PEACE AND WAR

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At the end of July, I had a very special holiday, with some of my family, in Orkney, the cluster of small, wind-swept islands (Fig. 1) that stand bravely between the Atlantic and the North Sea off the extreme north-east corner of Scotland. I had always wanted to visit Orkney because my great-grandmother, Isabella Allan, was born on the tiny island of Stronsay in 1843. By any standards, these islands have an extraordinary human history, stretching from Neolithic times, some 5,000 years ago to the two great wars of the 20th century.

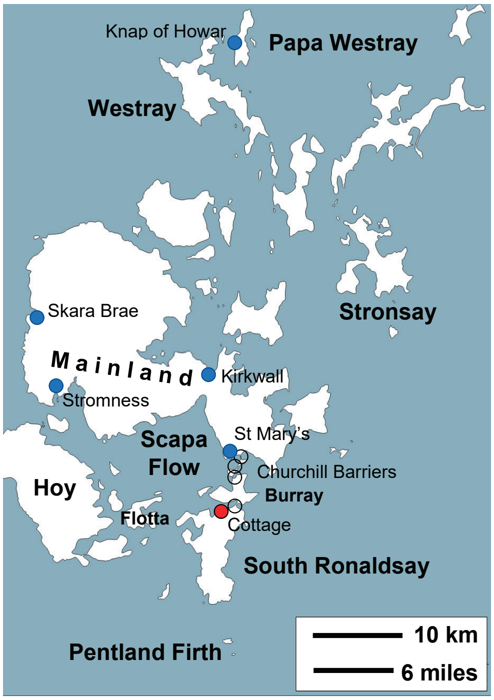

Figure 1 Map of Orkney showing places mentioned in the text. The north coast of Scotland is just below the lower edge.

Orkney is made up of about 70 islands (depending on what size of islet you count as an island). Three of the largest, Mainland, Hoy and South Ronaldsay, enclose a large protected anchorage, Scapa Flow (Fig. 2), which played a pivotal role in both world wars. Sixteen are inhabited by a total population of 21,500. Because of the frequent high winds, there are hardly any trees, but much of the land is gently rolling hills and lush grass, dotted with sturdy stone farmhouses, with large numbers of cattle and sheep. There are many wind turbines, some of them enormous, though smaller ones provide near-continuous low-cost, green power for individual farms. One island, Flotta, is a terminal for oil from the North Sea.

Surveys of social attitudes have shown that the inhabitants of Orkney are the happiest people in Britain. Any preconception one might have of Orcadians clinging to life on the feather-edge of Europe is manifestly wrong. A high-speed catamaran (Fig. 2) whisks you across the Pentland Firth, the stretch of water between mainland Scotland and Orkney, much feared by mariners in the days of sail because of its powerful currents and contrary winds. Roll-on–roll-off ferries scurry between the islands, on time, manned by competent and cheerful crews, efficient but informal. There are flights to several mainland destinations from the capital Kirkwall, and the six most northerly islands are linked by regular services using short-take-off Islander aircraft. The flight from the island of Westray to its smaller neighbour, Papa Westray, is the shortest scheduled flight in the world, taking nearly 2 minutes!

Figure 2 Scapa Flow as seen from our holiday cottage, taken at about 10 p.m. The hills on the left are on the island of Hoy.

On Papa Westray, at a place called Knap of Howar, there are two stone-built houses, with curved ends and low doors but without roofs, partly buried in wind-blown sand. They are Neolithic, probably a farmstead. Radiocarbon dating shows that they were occupied from 5,700 to 4,800 BP, the oldest North European dwellings still standing and pre-dating the Egyptian Pyramids. Neolithic buildings and stone circles abound in Orkney. The most famous buildings are at Skara Brae (Fig. 3), on the western edge of Mainland. It is part of a UNESCO World Heritage Site and Europe's most complete Neolithic village. Skara Brae was occupied from 5,180 to 4,500 BP and came to light in 1850, when a violent storm, which caused more than 200 deaths in Scotland, stripped away soil and sand dunes revealing a village of eight houses.

Figure 3 A 5,000-year-old home at Skara Brae. On the left, facing the low entrance, is a dresser, where prized objects were perhaps displayed. The central square is a hearth, flanked on either side by box beds. Small tanks set in the floor were for preparing fish bait.

The islands of Orkney are built almost entirely of Middle and Upper Devonian sandstones and mudstones (the 'Old Red Sandstone'), formed by the erosion of the Appalachian–Caledonian orogen when Britain was on the edge of Laurussia, a few hundred kilometres north-east of Newfoundland. Today, many parts of the islands end abruptly in steep cliffs (Fig. 4). The pronounced bedding and jointing of the mudstones would have provided ideal building stones for Neolithic builders,

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FIGURE 4 Devonian mudstone cliffs at Yesnaby, 3 km from Skara Brae. The naturally broken slabs would have been ideal for building the dwellings. The gentle folding is Acadian (Middle Devonian) in age.

requiring minimal dressing. The Devonian of Orkney is celebrated for its fossil fish and, on the island of Burray, there is a marvellous museum, run by the local community, with exhibits of exquisite fish fossils, as well as rocks and minerals and an excellent illustrated account of geological principles and plate tectonics.

From the 9th to the 15th centuries, Orkney was ruled by Norway, and had its own language, Norn, which is similar to Faroese. Its present-day flag, which you see often, is identical to the flag of Norway, except the white is replaced by yellow; Scandinavian readers will feel comfortable with names like 'Kirkwall' and 'Stromness', the largest towns. When the referendum was held in 2014 to decide whether Scotland should remain part of the United Kingdom, Orcadians voted most strongly of all the voting constituencies to remain. Wise, as well as happy, these people!

But Orkney has a tragic side. Because of its position, it had a critical role in both World Wars, for both maritime and airborne action[2]. Scapa Flow (Fig. 2) provided a protected anchorage that became the main base for the British Home Fleet, joined later, in both wars, by ships from the United States. Gun emplacements and lookout towers still dot the countryside. During the First World War, 100,000 military personnel were based in Orkney; 60,000 in the Second World War. Twice in world history that calm, peaceful view from our holiday cottage (Fig. 2) would have taken in great fleets of warships. From here, in May 1916, the British Grand Fleet set out to engage the German High Seas Fleet in what the British call the Battle of Jutland and Germans call the Battle of the Skaggerak. Losses, of both ships and men, were worse for the British, but the admirals of both fleets learned the futility of trials of fire-power between great battleships.

After the Armistice in November 1918, 74 ships of the German High Seas Fleet would have been visible on the far side of the Flow (Fig. 2). They were escorted there while Germany and the Allies haggled about what should be done with them. The German crews were repatriated, leaving caretaker crews aboard, unable to go ashore. There was some illicit trading with Orkney fishermen, but otherwise these men had a miserable time. The commander of the German fleet, who was relying on four-day-old copies of the London *Times* for news about what was going on, was determined that his ships should not fall into the wrong hands. On Midsummer Day, 1919, he gave the order that the fleet should be scuttled. Fifty-two fighting ships were sunk, the rest were beached.

2 Information about Orkney's wartime history was taken from *Scapa: Britain's Famous Wartime Naval Base*, by James Miller, published in 2001 by Birlinn, Edinburgh.

The superstructures of some of the larger ships were visible above the water and others were near enough to the surface to be a danger to shipping. That Scapa Flow was returned to its present state was largely due to the entrepreneurial daring and engineering skill of one Ernest Cox, from the English Midlands, who bought the wrecks from the Admiralty with the intention of raising as many as possible. Starting in 1924, he and his team (many of them Orcadians) set-to with gusto, raising ten of the smaller destroyers in a few months. Cox then turned his attention to the biggest battle-cruiser in the fleet, the *Hindenburg*. Raising a ship of this size had never been attempted before, and Cox introduced new techniques that have been widely applied subsequently. The smaller ships had been raised using a floating dock but this was not feasible for the mighty *Hindenburg*. Cox decided to pump the water from the hull to make it buoyant, but this required sealing any holes with heavy steel plates, a feat performed by divers working in the dark and being bothered by whales that played around the ship. In 1930, they succeeded in raising her. Until very recently, this was the largest ship ever salvaged.

The Second World War, at sea, was dominated by the submarine. The British Home Fleet, including six battleships and an aircraft carrier, were sent to Scapa Flow in August 1939, prior to the outbreak of hostilities on the 3rd of September. The main, south-western approaches to the Flow were well defended, but less attention had been paid to the narrow points of entry between the small islands to the East (Fig 1). The navy was relying on 'blockships' sunk beneath the channels to prevent the entry of enemy submarines. However, at midnight on the 13th of October, in an extremely daring raid, the German submarine U-47 was able to slip into the Flow through Kirk Sound near the village of St Mary's (Fig. 5), her captain recording in his log that the Northern Lights were providing an eerie glow from the sky. Loose inside the Flow, U-47 torpedoed the battleship *Royal Oak*, which sank in 8 minutes with the loss of 834 lives.

FIGURE 5 Kirk Sound and the village of St Mary's, viewed across Churchill Barrier No. 1.

In response, Winston Churchill ordered the construction of four barriers, made of enormous concrete blocks (Fig. 5), between a chain of five islands (Fig. 1). They are still known as 'Churchill Barriers' but now support a busy main road, used by thousands of tourists, that links a ferry terminal near our cottage to Kirkwall. They carry official signs bearing the words 'Drivers cross at their own risk', a reminder that the weather in Orkney can be very, very wild.

I found my Orkney holiday a moving experience. An immensely long human history, great-grandmother Isabella's birthplace on the tiny island of Stronsay, beautiful, agreeable and peaceful today, but scarred forever by two terrible wars.

PROPER TERMINOLOGY IN ANALYTICAL GEOCHEMISTRY

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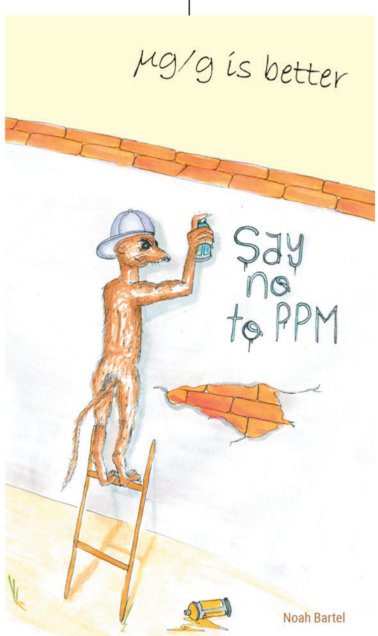
Success in science has basically two components: (1) what one might call the “research component,” involving the testing of a hypothesis or the acquisition of a unique data set that provides insight into the workings of nature; (2) the “communications component”, which involves the dissemination and archiving of the knowledge that has been won. For me, the importance of this second, communications, aspect within the scientific process seems all too often underappreciated. Problems that many of us have certainly encountered in the geochemical literature range from incomplete descriptions of an analytical method, to the use of ambiguous jargon, to authors simply using the wrong terminology, etc. A case in point is a manuscript that I recently had the pleasure to review. I will refer to its authors as “Smith and Jones”, who were reporting on a new analytical method which they found to have a “significantly improved *sensitivity*” as compared to a long-established reference method. In truth, the newly developed laboratory strategy by Smith and Jones gave a somewhat lower signal intensity for a give sample size (i.e. a lower sensitivity) but had an improvement of signal-to-noise ratio of at least 100x over that of the reference method. My enthusiastic congratulations to Smith and Jones for an important methodological breakthrough, but please state that your discovery offers a “significantly improved *selectivity*”.

Within the field of analytical geochemistry, one often finds a vast divergence from established vocabulary and “correct” metrological terminology. The obvious question from the reader is, “How does one define ‘correct’?” It turns out that quite an extensive literature exists on this topic, and, in particular, I point the reader to the Joint Committee for Guides in Metrology (2012) contribution, commonly referred to as the “VIM3 guide”. This document is a rather heroic effort to unify the terminology used across diverse fields of analytical science and engineering. In it, one sees that the “correct” terms often diverge greatly from what one commonly reads in geoscientific literature. I have to confess that VIM3 can be a challenging document to read, especially when encountering the definitions for such terms as “the repeatability of condition of measurement” and “true quantity value”. Nonetheless, VIM3 is a document that all scientists working with quantitative data should be familiar with.

A second source of information is the Joint Committee for Guides in Metrology (2009) “Guide to the Expression of Uncertainty in Measurement”, otherwise known as the “GUM guide”, and which, likewise, can be downloaded from the *Bureau International de Poids et Mesures* website. This second information source focuses specifically on the description of analytical uncertainty and various conceptual components for describing the reliability of quantitative results. More specifically, the GUM guide provides extensive discussion of such topics as estimating analytical uncertainty and establishing the confidence level that the “true” result lies within a specified range. GUM is another document well worth being familiar with.

So, now I would like to mention a few examples of terminology that are well-established – and widely misused – within the list of geochemical jargon. One term that one should studiously avoid is “ppm”, even though the majority of geochemistry publications continue to make use (and abuse) of it. So, what is the problem with “ppm”? The problem is that it is ambiguous in meaning: is the author referring to µg/g (parts-per-million by mass), or µmol/mol (atomic ppm) or even µl/l (volume fraction within a gas)? A second example of widely misused term is that of “analytical error”, which actually suggests a mistake or blunder made during an analytical procedure. If you are describing the number provided after the plus-or-minus, then this should properly be referred to as the “analytical uncertainty”. Finally, the term “standard” is generally wrong when talking about a substance that is used for calibrating analytical instrumentation. Generally correct is the term “reference material”, which VIM3 defines as a “material, sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties”. Now that’s a definition!



I will conclude with a couple of additional tips where one can seek information about proper usage of terms in metrology. I can strongly recommend the contribution of Potts (2012), which gives clear and easily readable definitions of no less than 73 terms and concepts relevant to the analytical geochemist. Also worth a look is the recently established on-line guide at www.geoanalyst.org/glossary, which provides a more humorous take on the topic.

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2018

January 7–12 **Chapman Conference on Merging Geophysical, Petrochronologic, and Modeling Perspectives to Understand Large Silicic Magma Systems**, Quinamavida, Maule Region, Chile. Web page: chapman.agu.org/silicic-magma/

January 21–26 **42nd International Conference and Expo on Advanced Ceramics and Composites (ICACC'18)**, Daytona Beach, FL, USA. Web page: ceramics.org/icacc2018

January 29–February 2 **Fourth International Diamond School**, Bressanone, Italy. Web page: www.internationaldiamondschool.org/

February 27–March 2 **Training Course: The application of analytical SEM (EDX) and EPMA (WDX) in the earth sciences**, Natural History Museum, London UK. Web page: www.nhm.ac.uk/business-services/training/application-of-analytical-sem-and-epma.html

February 28–March 3 **GOOD (Geology of Ore Deposits) Meeting 2018**, Erlangen, Germany

March 11–15 **TMS (Minerals, Metals & Materials Society) 2018 147th Annual Meeting & Exhibition**, Pheonix, AZ USA. Web page: www.tms.org/tms2018

March 18–22 **255th ACS National Meeting & Exposition**, New Orleans, LA, USA. Web page: www.acs.org

March 19–23 **49th Lunar and Planetary Science Conference**, The Woodlands, TX USA. Web page: www.hou.usra.edu/meetings/lpsc2018/

May 1–3 **Mercury: Current and Future Science of the Innermost Planet**, Columbia, MD USA. Web page: www.hou.usra.edu/meetings/mercury2018/

May 20–23 **AAPG 2018 Annual Convention**, Salt Lake City, UT, USA. Web page: www.aapg.org/events/conferences/ace

June 5–7 **Cryovolcanism in the Solar System Workshop**, Houston TX, USA. Web page: www.hou.usra.edu/meetings/cryovolcanism2018/

June 11–14 **55th Clay Minerals Society Meeting**, Urbana-Champaign IL USA. Web page: conferences.illinois.edu/cms/

June 16–21 **Canadian Institute of Mining, Metallurgy and Petroleum (CIM)**, Geological Association of Canada (GAC) and Mineralogical Association of Canada (MAC) Joint Meeting, Vancouver, BC, CANADA. Web page: rfg2018.org

June 17–21 **Sixteenth International Symposium on Experimental Mineralogy, Petrology and Geochemistry (EMPG-XVI)**, Clermont-Ferrand, FR. Web page: empg-xvi.sciencesconf.org

June 18–22 **Amazonian [Mars] Climate Workshop**, Lakewood CO, USA. Web page: www.hou.usra.edu/meetings/amazonian2018/

June 24–29 **Zeolite 2018**, Krakow, Poland. Web page: www.inza.unina.it

June 26–28 **3rd European Mantle Workshop (EMAW), "Geochemistry, Petrology, Mineralogy, Geophysics and Numerical Modeling of the EARTH's mantle."** Pavia, Italy. Web page: emaw2018iggpavia.unipv.it

July 8–12 **15th International Conference on the Physics of Non-Crystalline Solids and 14th European Society of Glass Conference**, Saint-Malo, France. Web page: pncs-esg-2018.sciencesconf.org/

July 8–13 **Geoanalysis 2018 meeting**, Macquarie University, Sydney, Australia. Web page: 2018.geoanalysis.info/

July 10–13 **Granulites and Granulites**, Ullapool, Scotland, UK. Web page: http://www.minersoc.co.uk/2018-meeting-granulites-granulites.html

July 20–24 **American Crystallographic Association Annual Meeting**, Toronto, Canada. Web page: www.amercrystalassn.org/2018-meeting-homepage

July 23–27 **81st Annual Meeting of the Meteoritical Society**, Moscow. Russia. Web page metsoc81-moscow.ru/

August 5–9 **Microscopy & Microanalysis 2018**, Baltimore, MD USA. Web page: www.microscopy.org/events/future.cfm

August 11–17 **2018 Goldschmidt Conference**, Boston, MA USA. Web page: www.geochemsoc.org/programs/goldschmidtconference/

August 13–17 **XXII Meeting of the International Mineralogical Association**, Melbourne, Australia. Web page: www.ima2018.com

August 13–17 **20th International Sedimentological Congress**, Quebec, QC, CANADA. Web page: www.isc2018.org

August 19–23 **256th ACS National Meeting & Exposition**, Boston, MA, USA. Web page: www.acs.org

August 22–27 **31st European Crystallography Meeting**, ECM-31 Oviedo, Spain. Web page: ecanews.org/mwp/meetings/

September 2–6 **GEOBONN 2018: Annual Conference of DGGV, DMG and PalGes**, Bonn Germany. Web page: www.geobonn2018.de/imprint.html

September 4–7 **European Microbeam Analysis Society (EMAS) 2018 Workshop**, Bristol, UK. Web page: www.microbeamanalysis.eu

The meetings convened by the societies participating in *Elements* are highlighted in yellow. This meetings calendar was compiled by Andrea Koziol (more meetings are listed on the calendar she maintains at https://sites.google.com/a/udayton.edu/akoziol1/home/mineralogy-and-petrology-meetings). To get meeting information listed, please contact her at akoziol1@udayton.edu

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