level: productids, spiriferids, orthids, rhynchonellid, terebratulida, lingulid and possible '*Lingula*' from Duloch, crinoid fragments, the corals *Aulaphyllum*, *Dibunophyllum*, *Zaphrentis*, *Lithostrotion*, *Lonsdaleia* and *Caninia* (Isle of Man), the gastropods *Euomphalus*, *Palaeostylus*, *Glabrocingulum* and several bellerophontids, cephalopods including an *Orthoceratites* from Closeburn (Fig. 35), orthoceratid from the Isle of Man, goniatites and other ammonoids, and trilobites from Laddedie, Fife, assigned to Phillipsiidae (Order Proetida), one preserved with a productid brachiopod. Carboniferous vertebrates are limited to several *Rhizodus* and a fish from Wemyss, Fife. Plant fossils are of *Cyclopteris*, *Neuropteris*, *Celodendron* (Forest of Dean, Gloucestershire), *Lepidodendron*, *Sigillaria*, a pteridophyte specimen and the thallophyte (group of fungi, lichens and algae, etc) *Metaspora*. There are many additional fossils, not identified or without locality information, that might also originate from the Charlestown Quarry locality and/or be linked to the collector Robert Dunlop (1848-1921).

The remaining fossils are Post-Palaeozoic. The Jurassic is represented by cephalopods (belemnites, orthoconic nautiloid, ceratites, ammonites *Perisphinctes* and *Hildoceras*), coral (*Isastrea* and scleractinian coral preserved with a pectin-like bivalve from Shotover, Oxford), gastropods (*Pleurotomaria* from Wiltshire), echinoids (*Echinocorys*, cidaroid, *Clypeus* and indeterminate echinoids), bivalves (*Ostrea*, *Trigonia*, *Neithea gibbosa*, *Calpitoria* and *Gryphaea* (some from Portree)) and a cast of the sponge *Siphonia*. Vertebrate fossils are of the fish *Pholidophorus beechi* from the Jurassic at Lyme Regis and an ichthyosaur. Other specimens from younger or unknown levels are of the gastropod *Aphorrais*, arthropods (cirripedes and Eocene crabs *Dromilites* and *Zanthopsis*), plants from Shanklin on the Isle of Wight, and *Serpula vermiculeris*. There is a mammal tooth, perhaps from a horse or other herbivore (Recent), and a whale ear bone from Suffolk described as a fossil fish.

Research/collection links
Collaborative projects could investigate the Devonian fish from Fife and/or the diverse Carboniferous fossils.

Kirkcaldy Galleries (Fife Cultural Trust)

Collection type: Local authority (Fife Cultural Trust)
Accreditation: 2019

War Memorial Gardens, Kirkcaldy, Fife, KY1 1YG
Contact: Kirkcaldy.galleries@onfife.com

Location of collections
The Museum opened in 1925 as part of the town's War Memorial with an extension in 1928 providing space for a library. The location has fossils on display but no storage, which is at the Collection Centre at Glenrothes.

Size of collections
5 fossils.

Onsite records
Fossils are on a KE EMu CMS centrally at the Fife Collections Centre.

Collection highlights
1. Fossils from the local area.

Collection overview
Fossils are the rugose coral *Dibunophyllum* from the Seafield Colliery at Kinghorn, productid brachiopod *Gigantoproductus*, the seed fern plant *Mariopteris* and trunk *Sigillaria*, and impression of mussel band bivalves from the Frances Colliery (Fig. 36), all Carboniferous in age.

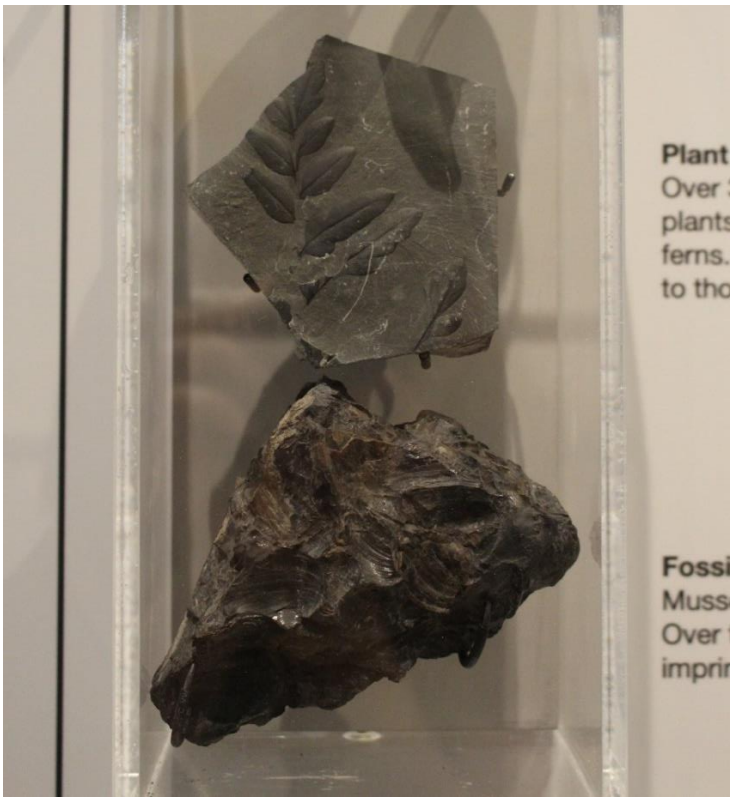

Figure 36: The Carboniferous plant *Mariopteris* (top) and bivalves in a mussel band (below) from Frances Colliery, Fife (Kirkcaldy Galleries, ONFife)

Falkirk Collections Centre (Falkirk Community Trust)

Collection type: Local authority (Falkirk Community Trust)

Museum store
Contact: callendar.house@falkirkcommunitytrust.org

Location of collections
The facility houses the stored collections of Falkirk Council, managed since July 2011 by Falkirk Community Trust. Stored collections are available for display at Callendar House, Kinneil Museum and other venues in the Falkirk area.

Size of collections
100-200 fossils.

Onsite records
Fossils are recorded on a Vernon CMS database with a photograph for each entry. An online collection database is available at: https://collections.falkirk.gov.uk/explore.

Collection highlights
1. Examples of Carboniferous fossils.

Figure 37: Bivalves in a Carboniferous mussel band (Collections of Falkirk Community Trust)

Collection overview
The fossils are almost exclusively from the Carboniferous in the local area, notably the River Avon and Bo'ness shore. Plant fossils consist of both identifiable forms and indeterminate fragments in matrix such as the moderately-sized pieces of *Lepidodendron*, *Calamites*, *Sigillaria*, *Alethopteris* and *Annularia*, several smaller fragments of similar plants and a smaller section of *Stigmaria* with

rootlets; one specimen is a large slab more than a metre across showing a mass of leaflets. Invertebrate fossils are the disarticulated crinoid ossicles and fragments of bryozoans, some occurring together, bivalves in mussel band (Fig. 37) and the coral *Zaphrentis* dated 1920. There are numerous small fragments of productid brachiopods, often difficult to identify as such, and specimens of the brachiopod '*Lingula*', a name under which many fossils have been placed in the interim or absence of a more accurate identification. Several trace fossils are described as worm burrows. Some of the fossils might be from the Hurlet Limestone, a bed used for correlation laterally. Other stratigraphic levels are represented by a few specimens, such as a shelly bioclastic rock possibly from the Cenozoic.