Message from the MTD Board Chairman

“Spring is here folks, but as I write this, it has come with snow and blizzards!”

That was how I introduced our Spring Newsletter. Well what a difference a few months make. Summer has been well and truly here for a number of weeks, and the talk is of hot weather, hosepipe bans, and wildfires.

Our interview of the issue is with Rhae Adams; Managing partner with Synchronous, a determined ‘Space Miner’, looking at the huge potential of mineral reserves away from this planet. Additionally, we have a feature on the work being done deep underground at Boulby Potash mine. For the last five years, Boulby Mine has been host to a research program called MINAR (Mine Analog Research), led by the UK centre for Astrobiology (UKCA) at Edinburgh University, to test equipment for the exploration of space. This programme is taking place at the existing underground science facility at the mine. The purpose of MINAR is to make a link between planetary scientists who are building instruments for future robotic and human exploration of space, and a real mining environment.

We have the latest edition of our regular feature on mining in Latin America, this time looking at Nicaragua and the way that political turbulence in that country threatens the success story of mining. Andy Birtles, the architect of our website, has prepared two pieces covering Mining Conferences and Information Reference Systems within IOM3, hopefully to guide members as to what is available for them and how to access it.

Our mining heritage section this issue travels north of the border to describe the lead mining museum at Wanlockhead in Dumfries & Galloway.

I hope you enjoy the content. If you’d like to have a go yourselves at preparing contributions for the next Newsletter in the Autumn, please come forward, your help will be very welcome.

Christine Blackmore
IOM3 MTD Chairman

QUESTION

Should the IOM3/MTD support hydraulic fracturing as a means of accessing suitable fuel for feeding the UK’s power generation sector?

Send your comments to MTD@IOM3.org

IN THIS ISSUE......

• Interview with Rhae Adams, Managing Partner at Synchronous
• Boulby - Gateway to the Solar System
• Letters from South America
• Information Avaliable Online
• Conferences to Watch
Interview with Rhae Adams
Humankind has maintained a permanent presence in space for over 17 years. However relative to what’s out there, we’ve not gone particularly far! The thought of placing a colony on Mars means our logistics and supply chain will need developing.

As with mine development, it’s entrepreneurial spirit and innovation that will get us there.

MTD spoke with Rhae Adams; Managing partner with Synchronous, a determined ‘Asteroid Miner’ and previously Director of Energy and Mining for the Business Development team at Planetary Resources, about what drew him into this field and what defines the future economies of space.

Why space?
The sheer magnitude of the universe tempts an unlimited amount of exploration and adventure, if we could only escape the deep gravity well we are bound to on Earth.

In the late 2000s I noticed that the right pieces to do just that were starting to appear. Additive manufacturing, extreme miniaturization, autonomous robotics, and a commercial push towards space sparked my frustration into a full-on sprint towards helping to find a solution. Learning to use the resources of space, in space, continues to be the largest barrier for full commercialization of the solar system.

Today’s challenges?
Today, space travel is similar to attempting to travel from New York to Los Angeles on a single tank of gas while storing 100% of your consumables in your car. It doesn’t have to be that way.

There are over 16,000 near-Earth asteroids that share a similar orbit to Earth. Asteroids contain the resources that make it possible to fuel and sustain life in space, creating a new paradigm of travel and human presence in space.

More accessible than the Moon, near-Earth asteroids are comprised of natural resources that will accelerate humanity’s exploration and development of deep space.

In orbit, spacecraft propellant is a multi-billion dollar industry with each pound of fuel worth more than an equivalent pound of gold on Earth. Certain asteroids are loaded with hydrogen and oxygen, the components of rocket fuel. These asteroids can provide a fuel source that is 100 times closer energetically to Earth orbit, and thus far less expensive, than the Apollo-Era “bring-everything-with-you” propellant used today.

Water – The key resource in space

Who’s involved?
The world’s richest can’t be wrong. Elon Musk, Jeff Bezos and Yuri Milner all have stakes in the industrial development of space. Whilst this is a long term investment strategy, the earth bound applications of what we develop today are huge.

This is what we do at Synchronous where we believe that multidisciplinary teams armed with the latest technology can produce outsized value for businesses, governments, and individuals.

Tomorrow’s space talent?
Space exploration, mining, travel and colonization will call on every type of skill – not just engineers, astrophysicists and scientists. We’ll also need chefs, architects and safety officers.

The advice is jump in now, soon space travel will be the norm. Armed with good ideas there is no limit. I’m looking forward to humankind’s first art exhibition in space!

Rhae Adams
Managing Partner
Synchronous
**Boulby – Gateway to the Solar System**

One of the most ambitious objectives that society has is to explore and settle other worlds. Although we talk of environmental crisis and resource limitation on our own world, there are bountiful resources in outer space. And that’s not surprising. Our planet was forged out of the same material from which the rest of the Solar System was fabricated. On the Earth, there is about 300 years worth of easily accessible iron ore left. The asteroid belt in the orbits beyond Mars and Jupiter have about 300 million years worth of the stuff. Of course, getting that material and the economics of mining it are another matter, but the general principle still holds – there’s a lot of material out there that is accessible to us.

For the last five years, Boulby Mine has been host to a research program called MINAR (Mine Analog Research) to test equipment for the exploration of space. The MINAR programme led by the UK centre for Astrobiology (UKCA) at Edinburgh University and supported by the existing underground science facility Boulby (the STFC Boulby Underground Laboratory) which hosts a range of science studies from astrophysics (the search for Dark Matter), to studies of geology/geophysics, climate, environment and more. The purpose of MINAR is to make a link between planetary scientists who are building instruments for future robotic and human exploration of space and a real mining environment.

The largest of these activities was MINAR 5 last October. Over 40 people descended to the lab to carry out a wide range of studies. A Close-Up Imager, essentially a fancy microscope, was tested that is to fly on Europe’s Mars rover, due to launch in 2020. Another instrument is the HABIT instrument, which is to be sent to Mars in 2020 to see if salts can be used to extract water from the Martian atmosphere for future human explorers. That too was tested. Literally running around all these instruments was Matthias Maurer, a European Space Agency astronaut in training for future missions to the International Space Station and beyond. Boulby provided an ideal place for him to learn about what planetary scientists are doing and how he might use their instruments in space.

You might wonder – why do all this in Boulby? First, there is the obvious link with a working mine. Planetary scientists are interested in building small, lightweight and robust instruments for other planets. These are the same characteristics that miners want in their instruments to look at ore quality on Earth. By carrying out this work in a working mine, planetary scientists come face to face with real environmental conditions in mines. One of our teams, who used MINAR to test a small X-ray Diffraction instrument, is now using the lessons they learned in Boulby to develop an instrument with companies involved in iron ore mining. Boulby mine has stimulated technology transfer from space to Earth.

We’re also interested in doing science in Boulby. The study of microbes deep underground that naturally live in salts and brines gives us ideas about whether similar deep salty habitats on other planets might be habitable. We know that there are chloride and sulphate salts on Mars, just like Boulby. Even on the Earth, deep subsurface salts play an enormous role in influencing water quality. Microbes underground are pivotal in cycling elements crucial to the biosphere such a carbon. The MINAR campaigns allow us to use all the instruments to do all this science.

Running through all this effort is education. Last October we had a group of educators join us. By following scientists and their work, they were able to come up with new lesson plans that are to be used in primary and secondary schools to teach science based on the real work going on in Boulby.

Across science, technology, education and astronaut training, Boulby is the first underground mine and lab to make a significant contribution to the exploration and settlement of the space frontier.

For further information see the following web links.
UK Centre for Astrobiology: www.astrobiology.ac.uk
STFC Boulby Underground Laboratory: www.boulby.stfc.ac.uk/
ICL Boulby Mine: www.icl-uk.uk

**Professor Charles Cockell**

**Director of the UK Centre for Astrobiology (UKCA)**

**Edinburgh University**
Letter from Central America

It is odd how several similar countries in the same part of the world can have very different attitudes towards mining. In Central America, Costa Rica and El Salvador have banned mining while Nicaragua and Guatemala welcome both exploration and exploitation. Nicaragua is currently simplifying and easing up the permitting process and over 10% of the country is covered by exploration leases. In contrast, Costa Rica, despite its considerable potential, has decided that its eco-tourist industry is more important than mining. Nicaragua’s future was bright indeed, yet in the past month it has all gone pear-shaped.

The country’s president, Daniel Ortega, is undoubtedly the best leader Nicaragua has had in the past 40 years. He has vision, a clear path forward, and the drive and intelligence to push through obstacles. Yet he has a dark side. Nicaragua has been badly served by democracy – various leaders have absconded from the country taking the Central Bank gold reserves with them. They have been ineffectual, apparently unable to make headway in a political culture where endless talking, committees and infighting have been the norm; typically sound and fury in a coffee cup.

Ortega understandably has little patience with the political talking shop. But to get his policies through he has emasculated the already weak political institutions and stuffed them full of friends and relatives. He even made his wife his vice president, a woman devoid of all charm and political ability. He abolished the restrictions on standing for a third term; apparently setting up an absolute hereditary monarchy Saddam or Gaddafi style. However, so long as he kept the country safe and the economy growing, the people overlooked his dictatorial tendencies and Marxist-Leninist rhetoric.

On the 11th April, last month, Ortega decided to change the social security laws. The reforms were rational and sensible. Nevertheless, the pensioners protested and a small number took to the streets. At roughly the same time, a group of university students was incensed that part of a nature reserve had burnt down, and with a very ‘snowflake’ sense of priorities for the cremated fauna decided to have a sit-in. In most countries the government would have ignored it; the students would have eventually got bored and drifted off to the pub or home to supper for Mamma’s maize tortillas.

Instead and inexplicably, the government sent in the riot police, accompanied by the Juventud Sandinista (Young Sandinistas) who have developed an unsavoury reputation as Daniel’s enforcers and secret police. Heads were kicked in, bones broken, some dragged away for torture, and over 30 students were shot dead. Then within days, the people came out on to the streets, first in their hundreds, then eventually in their millions. The original request to drop the social security reforms have morphed into demands that the Ortegas move instantly to the departure lounge.

And to the present day. There is chaos on the streets of the capital, and the roads have been torn up and used for barricades. The police continue to tour around in force breaking heads and limbs, using live bullets, and so adding petrol to the flames of the revolt.

So where does it go from here? It can be seen as a right-wing populist revolt against a left-leaning establishment, and Ortega has most of the support in the left-wing media of the USA. So far, miners and investors haven’t yet pulled out of the country or cancelled commitments. It is a wait and see game.

El Perrito
Mexico
Information Avaliable Online
Anyone who has searched the internet for a specific mining related topic will know that there are plenty of papers, presentations and websites that are displayed following a search, but are there specific sites or areas that can be accessed that may have the information, and for free as well? The list here is not exhaustive, but should give you some idea as to the sites that might be useful.

Our library facility at the IOM3 Grantham Centre in the East Midlands, known as the National Materials and Mining Archive, has a significant collection on metals and a world-class library of mining journals, books, conference proceedings, reports and maps, all subject indexed – but in terms of online access it isn’t a one-stop shop! Click on the free member link to IMMAGE (Information on Mining, Metallurgy and Geological Exploration) on the IOM3 technical information or publications pages (www.iom3.org/immage-online-access) to search through everything from 1979 onwards and read the abstracts, many of which do include the data and/or conclusions – but for the full text you’ll have to ask (and pay!) for loans/pdfs or arrange either to visit the library or to have resources brought to the London office for you – and for most older references (1894-1978) you’ll have to consult the card/fiche subject catalogues in Grantham. To complement the archive, IOM3 is creating a digital collection of all its predecessor institutes’ materials and mining publications; watch the IOM3 website for the online link, which is due to appear shortly, but meanwhile the digitised mining papers are also being added to OneMine (see below). Our mining contact is Frances Perry (Frances.Perry@iom3.org), who has been sourcing and abstracting documents for IMMAGE for many years.

The SAIMM, the South African equivalent of the MTD, has a lot of papers and presentations and articles in the public domain, many relating to innovations in the mining and minerals industries. If you know the topic for which you are looking, the advanced search on the right of the page (www.saimm.co.za/publications/journal-papers) is extremely useful. Currently there are many articles (many presenting theories) by Chinese mining engineers, looking to publish their findings to the global mining community. The papers are reviewed by at least two referees prior to publishing, and so the high standards of the papers are maintained. The papers are converted into portable document formats (pdfs) and generally have a mixture of letters and numbers (usually beginning with “v”) as the file name.

Another useful site is AMC, Australian Mining Consultants, and in their old format, had a library of useful articles. In their revamped format, these articles are found at amcconsultants.com/our-experience/, and can be adjusted slightly using the service drop down box to the right of the page. The articles on Feasibility Studies and Reporting of Mineral Resources are particularly thought provoking.

OneMine is a great site if you know for what you are searching, and is easily accessible from the IOM3/MTD page. It contains all the scanned publications of SAIMM, AusIMM, SME, CIM and more! Click on the OneMine link on the MTD home page, and you will be redirected to an IOM3 page, which has a direct link to www.onemine.org/index.cfm. All the information is readily available and free to IOM3 members. One can also search for articles by professional body (including IOM3, though there’s very little there as yet).

The AusIMM Bulletin (www.ausimmbulletin.com/) has many interesting articles, but some of the more interesting AusIMM publications require, unfortunately, payment. However, all may not be lost as the publication may well be included in the OneMine site, with which the AusIMM are partners! IOM3 and the AusIMM collaboratively produce a series of highly technical journals, containing papers covering cutting edge science and technology in the industry, entitled the ‘Transactions of the Institutions of Mining and Metallurgy, incorporating The AusIMM Proceedings’. The IMM Transactions are published by Taylor & Francis, and comprise three sections, Mining Technology, Applied Earth Science and Mineral Processing and Extractive Metallurgy:

Section A - Mining Technology
Section B - Applied Earth Science
Section C - Mineral Processing and Extractive Metallurgy

The CIM’s also part of the OneMine fraternity, but if searched via their own website then transactions from their conferences and in-house publications appear to require some form of payment. The CIM Magazine has some quite interesting articles from across all sectors of the mining industry (magazine.cim.org/en).

No article would be complete without reference to the website miningmayhem.com.au/, which has some of the finest images of things that can go wrong and have gone wrong in the course of getting stuff out of the ground.
MINING HERITAGE

The Museum of Lead Mining

The Museum is a Visit Scotland 4 Star Visitor Attraction set in the picturesque village of Wanlockhead, set amid the Lowther Hills, which at 468m feet above sea level, is the highest village in Scotland.

The aim of the Museum is to preserve the heritage of this important lead mining region, which encompassed Wanlockhead and Leadhills. Attractions include a real 18th century lead mine set deep in the hillside where visitors can experience the thrill of going underground, miners’ cottages, the second oldest subscription Library in Europe, and a Visitor Centre that has a fantastic display of rocks, minerals, gold, mining and local artefacts.

Wanlockhead Gold - Gold can be found in many areas of Scotland and particularly in the Lowther Hills. It is found in the sands and gravels in the burns which act as a natural means of concentrating the gold. The first documented evidence of the recovery of gold in the area is from the reign of King James IV of Scotland in the early 16th century. During the reign of King James V, gold from the Crawfurd Muir was incorporated in the new crowns for the King and Queen. Much of the gold coinage from the 16th century was minted using gold from this area.

Lochnell Mine - The history of Lochnell Mine extends over a period of 150 years and reflects the various changes which took place in winning the lead ore, draining the workings, organising the miners to carry out their activities, and rewarding them for their efforts. The entrance drift to Lochnell mine, a timbered passage opens out and has an average height of 7 feet and a width of 4 feet. The part of the mine, which is open to visitors, is described in terms of the minerals found, the methods used in cutting the rock, winning the ore, ventilating the workings, and transporting men and materials to the surface. A guided tour of Lochnell Mine gives the visitor a vivid sense of what lead mining was all about – a job which separated the miner physically and, to a large extent, socially from the wider world in which he lived. It concentrated his undivided attention on winning a basic living for himself and his family in conditions, which were always physically dangerous and also hazardous to health. It taught him, when at work to be dependent on the trustworthiness and comradeship of his mates and this special relationship coloured his leisure time activities too.

Visitor Centre - The Visitor Centre is situated in the heart of the village of Wanlockhead. Within the Visitor Centre there is a walk-through exhibition, which tells the story of how lead ore (galena) was won at the face and the processes it went through to become the lead products that we know today. Here you will see the different equipment used by the miners to win the ore and keep the water levels down. Also, on display are some of the most spectacular minerals found in the Lowther Hills, an area which is responsible for 1% of all known minerals in the world today.

As Wanlockhead was an isolated place, many generations of the same families lived and worked here. During the recessions in the lead industry, many of the families left to start new lives in Canada, South Africa, Australia, New Zealand and United States. At the Straitsteps Cottages you can experience what it was like to live as a miner in the 18th and 19th centuries. Cottages depict interiors from around 1750, 1850 and 1910, illustrating how the people of Wanlockhead lived, worked and played.

The Miners Library - Wanlockhead Miner’s Library is the second oldest subscription Library in Scotland and indeed Europe and was established ‘for our mutual improvement’ in 1756. The Library was funded by subscriptions from the miners, but a contribution was also made by mining companies too in order to encourage ‘self-improvement’ in the miners. There was a hidden agenda, as the mining companies believed that the Library would help to cut down on the unruly behaviour which existed at the time!

The Wanlockhead Engine - Beam engines and waterbucket pumps were introduced in Wanlockhead in 1745. The famous Wanlockhead Beam Engine is a survivor of this technology. No certain history of the Wanlockhead Beam Engine has been found to date but descriptions of similar engines have survived from 1745 and one is recorded to have been used on a coal mine at Canonbie, Dumfriesshire in the 1790’s. The Wanlockhead Beam Engine was built, it is believed, in the mid-19th century and is the only remaining example of a waterbucket pumping engine to be seen on a mine in the United Kingdom today.

The Museum of Lead Mining, Wanlockhead Village, Dumfries & Galloway ML12 6UT
info@leadminingmuseum.co.uk
www.leadminingmuseum.co.uk

David Seath
MTD Board
Conferences to watch

There are always plenty of conferences appertaining to the materials, minerals and mining sectors, and perusal of the IOM3 website (www.iom3.org/iom3-events) covers an event for just about every day of the year. Within the MTD website, we have tried to narrow down the events (not always successfully) as they relate to mining, minerals and metallurgy (www.iom3.org/mining-technology-division/events), or type into your search engine "iom3/mtd", and the first result should be:

Click on this and then on either MORE EVENTS (near the centre on the home page) or the EVENTS tab on the navigation bar.

The events with which MTD are involved are presented on the “banner” (the grey area on the right of the screen, labelled “MINING MATTERS”, below the “BI-ANNUAL QUESTION”) and these have links to the organising committee, or to a page where a registration form can be downloaded. Where conferences have occurred, where possible, there are links to the presentations or to contacts from whom presentations can be obtained. Specialist conferences with which the MTD is associated, and which are still to occur, are as follows:

- IOM3 Russia-UK Raw Materials - 23rd to 25th October - London
- ABMEC Annual Conference - 22nd & 23rd November - Nottingham
- FAME Feedback Conference - 5th & 6th December - London
- Iron/Steel Conference – 2019 – details still to be finalised

Annual conferences, with which the MTD is proud to be associated, are:

- The MIME “Safety Seminar” in Sheffield, usually in April
- The MES/SMMMI annual symposium in Kegworth, usually in May
- The ABMEC annual conference in south Yorkshire, usually in November

If any MTD members are aware of any conference, anywhere in the world, which they feel should be included on our website, then please contact the webmaster, currently Andy Birtles (anbmining@gmail.com).