Newsletter No. 278
April 2023

Contents:

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Copy date for the next Newsletter is Thursday 1 June

Mark Jeffs **Honorary Secretary,** honsec@bcgs.info	**Andy Harrison,** **Field Secretary,** ☎ 07973 330706 fieldsecretary@bcgs.info	**Julie Schroder,** **Newsletter Editor,** 42 Billesley Lane, Moseley, Birmingham, B13 9QS. ☎ 0121 449 2407 newsletter@bcgs.info
For enquiries about field and geoconservation meetings please contact the Field Secretary. To submit items for the Newsletter please contact the Newsletter Editor. **For all other business and enquiries please contact the Honorary Secretary.** For more information see our website: bcgs.info, YouTube, Twitter: @BCGeoSoc and Facebook.		

Future Programme

Indoor meetings are normally held in the Abbey Room at the Dudley Archives, Tipton Road, Dudley, DY1 4SQ, 7.30 for 8.00 o'clock start unless stated otherwise.

Visitors are welcome to attend BCGS events but there will be a charge of £1.00.

Monday 17 April *(Indoor Meeting):* N.B. Change of Subject and Speaker. 'The Newt Route'. Speaker: Courteney Smith (Assistant Nature Reserve Warden). The speaker will talk about a new nature trail linking Barrow Hill, Fens Pools and Baggeridge Country Parks, to be called the 'Newt Route' as it is centred around the conservation of amphibian wetlands.

Saturday 20 May *(Field Visit):* Little Doward and Arthur's Cave. Led by Jim Handley (EHT Champion for the Dowards and Arthur's Cave). Meet for a 10.30 start in the car park near the Doward Campsite between Little and Great Doward (GR: SO 547157). **Do not rely on the post code for this site.** Follow the instructions from the A40 detailed here by Jim: Travelling south from Ross or Hereford, turn left off the A40 at the turning for Symonds Yat West and follow the brown signs to the Doward Campsite. In detail: having turned off the A40 at Whitchurch, turn right immediately at the small roundabout. In 250 yards go left (not over the bridge). In about a mile at Crockers Ash turn left between houses. Follow the single track road with passing places for about a mile and a half. Where the road turns sharp left, go right onto a rough track past Doward Campsite entrance. Parking in 150 yards.

The walk will visit the Carboniferous Lordswood Quarry, and an excellent case study can be found here: https://deeptime.voyage/resources/lordswood/. We will view the Wye Gorge and think about its formation, visit a tufa covered cliff and a limestone pavement made up of a reef of colonial corals. We will also see some local heritage and spectacular scenery. The route is about 4 miles long on good tracks and paths, with some rough and inclined sections, but the gradients involved are not steep. Wear stout footwear and bring a packed lunch. Finish around 4.00.

Saturday 17 June *(Field Visit):* North Malvern – Tank Quarry and North Quarry. Led by Peter Bridges (EHT Champion for Tank and North Quarries). Meet to start at 11.00 at Tank Quarry Car Park, West Malvern Road, North Malvern, Worcestershire, WR14 4NA (GR: SO 768470). We will look at ►

the Malvern Complex northernmost exposures and some exposures related to the East Malvern Fault (EMF). There are some steep paths and rough ground. Stout footwear is required. Either bring a packed lunch, or a proposed lunch stop is at The Nags Head 19-21 Bank St, Malvern, WR14 2JG. **Essential that you inform the field secretary of your intention to join this visit** as we need numbers for lunch at the Nags Head (booking ahead is essential) and for handouts. Aim to finish around 4.00.

Saturday 22 July *(Field Visit):* Glacial Boulder Trail 8 - The Illey Valley Wilderness Trail. Led by Julie Schroder. Meet to start at 11.00 at Woodgate Valley Country Park car park, Clapgate Lane, B32 3DS. GR: SO 995 830. This is a pre-launch walk on the final trail in the Glacial Boulder series produced during the project 'Birmingham's Erratic Boulders: Heritage of the Ice Age'. The trail is 5½ miles, crossing 3 district boundaries, the M5 and the Midland watershed. It links some fine specimens of glacial erratic boulders, with opportunities to consider the underlying geology and the surrounding landscape. There is some rough ground, muddy in wet weather. Stout footwear is required. Bring a packed lunch or obtain food at the Black Horse Inn, Illey. The trip will finish around 4.00.

Other Societies and Events

Abberley and Malvern Hills Geopark 20th Anniversary – Geofest 2023

This year is the 20th anniversary of the Abberley and Malvern Hills Geopark. The annual Geofest is running from 27 May to 3 September. One of the main events will be a 20th anniversary celebration open to the public on 21st June. There will be more information on the their website in due course.

For further information go to: http://geopark.org.uk/ or contact the BCGS Field Secretary, Andy Harrison (details on p.2).

The Geologists' Association, Evening Lectures

Friday 14 April: 'The pebbles of the Ice Age Coast'. Speaker: Mike Horne.

Our hybrid lectures will be held both in the Janet Watson Lecture Theatre of the Geological Society, Burlington House, Piccadilly, W1V 0JU, & simultaneously over Zoom. Non-members are always welcome to attend for an introductory visit arranged by phoning (020 7434 9298) or emailing (sarah@geologistsassociation.org.uk) the Executive Secretary to book a place. The GA reserve the right to request a small charge for returning non-member attendance.

Teme Valley Geological Society

Monday 22 May: 'Volcanism in Skye'. Speaker: Dr. Simon M Drake.

Talks take place in Martley Memorial Hall at 7.30. Non-members £3. For field trip details and further information contact John Nicklin, email: martleypfo@gmail.com or phone on 01886 888318 or visit: https://geo-village.eu/

Mid Wales Geology Club

Wednesday 19 April: 'The River and the Rock: River Potholes of Wales'. Speaker: Dewi Roberts.

Wednesday 17 May: 'Wales – Coming out of the Ice Age'. Speaker: Tony Thorp.

Sunday 21 May: Field Trip to Coed y Brenin. Led by Dr John Mason.

Further information: Tony Thorp tel. 01686 624820 and 622517 tonydolfor@gmail.com
Web: http://midwalesgeology.org.uk lectures start at 7.15 via Zoom.

Woolhope Naturalists' Field Club - Geology Section

Saturday 22 April: Downton Gorge. Led by Tom Wall.

Wednesday 3 May: Purlieu, West Malvern. Led by John Payne.

Saturday 27 May: Silurian Anticlinal Inliers on the Hereford-Gloucester Border. Led by Dave Green.

Thursday 8 June: Offa's Dyke, Knighton. Led by Prof. Keith Ray.

Non-members of the Club pay £2. Visit: https://www.woolhopeclub.org.uk/meetings All meetings will be held in Hereford Town Hall. Friday evening meetings start at 6.00, unless otherwise notified. Non-members are welcome.

East Midlands Geological Society

Saturday 15 April at 6.00: 'Giant Pterosaurs of the Sahara Desert'. Speaker: Professor Dave M Martill.

Sunday 30 April: Day visit to Ecton copper mine, near Warslow, Staffordshire. Led by Dr Richard Shaw and Tim Colman.

Wednesday 17 May: Afternoon visit to Ashover in Derbyshire. Led by Tim Colman.

Sunday 4 June: Day visit to the Claxby area of Lincolnshire. Led by Paul Hildreth.

Non-members are welcome and should register with the secretary. Meetings will be held in the Geography Department of Nottingham University, which is in the Sir Clive Granger Building. Further info: www.emgs.org.uk or email: secretary@emgs.org.uk

Warwickshire Geological Conservation Group

Thursday 20 April @ 7.30 - 9.00: 'The geology of the Chilterns and the potential impact of HS2'. Speaker: Haydon Bailey.

There is a charge of £2.00 for non-members. These meetings are both live at St Francis, Kenilworth and by Zoom. For more details visit: http://www.wgcg.co.uk/ or email: WarwickshireGCG@gmail.com.

Manchester Geological Association

Saturday 22 April starting at 1.30: Three talks as follows:

'How can the subsurface help us achieve Net Zero: examples from the North Sea and Greater Manchester'. Speaker: Prof. Mads Huuse.

'An overview of HyNet, with a focus on carbon dioxide capture, transport and storage'. Speaker: David Walker.

'Biosteering the world's oldest and deepest gas reservoirs'. Speaker: Wyn Hughes.

Sunday 23 April: The Fred Broadhurst Memorial Field Trip: Lyme Park Part 2 - Fossils and Features. Led by Jane Michael. Please note that non-National Trust members will have to pay for admission to the park, which includes car parking but not entry to the house. For further information and a copy of the Itinerary and Risk Assessment, please email Jane Michael (gmicsch@gmail.com).

Meetings are held in the Lecture Theatre in the Williamson Building, University of Manchester, 176 Oxford Road, Manchester, M13 9QQ, unless otherwise stated. Events are likely to take place via Zoom. Visitors are always welcome. For more information: http://www.mangeolassoc.org.uk/ or contact lectures@mangeolassoc.org.uk

Editorial

Please note the change of speaker and subject matter for our April talk. Although we are sorry that Dr. Aaron Hunter is not able to be with us, we are pleased to welcome - at short notice - Courtney Smith from the Dudley MBC countryside team. Her subject matter is local and may provide some insights about the care that is needed for geology and wildlife conservation to work together.

We have three all-day field trips to look forward to in May, June and July and hope that more of you will be prepared to venture out and join our field trip programme this summer. We are still in need of a dedicated Meetings Secretary for our indoor meetings. Please think hard about whether you could fulfil this role, and contact the Secretary, Mark Jeffs *(details on p.2)* if you can help.

This Newsletter brings you the usual mix of items for your information and enjoyment. If you have any items with or without photos which you'd like to include, please don't hesitate to get in touch with me *(details on p.2 above)*. Some of you may have some geological tales to tell from your travels through the summer months. ■

Julie Schroder

Geoconservation Reports - Autumn 2022 & Spring 2023

With March ending and spring upon us, we say farewell to another successful geoconservation working season visiting Wren's Nest NNR, Saltwells NNR, a glacial erratic boulder in the Illey Valley, and Portway Hill. These visits have seen BCGS members working in partnership with local Friends groups, the Birmingham and Black Country Wildlife Trust (BBC WT), and volunteers from the Birmingham Erratic Boulders Project.

Saturday 8 October 2022 and Saturday 4 February 2023: Wren's Nest NNR.

The season started at Wren's Nest on 8 October 2022, meeting the Reserve wardens at their base on Fossil View at 10.30 on a warm, sunny day. The area visited was the Lower Quarried Limestone trench, part way along the Reserve's eastern limb and south of the NCC cutting, which we had previously visited pre-pandemic. The day was spent clearing scrub, thinning out saplings and cutting semi-mature trees including ash and whitebeam to a stump, to keep the trench open and avoid the side slopes destabilising. A bonfire was useful for disposing of the thinned scrub and saplings.

Wren's Nest Trench clearance 8/10/2022

Such a confined space makes trees grow tall and spindly and therefore prone to destabilisation from wind loading. This can result in unstable rock slopes. Historical slope clearance by the Council had exposed the underlying Ludlow Shales at this location, but had not helped slope stability. The Ludlow Shale strata had subsequently weathered and eroded before slumping, and had then become overgrown with the scrub and trees seen today. Coppicing the trees to a stump allows them to regrow whilst improving slope stability. Laying felled trunks between stumps, and across slope, helps to act as a barrier, catching any material falling off the higher, more vertical rock faces.

An issue with ash trees is that they allow light through the canopy to the woodland floor, which does not help the battle against their saplings. Thicker woodland canopies, such as the sycamore trees on Castle Hill, help to subdue sapling growth. Ash dieback is still a serious threat on the Reserve, which in turn does not help the health of these trees. The danger is that when they die, they will topple and in locations such as this, will cause further slope instability.

Wren's Nest - White Rock clearance 4/2/2023

Our second visit to Wren's Nest NNR on Saturday 4 February, was to a new location at 'White Rock', on the Reserve's southern tip. We met the wardens at the usual time and place on a very overcast winter's day, and spent the day clearing ash saplings and scrub from the slopes to open up the outcrops and help create more limestone grassland. Larger trees were identified for removal by the wardens with heftier equipment later in the week. The overall aim was to create a woodland ride and make open areas more attractive to wildflowers and insects whilst providing better views of the rock outcrops. ►

The rock layers exposed reveal what are known as '*Cryptocrinus*' beds. These are flaggy, fine yellowish-brown limestone layers with thin grey bands containing shell, crinoid, coral and other fossil debris. These layers potentially represent debris washed off the patch reefs or carried in from elsewhere and deposited on the seabed during high energy events such as storms.

Sunday 6 November 2022: Saltwells NNR.

On a cold, breezy, grey day, BCGS members met the warden and Friends of Saltwells group at the new wardens' base and visitor centre, adjacent to the Saltwells Inn at 10.00.

Saltwells Tubline clearance 6/11/2023

The day was spent on the tubline between Highbridge Road and the Dudley No.2 canal where a mini excavator has recently been used to clear sections of in-filled slope to expose the rocks beneath. Spades and brushes were required to remove the remaining spoil and better expose the rocks. The spoil had been put there when the tubline was in use for disposing of waste soil and clay. Some members went up to Brewin's Cutting where there is an ongoing battle to keep vegetation from encroaching onto the exposures.

The new tubline exposures are revealing more information about the Downton Castle Sandstone at this location and its relationship with the intruding dolerite that can be seen up at Brewin's Cutting.

Saturday 10 December 2022 and Saturday 4 March 2023: Blue Rock Quarry, Portway Hill, Rowley.

Following on from our earlier summer field visit, these two work days marked a return for BCGS members to Blue Rock Quarry. The Birmingham and Black Country Wildlife Trust and local Friends of Rowley Hill are looking after the site. It is one of several land parcels that exist on Portway Hill and includes the only remaining dolerite exposures from the former Blue Rock Quarry. Together, the Wildlife Trust and the Friends Group have been working hard to keep hawthorn and brambles in check, to create open spaces for wildflowers and birds. This work has included forming a dead hedge to enclose parts of the dolerite exposures, and creating dedicated footpaths through the site.

Portway Hill - Blue Rock Quarry clearance 11/3/2023

On both days, under very cold conditions with variable snow cover, we spent time removing vegetation and spoil from a new part of the dolerite exposure included within the dead hedge enclosure. Within the newly exposed section are good examples of spheroidally weathered dolerite and columnar jointing located immediately adjacent to each other. The features illustrate different cooling rates and chemical variations within the magma when the molten rock was intruded. ►

Saturday 14 January 2023: Illey Valley Glacial Erratic Boulder

Illey Valley – Where's the Boulder?! 14/01/2023

This site is located near Illey, south of Halesowen within the Dudley MBC, and lies by a stream in a small wooded enclosure. It will be included in Glacial Boulder Trail 8, which is being established as part of the Birmingham Erratic Boulders project. Under guidance from Graham Worton and Julie Schroder, a small group of BCGS and Erratics Project volunteers attended the site on a cloudy and wet day to clear vegetation and soil to expose more of this largely submerged glacial erratic boulder. The boulder is formed from light grey volcanic rock which originated from North Wales and was deposited in this location before the last (Devensian) Ice Age, possibly as far back as the Anglian Ice Advance, around 450,000 years ago. Care had to be taken to prevent excavated soil from entering an adjacent stream, and no holes or depressions left that could injure livestock. It was not possible to fully excavate the boulder on this occasion. *(See also the Erratics Project report, p.13 and programme of events, p.2.)*

With the current conservation sessions at an end, we are now commencing the spring/summer field visits and hope to see more members on these. Meanwhile, I would like to thank all the wardens, friends groups and members for their time over the past few months and we look forward to commencing the new sessions in the autumn. ■

Andy Harrison

Torghatten - The Norwegian Mountain with a hole in the middle

Situated on the Island of Torget (latitude 65.464 longitude 12.198) the granite dome of Torghatten (elevation 258m) is remarkable for the natural hole which punctures through the centre of the massif.

The granite, thought to be some 470 million years old, forms part of the Trollfjell Unesco Global Geopark. The explanation given for this feature is that during the Ice Age in Scandinavia the dome was close to sea level and selective erosion of the sedimentary rocks into which the dome was intruded allowed the sea to erode this feature. Personally I prefer the Norse legend that the troll Hestmannen, disappointed in love, shot an arrow after the young girl Lekamøya, but it missed and formed the hole instead.

See also https://driftingapart.ccght.org Torghatten the land that rose up from the ocean - Drifting Apart (in English). ■

Mike Williams

Hebridean Gems: Raasay

Often overlooked by visitors to the far grander Isle of Skye (admittedly not without its own points of interest!), Raasay is a delightful place to spend a few days of exploration. It is an island of great contrasts; an island of 'thirds'; an island whose changes in character are so obviously underpinned by the geology, immediately apparent from even the most basic geological map *(Fig.1).*

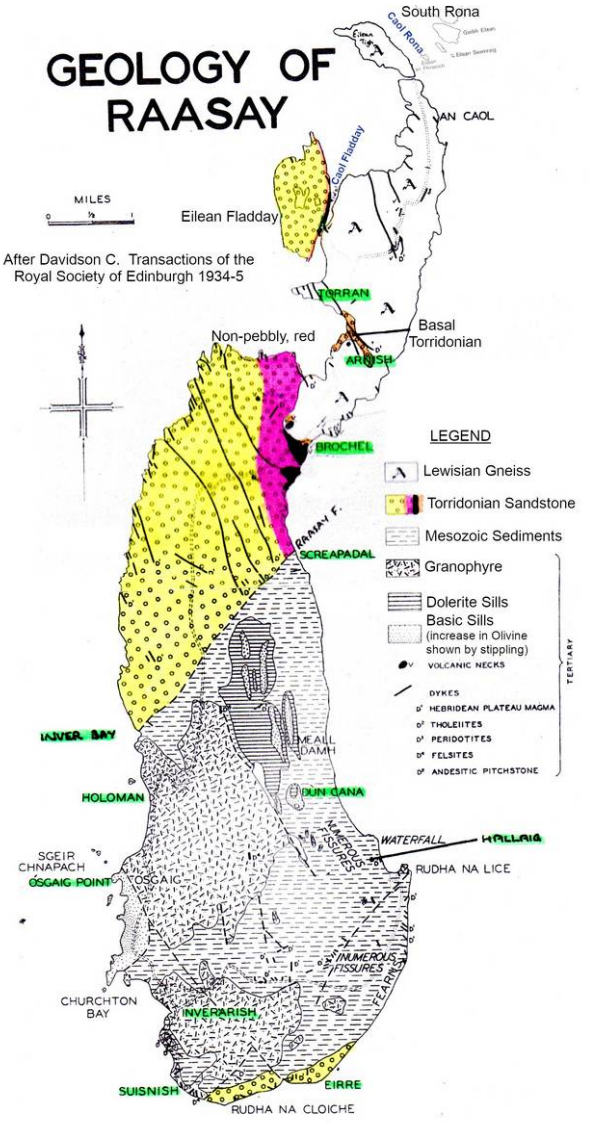


Fig.1

Raasay is most easily approached by the small vehicle ferry from Sconser on Skye, delivering you at Clachan pier near its only village, Inverarish. Most of the available facilities are found here, from whence roads take you off in three directions. A short southern route leads to the former point of arrival at Suisnish pier and then follows the coast round and beyond as far as the lighthouse at Eyre Point *(Eirre on the map, right).* An eastward route leads through woodland past the former ironstone mines and, via South and North Fearns, to the middle of nowhere, falling a kilometre short of the former clearance village of Hallaig.

Fig. 2 Raasay Raod Sign

According to a road sign, the main 'highway' north goes as far as the North Pole, *(Fig.2)* but in reality reaches Brochel and its celebrated ruined 16th century castle, before following Calum's Road as far as Arnish, some 3 kms beyond. This short extension to Raasay's original road network is entirely down to the determination and doggedness of a single former crofter obsessed with getting a road connection to his home, but whose pleas were persistently ignored by the authorities. He took matters into his own hands and spent 10 years carving out a rough but motorable highway *(Fig.3)* which he lived just long enough to see adopted, metalled and maintained (and, after his passing, commemorated): a tale that has become a legend in Scottish folklore. ►

Fig.3 Calum's Road (yes - pigs may indeed fly!!)

This, however, still leaves the northern third of the island, which is served by just two footpaths. Most of the much landslipped eastern side of the island *(Fig.4)*, from Brochel to Hallaig, is similarly only served by a single footpath. So much for the basic infrastructure of Raasay, which offers no public transport. This Hebridean gem is largely one for the cyclist or rambler.

Fig.4 Landslipped east coast looking north from Hallaig (Dun Caan summit features upper left)

I introduced Raasay as an island of 'thirds', controlled by the geology. The scenery and feel of the place becomes more intimidating the further north you travel. Arrival at Inverarish is within the 'homely' southern 'third' (actually nearer half in terms of area) that is underlain by Mesozoic sediments (largely Jurassic), and an assortment of Palaeogene intrusive sheet-like bodies.

Fig.5 View along east coast, north from Brochel (Torridonian foreground, Lewisian in distance)

The Raasay Fault transects the island from Inver Bay in the west to Screapadal in the east, the upthrow side of which carries you on to the central 'third' of the island, underpinned almost entirely by Torridonian beds dating to the Neoproterozoic. These also occupy the whole of the tidal island of Eilean Fladday, which you might be surprised to learn has a resident, if intermittent, population of up to 3 families. The scenery here is best described as subdued, but still with the warmth of a good soil and cover of grassy vegetation. An additional scrape of Torridonian also survives along the southern coast of the island.

Beyond Brochel the landscape is definitely one of more limited appeal; broad swathes of Lewisian gneiss with an intermittent cover of scrub and heather: 'a landscape worn down to its roots' as one description has it. A single small wooded valley between Arnish and Torran (both former crofting townships, still with permanent residents – though Calum MacLeod, of road fame, is no longer one of them), retains a covering of basal Torridonian lithologies now separated from the main crop *(Fig.5)*. Otherwise, all of this northern 'third' of the island is bleak, grey gneiss, with just the occasional excitement of a Palaeogene dyke to break the monotony.

So what, in more detail, is (geologically) worth investigating further? One can do no better than to start in the far south where, just above the road approaching Eyre Point lighthouse, outcrops reveal the unconformable relationship between two 'red beds'. In one location the lithologies exist in sharp contrast *(Fig.6)*. Here, coarse Triassic conglomerates overlie fluvial arkosic Torridonian sandstones (immature: rapid deposition in a cold or arid environment, as suggested by the high feldspar content). ►

Fig.6 Unconformity near Eyre lighthouse (grey Triassic conglomerate over red Torridonian sandstone)

East of Inverarish there are two sites of much historical interest. Emerging from Raasay Forest there are tracks around the site of the former ironstone mines, with many signs of original infrastructure still visible. The most impressive is the old incline railway that delivered ore to the pier at Suisnish for onward transport. The mines themselves are, unsurprisingly, unsafe, having operated from 1912 to 1942 for the extraction of Lower Jurassic (Upper Lias) sedimentary ironstone of borderline grade at around 23% iron content. The lime content rendered it more attractive for blending, and of course was helped by the need for steel during both world wars when the economics was not the uppermost of considerations.

Fig.7 East coast landslips (Jurassic sedimentaries in distance, left) overlain by Palaeogene sills (stepped near-ground) culminating in Dun Caan summit

Beyond the road head, a walk of 2-3 kilometres brings you to the 1852 clearance village of Hallaig which lies at the foot of an extensive area of landslip beneath Dun Caan. This is a confusing jumble of fissured Jurassic strata amongst which it is possible to find small outcrops suitable for the fossil hunter. Remains of the ancient habitations and their associated lazy beds are additional obstacles to negotiate. The headland of Rubha na' Leac offers a fine exposure of the underlying Triassic alluvial sandstones and conglomerates, invaded later by Palaeogene minor intrusions.

The highest ground was once attributed to a capping of Palaeogene basaltic plateau lavas but these have since been re-described as a complex of gabbroic and doleritic sills, culminating in the volcano-like peak of Dun Caan, the finest belvedere on the island *(Fig.7)*, which so moved Dr. Johnson as to perform a jig on its summit during his famous tour of the Highlands. Interestingly, fragments of Chalk have been found beneath some of these sills, suggesting a possible one-time Chalk cover, eroded away before the onset of igneous activity in the Palaeocene.

Returning to the 'road to the North Pole', the first few kilometres traverse the outcrop of the sheet-like intrusion of granophyre. 'Convenient' exposures seem thin on the ground except along the coast, and further north at Holoman Island (actually a tidal headland). Oskaig Point exposes a sill composed of an unusual rock called picrite, a variety of microgabbro consisting almost entirely of olivine and augite, and is part of the much wider 'Little Minch Sill Complex'.

A small stream delivers into Inver Bay, and where this crosses the road near Brae, a marked hollow occurs more or less coincident with the junction of the granophyre and Jurassic sediments. These then underlie the road for a few hundred metres before crossing the Raasay Fault (with no apparent topographic expression) and passing on to Torridonian sediments that extend all the way to Brochel. ►

Fig.8 Torridonian boulder bed incorporating pinkish boulders of Lewisian gneiss

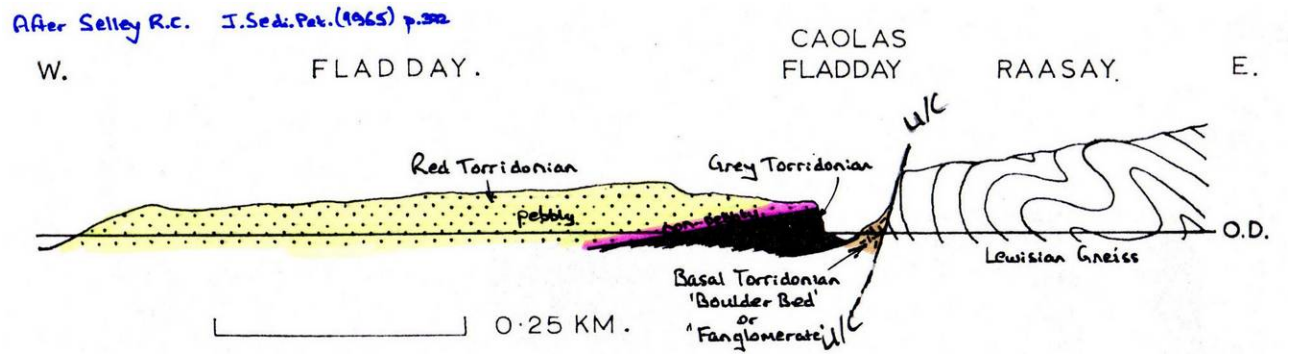


Fig.9 Schematic diagram of 'cliff collapse' interpretation of the Torridonian boulder beds ('fanglomerates')

Scattered outcrops and a few small excavations reveal three distinct facies within these ancient 'red beds' (pebbly, non-pebbly and grey fluvial sandstones) but perhaps the most interesting facies is the basal one seen in the Arnish valley and better still on the east side of Caol Fladday. The more usual interbedded grits and breccias give way to a boulder bed with little sign of bedding in which clasts of Lewisian gneiss of all sizes predominate *(Fig.8)*. These have been interpreted as a fanglomerate, a sub-aerial collapse of a contemporary cliff of gneiss, resulting in a steeply unconformable relationship *(Fig.9).*

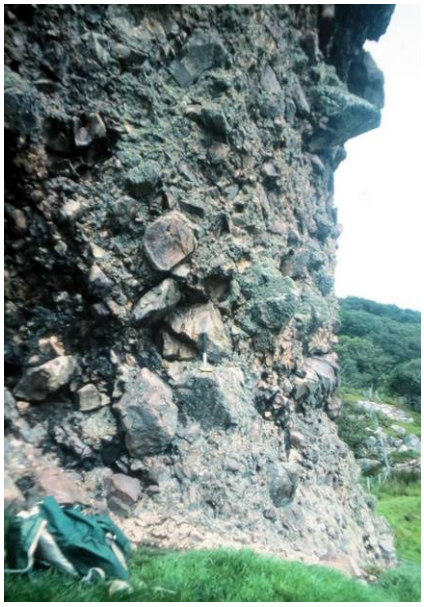


Fig.10 Brochel Castle outcrop

Further small patches of this basal facies occur near Brochel. The imposing castle itself, now in ruins, is perched upon a small outcrop of breccia once described as a vent agglomerate, but re-interpreted as a 'collapse infill' of some kind, as volcanic rocks are conspicuous by their absence! *(Fig. 10)*. Four further, smaller, patches of similar brecciated material line up along a NNW trend and seem exclusively to consist of clasts of Torridonian rock. Their origin is something of a mystery, but some kind of collapse structure seems to be favoured. Some accounts regard them as Triassic in age, others imply a contemporaneous Torridonian origin.

Beyond Arnish the gently undulating landscape is a sea of ancient, high-grade Lewisian gneiss. These are mostly felsic in nature, but the Scourian event (c.2,400 Ma) produced segregations of mafic and ultramafic gneiss, all of which was further deformed in the Laxfordian event (c.1,700 Ma), roughly the age of the oldest gneisses in this area. Foliation and banding are well developed, generally quite steeply dipping, and follows a NW-SE trend.

From the bothy in the far north of the island, the view across Caol Rona paints a bleak picture of still more grey gneiss *(Fig.11)* and it is hard to believe that South Rona, on the far shore, once supported a substantial population until effective abandonment in 1942 (since intermittently occupied only by lighthouse keepers and managers on behalf of the Danish owner): but those were different times. ►

Fig.11 View north across Caol Rona - a drab view of Lewisian territory

Tiny North Rona, incidentally, is an even more godforsaken and isolated island of gneiss, way out to sea, north of the Butt of Lewis. I can't recommend it, even for the geology! ■

Mike Allen

Acknowledgements:

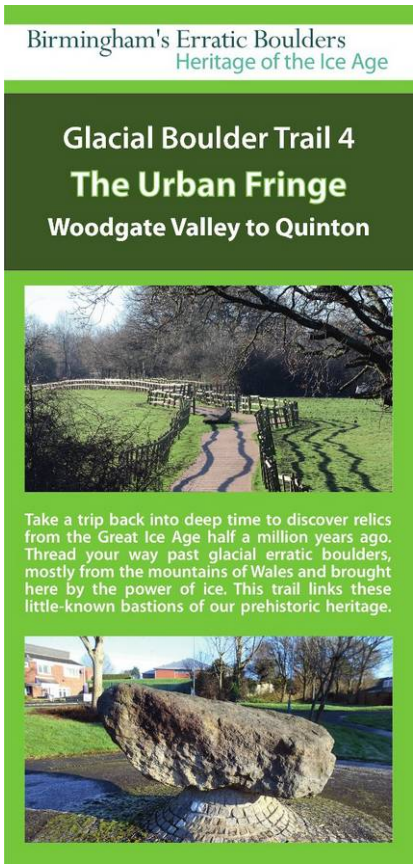
Fig. 1: map based on Davidson, C. 'Transactions of the Royal Society of Edinburgh' vol.58 (1934-5) Plate III.
Fig. 9: section based on Selley, R.C. 'Journal of Sedimentary Petrology' vol.35 (1965) p.372.

Birmingham's Erratic Boulders: Heritage of the Ice Age

Birmingham's Erratic link with Dudley MBC

Not only is BCGS one of the Birmingham Erratic project's partners, but there is a further connection in that one of the largest of all the project boulders lies within the territory of Dudley MBC. It is destined for inclusion in Trail 8, the 'Illey Wilderness Trail'. With only a small portion of it peeping above ground, the project team members were eager to gain permission to clear and reveal it in its full glory. The landowner was agreeable, but it lay within Illey Meadows SSSI - a seemingly insuperable obstacle. At this point the Dudley connection saved the day. Our Chairman, Graham Worton, came to the rescue, and It wasn't long before permissions were in place and the work was carried out by Erratics Project and BCGS volunteers on a cold, wet, muddy day in January, under Graham's watchful eye.

The Illey Valley team, the erratic, and lots of mud!



The boulder's close proximity to the bank of a stream put a stop to the excavation, but enough was uncovered to reveal most of its roughly three square metre surface area, leaving us guessing as to its full depth. It is one of the suite of Arenig ash boulders which form the majority of the erratics included in the project trails. Its rather remote location and great size suggest that it has not been moved far, if at all, by the hand of man. This was a new geological 'find' for Graham, and a star candidate for Trail 8, which will be launched in August. BCGS members can join our field trip on 22 July for a pre-launch exploration of the trail *(see the programme of events, p.3).*

Trail leaflets continue to dominate our work, and we now have five 'in the bag'. Following the launch of Trail 7 last September, the next job was a revision of Trail 1. Stocks were running low, and this gave us an opportunity to revise and produce a 2nd edition to include new finds and information from our ever-growing team of 'Rockhounds'. ►

Hot off the press is Trail 4: 'The Urban Fringe – Woodgate Valley to Quinton'. This is now available in print and on the project website. It will be formally 'launched' later in the summer. The team is now busy piecing together Trail 5, which has evolved into a hybrid cycling and walking trail around Calcot, Romsley and Frankley Hills. This will be launched towards the end of June. Trail 6 will be a cycling trail as originally planned, but will now focus on the Bromsgrove area, including some exciting new finds around Tardebigge.

Over the last few months there have been Project Team and volunteer training days for First Aid, Accessibility, and producing Information Boards. Work is underway to prepare and install five boards at strategic sites within the trail routes. Team leaders have given talks, and there are plans for various events through the next few months. There are still plenty of opportunities for you to volunteer and get involved!

Follow the links below to keep up to date. We still need more volunteers to help with improving trail routes, researching the history and social context of the boulders on our trails, helping at events, and with testing and proof reading the trails. ■

Julie Schroder (BCGS rep. Erratics Project steering group)

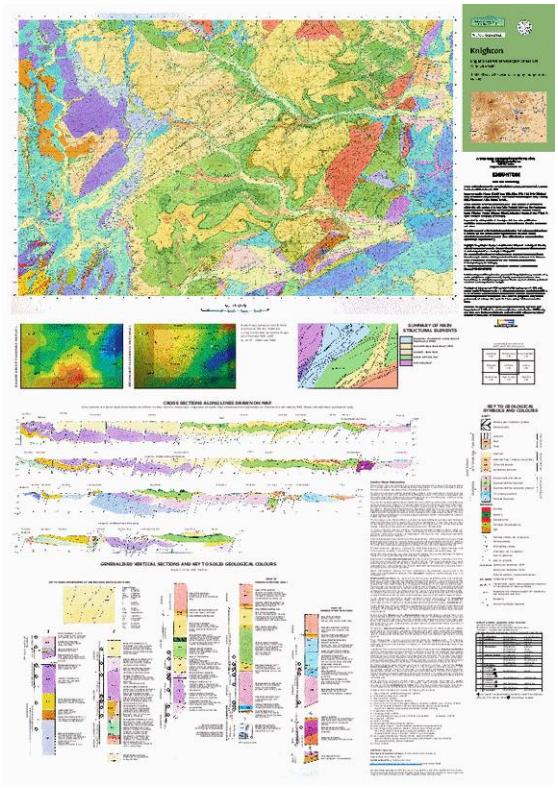
For more information:
https://erraticsproject.org/
https://www.facebook.com/birminghamerratics
https://www.twitter.com/erraticsproject
https://www.instagram.com/erraticsproject

Where is this?

Peter Parkes has found these old photos among his collection without any labels. He thinks that they were taken at a BCGS field meeting around the end of the 1970s. Can anyone help identify the quarry or date? *(See also front cover photo.)* ■

The Knighton Geological Sheet

The geological map for Knighton, sheet 180 of the BGS 1:50 000 series, has been surveyed, mapped and published as a limited edition 'provisional map', by an independent amateur survey between 2015 – 2020. There were eight surveyors who were members of the Teme Valley Geological Society, with some assistance from The Woolhope Club, Malvern U3A and many other associates as needed. Up to 40 people participated in field work overall.



The circumstances of the survey were first reported to the Geologists' Association in the Magazine of the GA March 2016, with a follow up report in December 2019, and also in Earth Heritage, issue 49 spring 2018.

Now with the assistance of the Curry Fund a limited edition of 100 maps has been printed. Forty of the maps have been made available to specific researchers, the surveyors, and the Libraries of BGS, The Geological Society of London, the Geologists' Association and six local geological societies, along with relevant museums. The rest of the maps will be used for education and supporting the work of the Herefordshire and Worcestershire Earth Heritage Trust who are managing the distribution.

It is hoped that this map will inspire further research and interest in the area. Some collaborative research has already followed on (Ray et al 2021), and we should anticipate more to come.

The folded A0 map sheet contains the geological map, sections and columns, along with a concise explanation, plus a structural interpretation and geophysical maps *(see image).* Of course, as soon as any map is published this forces out erstwhile unrecorded information and observations. Hence we shall maintain watch and continue to record new data, corrections and revisions of interpretation as needed.

Having completed the survey and cartography we have now moved on to work on the sheet explanation, based upon the abundant amount of data and observations that our surveyors and associates have made. New work will provide a stimulus to new ideas, along with a reinterpretation of the wide variety of published and unpublished sources.

The objective of this survey was to fill the gap left in the BGS mapping program in 2013, and to provide a basis for further research. We started from a clean sheet to test the state of existing knowledge, and hence we have not been bound by convention. Thus we provide a view of the geology which mostly confirms previous work, but challenges other aspects. So, it is now up to others to either prove our interpretation wrong, refine or reinterpret these observations. Such is the process of science.

In brief, much of the area has a Neoproterozoic basement, and integrates the geological sequences of the Welsh Basin with those of the Wenlock to Ludlovian Shelf successions. The area illustrates the ►

evolution of clastic facies on a slope and apron from Ordovician to Silurian, during an era of local and eustatic sea level variation accompanied by environmental change due in part to plate tectonics. ■

Teme Valley Geological Society, Herefordshire and Worcestershire Earth Heritage Trust

For details of how to purchase a copy of the Knighton Geological Map priced at £15.00 plus p&p, please email the Herefordshire and Worcestershire Earth Heritage Trust who are managing the distribution of the maps as follows: eht@worc.ac.uk or call the office on tel. 01905 855184.

Reference:

Ray D.C., Jarochowska E., Hughes H.E., Claussen A.L., Tingley A.C., Moseley J. and Bremer O. 2021
The Silurian Transgression of a Palaeoshoreline: The Area between Old Radnor and Presteigne, Welsh Borderlands
GeoScienceWorld: Lithosphere Volume 2021, Article ID 7866176, 24 pages:
https://doi.org/10.2113/2021/7866176

Mike's Musings No. 44

Some thoughts on Pebble Shape - Part 1

Whilst composing my last item on sedimentary rocks I revisited some notes I had accumulated over the years on the subject of pebble shape. This might not sound like a particularly productive line of enquiry, but, as in so many cases, a little further consideration reveals some interesting avenues of investigation.

Pebbles, to a geologist, are rock fragments, generally smoothed and rounded, within a certain size range that have been eroded from a larger rock mass, but for the purposes of the rest of this article we won't be too precise about the size factor. One size-independent definition of a 'pebble' is *'a rounded body with a near-gaussian distribution of curvatures'.* A gaussian, or normal, distribution is one in which the probability distribution is symmetrical about the mean and where the frequency increases towards the mean. This results in a 'bell-shaped' distribution curve that will probably be more familiar than the written description! *(Fig.1).*

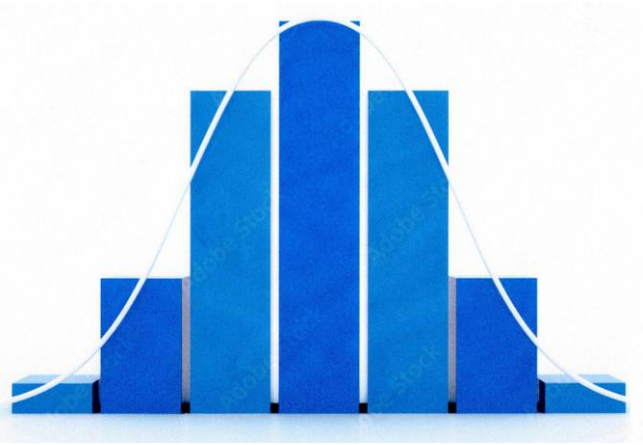


Fig.1 The 'Gaussian', or Normal, Distribution Curve

Aristotle proposed that the 'generally rounded shape' of a pebble arose from the points furthest from the centre of the original fragment eroding most rapidly. This intuitively suggests that the shape of a pebble will tend towards a perfect sphere as it is worn down by erosion.

We shall see whether this really is the case as we investigate further, but to begin with, what do we really mean by the 'shape' of a pebble? An intuitive approach is to begin with the 'most perfect', or simplest, starting point - the sphere (since we are considering things in three dimensions) - and in some way measure the extent to which a pebble deviates from this 'perfect' condition. But how do we best measure this? The academic world seems to favour four main metrics that are commonly described in the scientific literature: ►

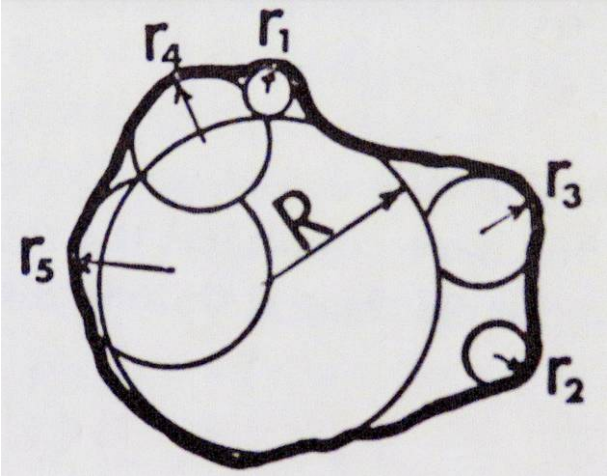


Fig.2 Wadell's measurement of Roundness - recording various radii of a sand grain!

Roundness is a difficult concept to manage rigorously. An early attempt by Wentworth[1] was taken further by Wadell to quantify roundness of sand grains rather than larger pebbles. He determined a measure of the average radius of the corners and edges of a grain and compared this with the radius of the largest circle it was possible to inscribe within the projected shape of the grain *(Fig.2).* This provides a single measurement per grain in the form of a ratio, i.e. in the range 0 (perfectly angular) to 1 (perfectly rounded). Most grains fell within the range of 0.3 to 0.9.

This was clearly quite complicated to do in practice. Krumbein sought to simplify this by producing a visual comparison chart for pebbles in the 16-32mm range, showing silhouettes for pebbles with roundness indices of 0.1 through to 0.9 *(Fig.3).* This can at least be used in the field for drawing comparisons much in the same way that the 'grain size comparator' is useful for estimating grain size *(see figure 5 in my last Musing, Newsletter 277, p.21)*.

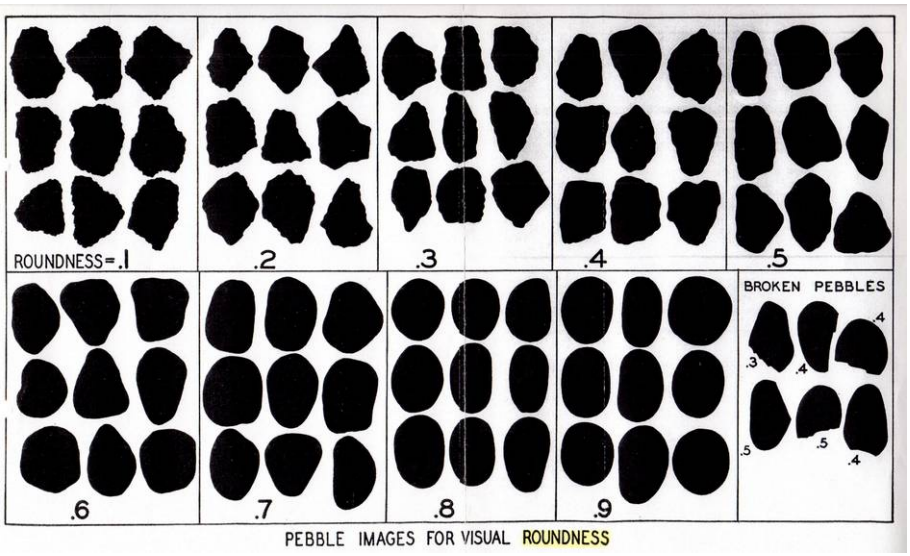


Fig.3 Krumbein's visual Roundness chart for 16-32mm pebbles

Pettijohn simplified matters further by suggesting five classes of roundness based on Krumbien's indices: angular, subangular, subrounded, rounded and well rounded *(Fig.4)*, to which other authors have added 'very angular' and/or 'extremely well rounded' classes just to confuse!

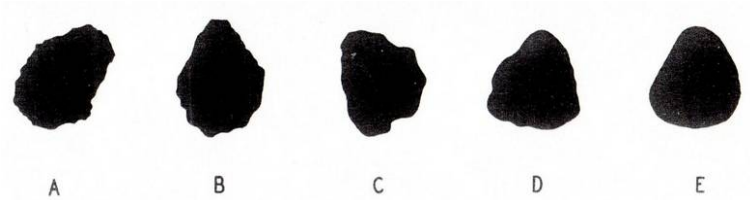


Fig.4 Pettijohn's Roundness Classes - A: angular, B: subangular, C: sub-rounded, D: rounded, E: well rounded

A slightly different approach was introduced by Sames who used 2-D projections from which to determine the percentage of the total circumference of the projection that is convex in shape. This is again a measure of the sharpness of the edges and corners of a pebble. This also suffers from being fairly complicated as well as involving a degree of individual judgement *(Fig.5).* ►

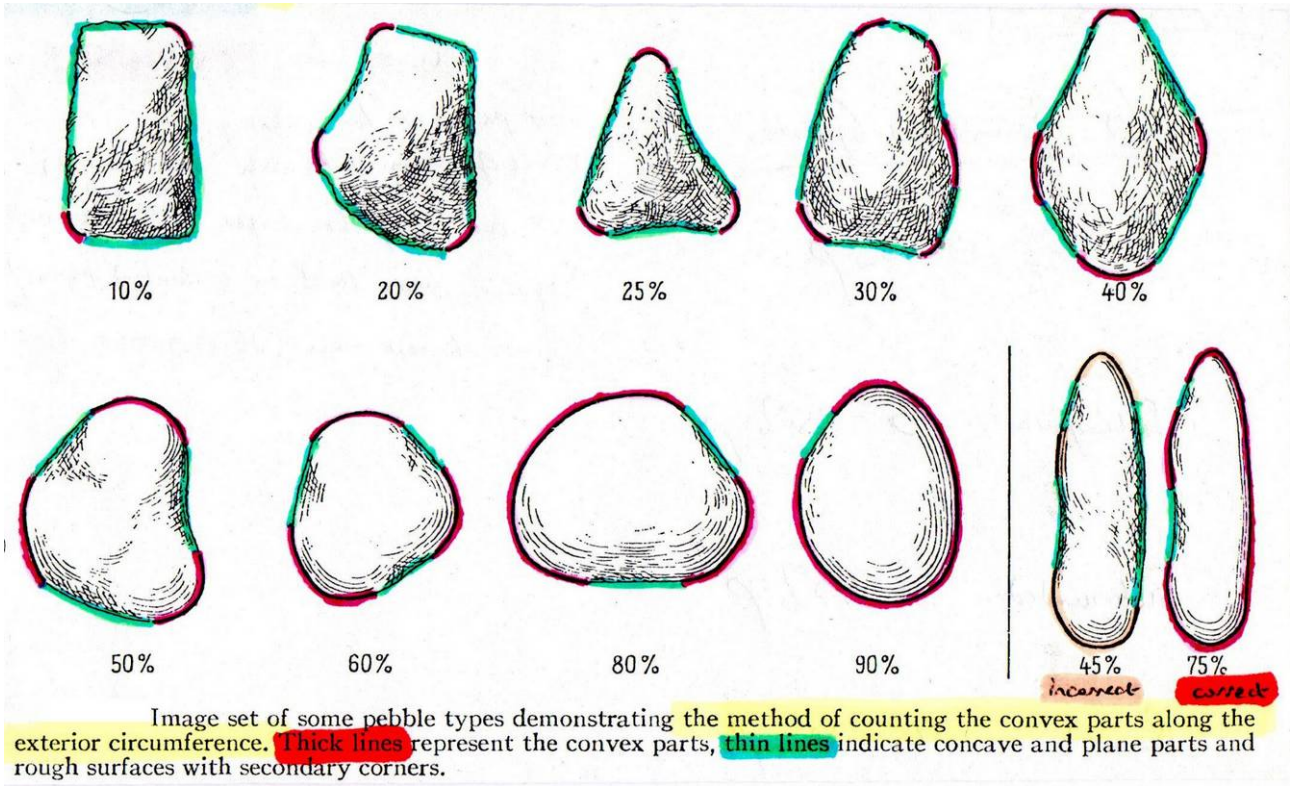


Image set of some pebble types demonstrating the method of counting the convex parts along the exterior circumference. Thick lines represent the convex parts, thin lines indicate concave and plane parts and rough surfaces with secondary corners.

Fig.5 Sames' (rather subjective?) method of evaluating Roundness by 'percentage of convexity' of a pebble

This whole concept has the obvious weakness of introducing a bias in the way the 2-D 'shape' is selected, unless one is more rigorous and an average of three projections along the three dimensional axes of the pebble are taken, making things even more complicated and time consuming!

Sphericity fundamentally relates the surface area and volume of a pebble, which gives a measure of how close the pebble shape is to a sphere. However, the surface area is difficult to measure, so Krumbein proposed a method which compares the volume of a pebble with the volume of the smallest possible circumscribing sphere. This again isn't the simplest of things to envisage or compute, but at least adopts a three dimensional approach to the matter. It also provides a measure in the form of a ratio, such that a perfect sphere has a value of 1.0 whilst any value less than 1.0 marks the degree of deviation from a sphere.

An alternative measure known as the 'Riley Projection Sphericity' has been described as the ratio of the diameter of the largest possible inscribed circle (di) to the diameter of the smallest possible circumscribed circle (Dc) drawn on a 2-D projection of a pebble *(Fig.6).* ►

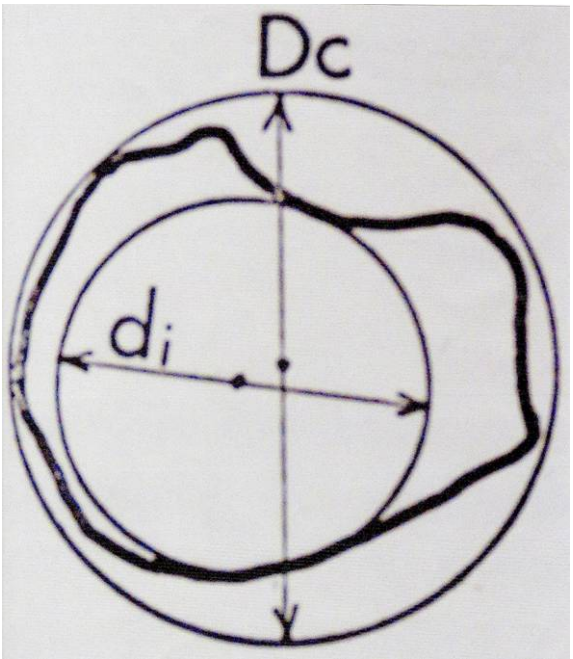


Fig.6 Riley's Projection Sphericity - the ratio of 'di' to 'Dc'

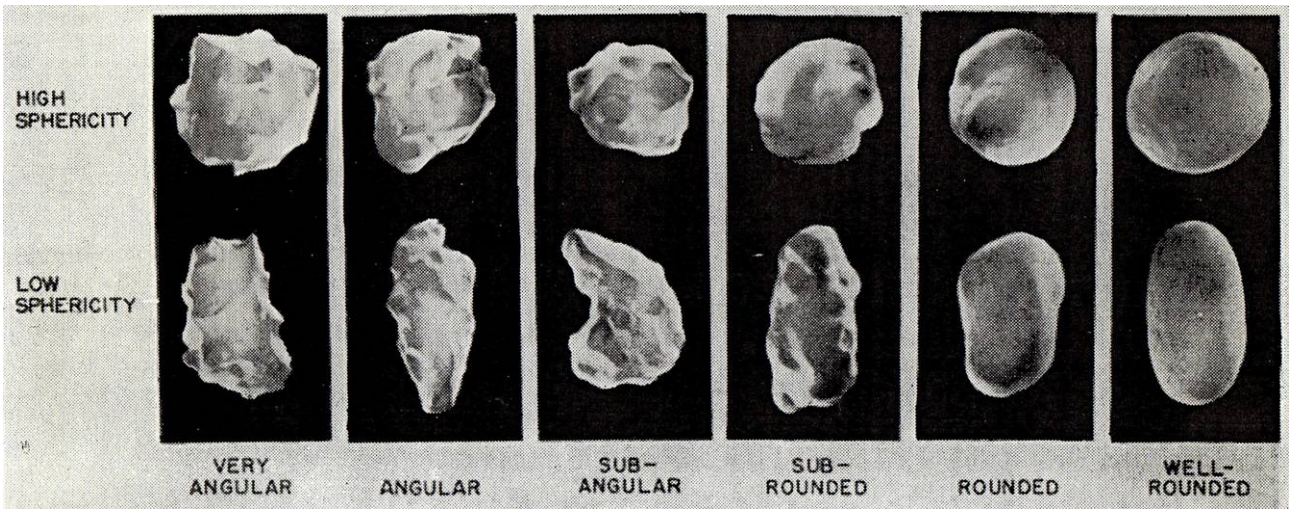


Fig.7 Powers' Visual Comparison Chart for Sphericity and Roundness combined (note his addition of 'very angular' to the Roundness classes)

Various illustrations have been constructed to depict roundness and sphericity variations on a single diagram. Powers produced a visual comparison chart for two series of pebbles, comparing the roundness classes of pebbles with those of either high or low sphericity *(Fig.7).* He further speculated that these metrics were influenced by both the tectonic and transport histories of the pebbles; notions to which I shall return in part 2. Krumbein and Sloss produced an alternative, arguably clearer, way of displaying this relationship, as shown in figure 8. Roundness and sphericity are respectively plotted along x and y axes with representative pebbles shown in outline.

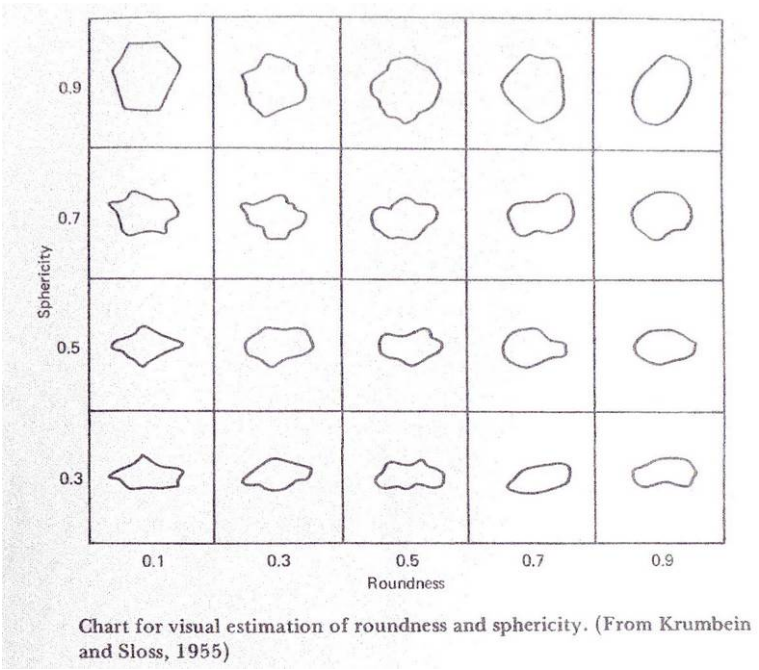


Fig.8 Krumbein & Sloss' improved (?) chart for estimating Sphericity and Roundness

Two further metrics that I am inclined to favour as being easier to measure and more practical to apply are **Elongation** and **Flatness**. Any three-dimensional object can be described in terms of three measurements perpendicular to each other: up/down, back/front and left/right. These are usually referred to as the long, intermediate and short axes (conventionally designated the a/b/c or x/y/z axes). The longest and shortest dimensions are generally fairly easy to visualise, whilst the intermediate dimension requires greater judgement, particularly with more irregular shapes. To overcome this problem it is best to use a statistical approach by measuring several pebbles in any particular study.

Elongation is then simply defined as the ratio of the intermediate to longest dimension (b/a or y/x).

Flatness is similarly defined as the ratio of the shortest to the intermediate dimension (c/b or z/y). ►

These two metrics appear to have been combined into a single cross-plot by Zingg. This plots the ratio b/a (elongation) against the ratio c/b (flatness), conveniently relating all three dimensions to each other in just two dimensions. Four fields are conventionally recognised on such a diagram *(Fig. 9).* These can be described in geometric terms (equant, triaxial, oblate and prolate spheroids), or in more vernacular language (spheroids, blades, discs or rods) or more informally still as meatballs, ryvitas, pancakes or sausages for the less scientifically minded!

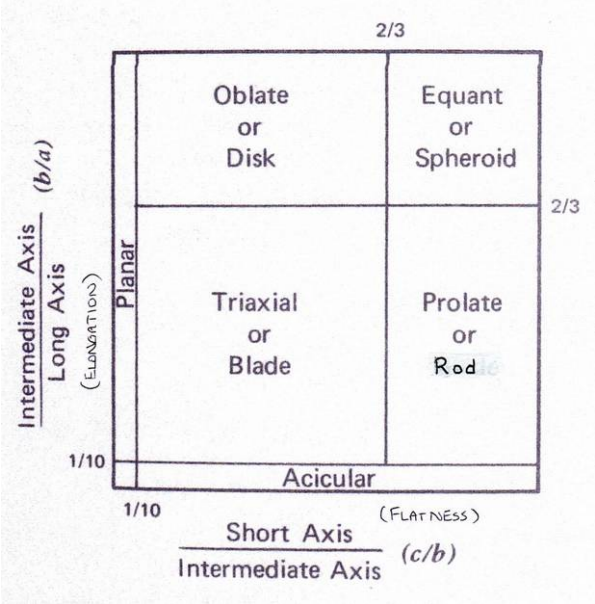


Fig.9 The basic 'Zingg Plot' diagram charting 'Elongation' against 'Flatness'

So much for the rather tedious 'definitions of shape', but it has been necessary to establish some sort of a scientific framework on which to compare pebble shapes before discussing why differences arise. Shape analysis, as we shall see, can provide useful information about the history of any deposit in which pebbles form a major, if not complete, component.

As already mentioned, such an approach has also been applied to smaller sedimentary particles. A well known fact is that sand grains in desert environments, subject to much wind transport and erosion, are often very well rounded ('millet-seed' sands) in contrast to more angular sand grains deposited in other environments. This example begs the question of what factors are likely to influence pebble shape.

Some primary properties which should be considered include the size and shape of the initial rock fragment as it becomes detached from its outcrop. The presence, or absence, of natural structures (e.g. bedding, faults, joints, folds and cleavages) in the parent outcrop come to bear in respect of initial shape, but structures within the fragment itself will play a part in how it behaves thereafter. Another obvious factor will be what it is made of - its mineralogy, lithology or even crystallography. Substances that are most persistent may be recycled many times over through geological time, and are generally those which are hardest, strongest or most resistant to the physical forces that accompany erosion, transportation and deposition. Often such substances are also the most chemically inert and/or ones with least internal variability. In geological contexts, most rocks are composed of silicate minerals, and the simplest silicate, quartz, often forms much or all of the rock. Secondary properties, which themselves are partly determined by these primary factors, include colour, density, porosity, permeability and thermal properties. ■

In the second part we shall look at some particular studies and discussions. The literature on pebble shape is already extensive and continues to grow at some rate! Whilst we are principally concerned with sedimentary rocks, an example from the metamorphic world shows how far the subject can be extended.

Mike Allen

1. As numerous sources have been used in the compilation of this article, I have not provided any further references than the names in the text. All references are acknowledged, and full details can be provided on request.