Miscellaneous commentary

Fieldwork and geological education (*July 2014*)

In March 2013 I wrote an entry (*Geoscience education: a cautionary tale from the Open University*) connected with the abandonment of field training at week-long summer schools by the UK's Open University. After 40 years of geoscientific summer schools connected with courses at Levels-1, -2 and -3 anonymous performance statistics were available for thousands of students who had studied those OU Earth Science courses that offered summer-school experiences in the field, first as compulsory modules (1971-2001) then as an optional element (2002-2011) and finally with no such provision. The March 2013 item compared statistics for the three kinds of provision. It should be noted that the OU once had possibly the world's largest throughput of degree-level geoscience students for a single higher educational institution.

After 2001, pass rates feel abruptly and significantly; in the *Science Foundation Course* the rate fell from an annual average of 69 to 54%, and in level-2 *Geology* from 65 to 55%. This was accompanied by a significant decrease in enrolment in equally and more popular geoscience courses that had never had a summer school element. The second statistical drop was of the order of 30 to 40%. It seemed that residential schools had played a vital role in boosting confidence and reinforcing home studies, as well as transferring practical field skills. After further falls in enrolment since summer schools were removed from the curriculum in 2012, the OU is in the process of completely revising its geoscientific courses and attempting to substitute virtual, on-line field and lab 'experiences'. Time will tell if it ever manages to reach its former level of success and acceptance

So, discovering that The Geological Society of America had surveyed attendees at its Annual Meetings (Petcovic, H.L. *et al*. 2014. Geoscientists' perceptions of the value of undergraduate field education. *GSA Today*, v. **24** (7), p. 4-10; DOI: 10.1130/GSATG196A.1) piqued my interest. Almost 90% of those polled agreed that field studies should be a fundamental requirement of undergraduate programmes; very few agreed that becoming an expert geoscientist is possible without field experience. Field courses develop the skills and knowledge specific to 'doing' geoscience; teach integration of fundamental concepts and broaden general understanding of them; inculcate cooperation, time management and independent thinking that have broader applications. Fieldwork also has personal and emotional impacts: reinforcing positive attitudes to the subject; creating a geoscientific *esprit de corps*; helping students recognise their personal strengths and limitations. Then there is the aspect of enhanced employability, highlighted by all categories of respondents.

Set against these somewhat predictable sentiments among geoscientists are the increasing strains posed by cost, time commitment, and liability, as well as the fact that some potential students do not relish outdoor pursuits. Yet overall the broad opinion was that degree programmes should involve at least one field methods course as a requirement, with other non-compulsory opportunities for more advanced field training

Place your bets for a chance of posterity on Lunar Mission One (*November 2014*)

A few days after the global excitement around ESA'a Rosetta mission, following Philae's landing on a far-distant comet and success with its core experiments, it did cross my mind that the unveiling of Lunar Mission One (LM1) was a bit of a let-down in PR terms. There's an old saying – 'What can follow the Lord Mayor's Show?' – and the thrill of Philae's landing rivalled any of the events at the 2012 London Olympics, plus the science it and Rosetta promise is likely to be about as leading-edge as it will get for quite some time. So what does LM1 offer that might achieve a similar scoop, and indeed your prospect of virtual immortality?

Unlike NASA or ESA missions, LM1 is to be a crowd-funded private enterprise by Lunar Missions Ltd, for which the subscribers will want something in exchange. Through Kickstarter anyone can have a punt to help raise the initial £600 thousand goal by midnight on 17 December. Apparently that sum is to fund 3 years full-time work by a professional management team to raise further mission funds from commercial partners to take the project further: it will cost around £1 billion. At this stage you can pledge any sum you wish, but what you get in return depends on your generosity. Highlights are: for £3 to 15 the reward is 'Our eternal thanks and a place in space history'; >£15 gets you a certificate and a place in an online 'wall of thanks'; >£30 escalates to your name being included in a digital 'time capsule' taken to the Moon and buried, plus membership of the Lunar Missions Club; >£60 entitles you to a voucher to invest in your own digital 'memory box' to go in the capsule – one of 'millions and millions' – and a vote on key decisions; for >£300 you can 'Meet the Team'; >£600 gets you annual meetings and a chance to ballot for the landing module's name; for higher contributions there are invitations to the launch (>£1200), sealing of the digital archive capsule and your name engraved on the lander (>£3000); and – wait for it – you get a place in the viewing gallery at Mission Control if you can stump up more than £5000.

For those contributing £60 or more, what goes in the much vaunted digital 'Memory Box' is on a sliding scale, from the equivalent of a text message to a strand of your hair and the DNA in it. One catch, if you are thinking of resurrection, is that it will be at the bottom of a 5 cm diameter hole at least 20 m deep. The buried digital archive will also contain a record of all living species on Earth and the entire history of humankind to date, but a continually updated copy will also be freely available online. Wikipedia seems not to be associated for some reason, but every item in this public archive will be peer-reviewed through an editorial board to whose deliberations schools, colleges and universities can contribute. The buried, multi-Terabyte, digital capsule is said to have a life of perhaps a billion years. Currently the longest lived data storage (~1500 years) is still ink on vellum, whereas the most advanced static and optical digital media are estimated to have a maximum 100 year lifetime, subject to technical obsolescence. On the plus side, privacy is guaranteed, partly by the nature of the storage. So, for £10000 Joe and Josie Soap will figure on a kind of cenotaph but who- or whatever digs up the module will learn absolutely nothing about them and but conceivably could clone them from their anonymous strands of hair, perhaps as pets.

What are the science goals for an LM1 landing scheduled for 2024 that cannot be achieved by lunar-lander and sample-return missions currently under state-funded development by China, Russia, NASA, Japan and India before LM1 reaches the 'Go/No Go' stage? The landing is planned for the Moon's South Pole, on the rim of a major crater. There, LM1 will drill a hole to between 20-100 m deep, using a maximum of 1 kW of solar power – this '*will also be* *a major leap forward for safer and more efficient remote drilling on Earth*': make of that what you will. Such a hole is said to enable sampling of pristine lunar rock in 15 cm lengths of 2.5 cm diameter core through the debris of the impact that caused the crater. The core samples are to be chemically analysed in the lander to test the hypothesis that Earth and Moon shared their origins. Future missions may pick up the cores and return them for more detailed analysis on Earth. But consider this: the oldest rocks known from the Apollo programme are approximately 4.4 billion year-old, feldspar-rich anorthosites that are thought to have formed the lunar highlands through fractional crystallisation of an early magma ocean that immediately followed Moon formation. Any unfractionated lunar material is only likely, if at all, at far greater depths than 20 m, and none was found or even suggested among the 0.4 tonnes of samples returned by the Apollo missions, which have been repeatedly analysed using advanced instruments. Indeed, near-surface debris from a crater rim is unlikely to be any more diverse lithologically than the various kinds of lunar surface from which the Apollo samples were collected, and may be contaminated by whatever caused the cratering and by the immense, long-lived heating at the impact site itself.

Compared with the prospect of advancing understanding of the origins of life and the Earth's oceans, and the early stages of Solar System evolution from data provided by Rosetta and Philae, LM1 might seem less exciting, though the buzz being hyped is that it would be a 'People's Mission'. Yet those who place their punt on it and the commercial concerns that ultimately earn from it are two different sets of people. The ambitious global education wing will, of course, face competition from the growth of MOOCs in the science, technology, engineering and maths area that have a considerable head start, but it does have a noble ring to it. Whatever, if you make a pledge before midnight on 17 December this year and the 'pump-priming' target is not met by then, you pay nothing. If £600 thousand is raised there is no going back and only 10 years to wait. But what a challenge, you may well think… LM1 definitely has the edge over Virgin Galactica, but here on Earth there are probably a great many more vital challenges than either.

(**Note added October 2018:** Although LM1 did raise the £600 thousand starter fund, over the last 4 years it has yet to find any further funding. Oddly, it claims that the latest member is Neil Armstrong, despite the fact that he died in 2012...)