

Scotland Field Trip Manual

June 1, 2016

Contents

1	Itinerary	3
2	Locality information	4
2.1	Tillywhandland	5
2.2	Cromarty and Eathie	8
2.3	Achanarras	8
2.4	Thurso	8
2.5	Cruaday Quarry	9
2.6	The Highland Park Distillery	10
3	Kit list	11
4	The trip	12
5	Accommodation details	13
5.1	Edinburgh: nights of 15th/16th June	13
5.2	Monickie: nights of 17th-21st June	13
5.3	North Kessock: nights of 22nd/23rd	14
5.4	Thurso: nights of 24th/25th	15
5.5	Stromness: nights of 26th-29th	15
5.6	Inverness: night of 30th	15
6	Contact details	16

1 Itinerary

Dates	Activity	People
15th June	Richard arrives in Edinburgh and sorts initial food shopping	
16th June	Everyone joins Richard in Edinburgh over the course of the day	
17th June	Drive from Edinburgh to Monikie	
18th June	Work Tillywhandland - Bob Davidson may join	
19th June	Work Tillywhandland - Bob Davidson may join	
20th June	Work Tillywhandland - Bob Davidson may join	
21st June	Work Tillywhandland - Bob Davidson may join	
22nd June	Drive from Monikie to North Kessock	
23rd June	Work Cromarty and Eathie	
24th June	Drive from North Kessock to Thurso. Possibly work Thurso	
25th June	Work Achanarras	
26th June	Drive from Thurso to Stromness	
27th June	Work Cruaday Quarry - joined by John Brown	
28th June	Work Cruaday Quarry	
29th June	Fun day of Orcadian fun	
30th June	Drive back from Stromness to Inverness	
1st July	Fly back to London	

2 Locality information

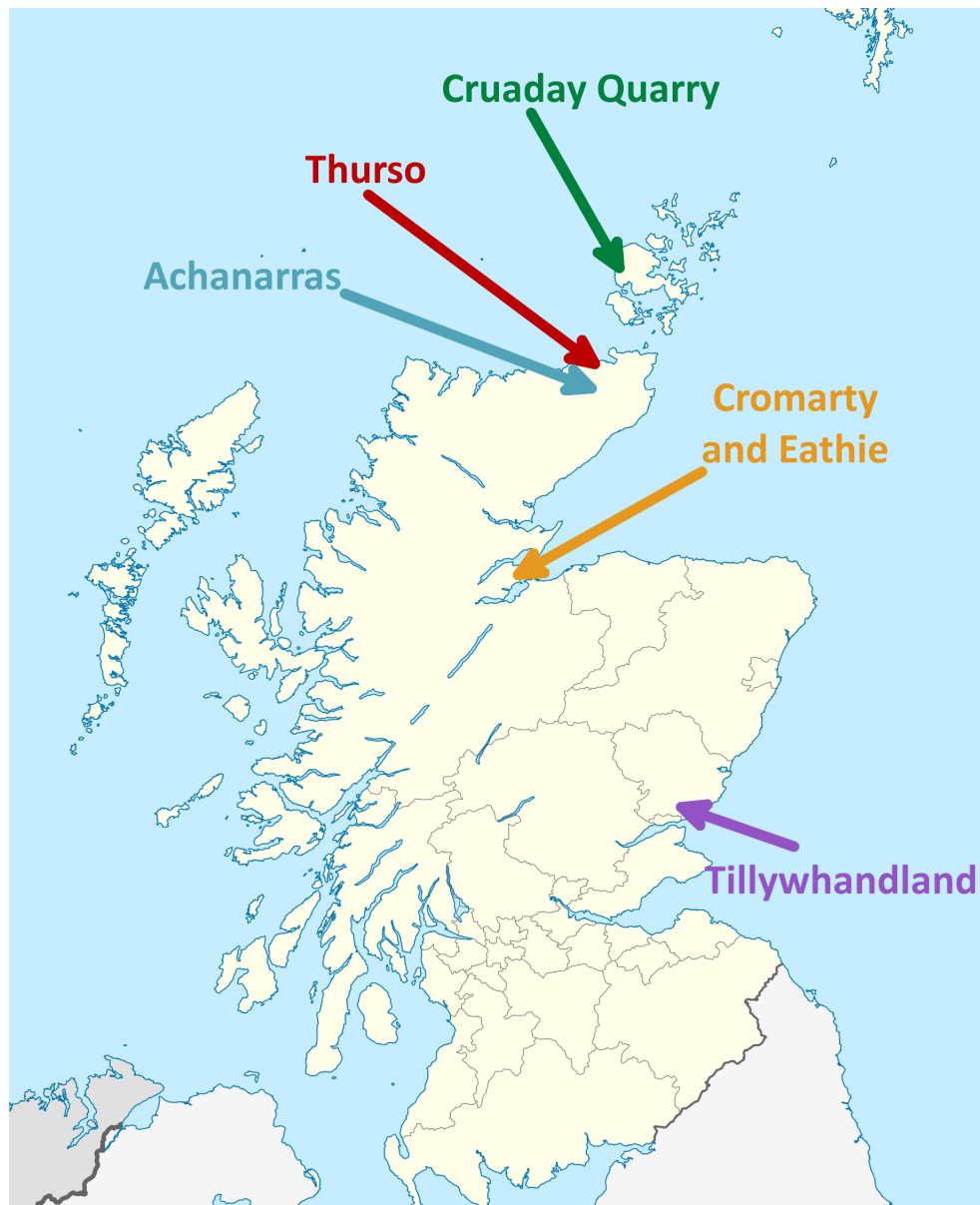
All of the localities we're going to are part of the Old Red Sandstone, famous for its Devonian fishes. I've written a brief introduction to each one below: this is based on Dineley and Metcalf's 'Fossil Fishes of Great Britain' help from Mike Newman, and googling. The book is now out of print, but you can find individual chapters by googling site names.

At the majority of the sites we will be looking for material for Martin's teaching collection, but at the first (Tillywhandland), we will hopefully also find material pertinent to my PhD project.

Many of the sites are also SSSIs (sites of special scientific interest). This means that it is illegal to take fossils out of the cliff, and it's probably best to keep any geological hammers etc out of plain site so you don't look like you're about to. Otherwise we're covered by (and ought to follow) the Scottish Fossil Code - this provides a set of guidelines and rules for collecting fossils in Scotland and is worth a skim, but essentially it amounts to don't be a dickhead.

The Scottish Fossil Code can be found here: <http://goo.gl/9Kr0S7>

Figure 1: Locations of sites

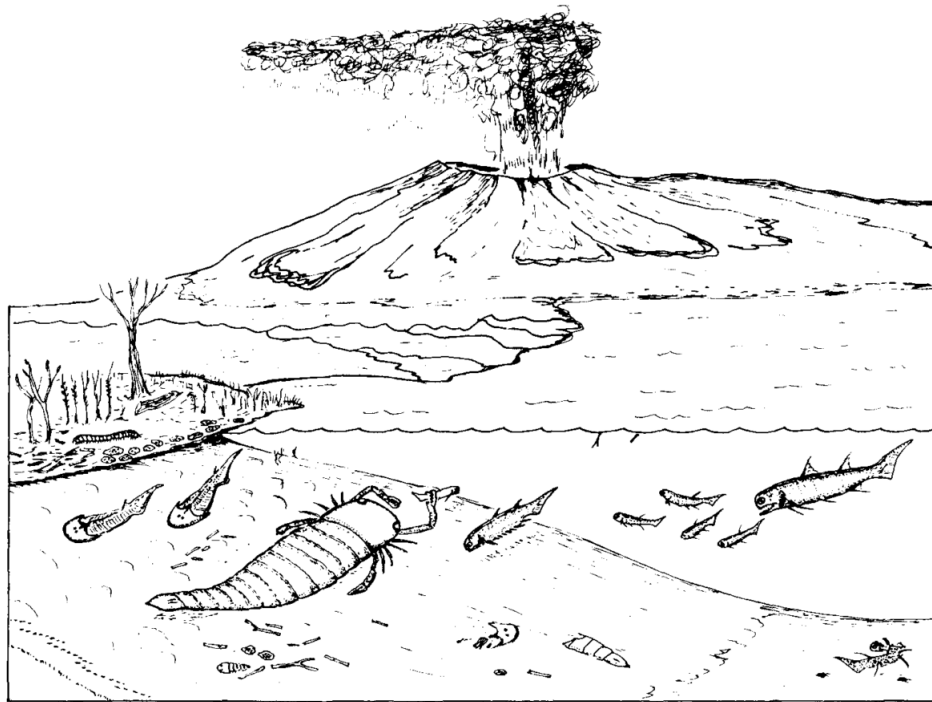


2.1 Tillywhandland

Tillywhandland is thought to be the source of many Scottish Old Red Sandstone fossils from “Turin Hill”; 19th century sandstone quarrying at

this site revealed a number of fossils including acanthodians, osteostracans, and eurypterids which were described by Powrie and others. The fish bearing rock is a laminite, comprising clastic, organic, and carbonate layers. This is interpreted as having been laid down in a shallow seasonal lake, Lake Forfar, in the Early Devonian. The fishy denizens of this lake (and/or surrounding rivers) were preserved in the anoxic sediment at its bottom.

Figure 2: A reconstruction of Lake Forfar from Trewin and Davidson (1996)



Fishy fossils at Tillywhandland are found only in one fish bearing bed, and are fairly few and far between: if you want to get your eye in for what these look like, we've got some in the lab. Fishes include the osteostracan *Cephalaspis*, and the acanthodians *Climatius*, *Ischnacanthus*, *Euthacanthus*, *Vernicomacanthus*, *Mesacanthus*, and possibly *Brachyacanthus* and *Uraniacanthus*: with modern acid preparation techniques these fishes are comparable in preservation to those from the much-vaunted Man on

the Hill (MOTH) locality in Canada We're (or at least I am) particularly interested in the acanthodian *Vernicomacanthus uncinatus*: I'm redescribing it as part of my PhD work and it displays an intriguing mixture of "acanthodian" and "chondrichthyan" characters. We may also find the eurypterid *Pterygotus*, millipedes, arthropod trackways, plant material, and coprolites.

Figure 3: The holotype of *V. uncinatus* from "Turin Hill"



Bob Davidson, who wrote a description of Tillywhandland and who has a lot of experience working there, will hopefully be joining us for a day. The land is privately owned by a Mr Middleton, who John Armstrong (another guy who works Tillywhandland regularly) has kindly contacted to let him know we're coming.

2.2 Cromarty and Eathie

Cromarty and Eathie (as well as all of the rest of our sites) are from the Orcadian basin, a sedimentary basin laid down by Lake Orcadie in the Middle Devonian. These sites are on the coast of the Black Isle, a peninsula (rather than an island) that juts out of the east coast of Scotland between the Cromarty, Beauly, and Moray Firths. Cromarty was the birthplace of the famous Scottish geologist Hugh Miller (1802-1856), and according to something I read on the internet the footpath down to the rocks at Eathie was built by him ^[citation needed].

These sites also have a Jurassic exposure: the Devonian fishes are all in concretions along the foreshore.

2.3 Achanarras

Achanarras is an extremely rich site from the Southwestern part of Lake Orcadie. It's probably most famous for *Palaeospondylus*, the enigmatic early vertebrate large quantities of which take up space in museum drawers all across the UK. Fishes are to be found in limestone laminites in several horizons: these include acanthodians *Mesacanthus*, *Cheiracanthus* and *Diplacanthus*, placoderms *Coccosteus*, *Homosteus*, *Pterichthyodes*, and *Rhamphodopsis*, and osteichthyans *Cheirolepis*, *Glyptolepis*, *Osteolepis*, and *Dipterus*. These can be found by splitting the limestone flags.

The land is public, but is an SSSI. Mike Newman tells me the spoil tips have recently been turned by a JCB, so it may be productive. Sometimes the quarry is flooded, if we don't get anywhere we can go to the next site, Thurso.

2.4 Thurso

The beach in Thurso where we are staying provides another exposure of the Orcadian basin and is similar to Achanarras: if we get a chance on one of the driving days or if Achanarras is unproductive, we could check it out. There are no restrictions.

Figure 4: Bring your Geiger counters

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487

No bands were found in a specimen fatigued at liquid-air temperatures.

The existence of many potential slip bands in age-hardened alloys undergoing fatigue provides an additional explanation of the poor fatigue properties of some age-hardening alloys relative to their static strength properties. Besides the possibility of over-ageing, slip can more readily occur in any one crystal and be transmitted to its neighbours. The alloy described is simply a super-pure version of a common commercial alloy, and it is of interest that crystallographic cracking can be found in such an alloy, although its analysis is complicated by the presence of gross inhomogeneities and intermetallics (Fig. 4).

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Nov. 8.

¹ Orowan, E., *Proc. Roy. Soc., A*, **171**, 79 (1939).

² Broom, T., and Molineux, J. H., *J. Inst. Metals*, **83**, 528 (1954-55).

³ Karnop, R., and Sachs, G., *Z. Phys.*, **49**, 480 (1928). Carlsen, K. M., and Honeycombe, R. W. K., *J. Inst. Metals*, **83**, 449 (1954-55).

⁴ Franz, E. C., *J. Metals*, **6**, 56 (1954).

⁵ Boas, W., and Ogilvie, G. J., *Acta Metallurgica*, **2**, 655 (1954).

An Unusually Radioactive Fossil Fish from Thurso, Scotland

DURING recent investigations on the distribution of radioactive elements in phosphates¹, it was noted that many of the Old Red Sandstone fish remains from north-east Scotland have an abnormally high radioactivity; in particular an unidentified *Homostius* plate (GSM 89090) was shown by rough radiometric assay to have an activity equivalent to 0.5 per cent U_3O_8 .

More detailed radiometric assays we have carried out indicated that this material is either in a state of secular disequilibrium, or contains appreciable amounts of thorium. As the latter alternative seemed the more likely, part of the specimen was assayed chemically (Radiochemical Group, Chemical Research Laboratory, Teddington) and found to contain 0.32 per cent U_3O_8 and 0.51 per cent ThO_2 , a result which is in excellent agreement with the equivalent U_3O_8 value of 0.48 per cent obtained on the same sample. On obtaining chemical confirmation that appreciable thorium is associated with this particular fish plate, additional investigations were undertaken in an endeavour to obtain more information on the distribution of the radioactive elements within the

2.5 Cruaday Quarry

Cruaday Quarry is the most high-profile exposure of the Sandwick fish beds in the Orkneys, located near the lewdly-named village of Twatt on the Western side of the Mainland. Fishes are preserved in a fish layer formed from dark grey siltstones. It has a similar collection of fishes to other Lake Orcadie sites, including acanthodians *Diplacanthus*, *Rhadinacanthus*, *Mesacanthus*, and *Cheiracanthus*, placoderms *Pterichthyodes*, *Coccosteus*, and *Homosteus*, and osteichthyans *Osteolepis*, *Cheirolepis*, *Gyropterychius*, and *Dipterus*.

If we have time in the afternoon after the ferry there is a museum of Orkney Fossils on the island of Burray: we could go there to get our eye in for what we're looking for, dependent on tiredness/time.

The quarry is in active use (owned by Orkney Aggregates), but the main fish bed part is controlled by John Flett Brown, the chairman of the fossil museum on Burray: John will be coming with us on one of the days to show us around the site. This site is also an SSSI.

2.6 The Highland Park Distillery

On our final day in the Orkneys we will be visiting perhaps the most important locality of all: the Highland Park distillery in Kirkwall, the “capital” of the Orkneys. Currently the plan is to go to Skara Brae in the morning, a stone-built Neolithic village that is part of a UNESCO world heritage site that covers several sites in the Orkneys. We will then drive to Kirkwall: on the way we will also see the Ring of Brodgar, a stone henge that is also part of the world heritage site, as well as the remains of the fleet scuppered by the German Navy in the Scapa Flow at the end of the First World War. I’ve booked us onto an hour-long tour at the distillery at 2pm. After that we can do whatever we want in Kirkwall.

Obviously these activities won’t be covered by the lab, so bring some money: the distillery tour costs 7.50 a head.

3 Kit list

I've put a list of things you'll need below: please try and pack reasonably lightly as there won't be enormous amounts of room in the car.

- Clothing - ensure you bring warm things.
 - Raincoat and ideally waterproof trousers. Scotland is wet.
 - Some kind of sun protection: hat and cream.
 - Walking boots: something with ankle support. Thomas, your shit-kickers will probably do.
 - A towel and washing things- not sure we'll need the towel, but best to be safe - I'll check
 - A hand lens
 - Geological hammer: not strictly necessary, and we may not be able to use them at some localities, but if you've got one bring it in case
-
- We will bring lab chisels, hard hats, and a crackhammer, so no need for them
 - No need for a sleeping bag: all the places provide bedding (?)

4 The trip

5 Accommodation details

5.1 Edinburgh: nights of 15th/16th June

The **Princes Street Travelodge** is just off Princes Street, the road that separates Edinburgh Old Town from New Town. It's 2 minutes walk from Edinburgh Waverley train station.

Figure 5: Directions from the station to the Travelodge



Address: Meuse Lane, off Princes Street, Edinburgh EH2 2BY, United Kingdom, EH2 2BY **Telephone number:** 08715 591855

5.2 Monickie: nights of 17th-21st June

For Tillywhandland we will be staying in the Monument Cottage in Monickie. It has free private parking and wifi: we'll have to cook ourselves.

Figure 6: This is the picture that Google Maps associates with the Trav-elodge. A charming place indeed.



Monument Cottage, Monikie, Nr Broughty Ferry, Dundee,, Monikie,
DD5 3QN

Contact no: 01382 370633

5.3 North Kessock: nights of 22nd/23rd

For Cromarty and Eathie we will be staying in an Airbnb in North Kessock,
near Inverness.

The Anchor and Chain Coulmore, North Kessock, Ross Shire IV1 3XB

Contact no: 07545 586849

5.4 Thurso: nights of 24th/25th

For Achanarras/Thurso we will be staying in Thurso at the Royal Hotel
Royal Hotel Traill Street, Thurso, KW14 8EH
Contact no: 01847 893191

5.5 Stromness: nights of 26th-29th

For Stromness we will be staying in Orkney self catering Loretto cottage.
Loretto, Hillside Road, Stromness, Orkney, KW16 3HR
Contact no: 01856 771865

5.6 Inverness: night of 30th

On the final night in Inverness we will be staying at The Waverley Guest House.
The Waverley Guest House, 25 Union Street, Inverness, IV1 1QA
Contact no: 01463 716008

6 Contact details

Name	Mobile
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Rob Sansom	????? ???????
Emma Randle	????? ??????
John Flett Brown	????? ????????