Welcome to the IOM3 Mining Technology Division Newsletter for Spring 2020. Up unto now we have tried to produce a Newsletter for the Mining Community of IOM3 that will interest and inform our constituency of members. This has normally appeared four times a year. However, this schedule has been hard to keep up with, so the Board has now decided that this will be reduced to three issues a year, whilst still maintaining a close link with all mining members and seeking to improve the content.

Our aim is to include a mix of articles and news items, some of the subject matter being hot topics and technical aspects of mining. I don’t want to make the content into full technical paper as such, as there is room on the MTD website for that type of material, but obviously the publication is aimed at professionals within the industry so we want to highlight good practice whenever we find out about it. Some of the content will review the activities of the MTD board and its members, with special emphasis on Conferences that have either been organised by the Board, or that have received the Boards support. We are going to continue our contact with contributors from around the world and the team are always on the lookout for new contributors to keep the content fresh and relevant.

We want to keep the section on mining heritage sites, and are going to introduce a new section covering how the media is treating mining activity, hopefully to promote a debate either on in the newsletter or on the website that allows members to air their views on matters of concern. We are also looking to use the newsletter to promote the activities of the IOM3 Local Societies that serve members in the mining sector.

Most of all I want this to be your newsletter and this can only happen if you send material to the editorial team for them to include. Don’t rely on us to fill all the pages!!

Christine Blackmore - Chair MTD.

STOP PRESS

Mining Technology Division (MTD) conference  Title: “Legacies of Mineral Extraction and Sustainability Opportunities”.
Date:  Tuesday, 17 and Wednesday 18 November 2020.
Venue:  The Common Room, Westgate Road, Newcastle-upon-Tyne NE1 3AS.
Call for papers ABSTRACTS:  Those wishing to present a paper at Conference 2020 should submit an abstract of 200 to 300 words to: Frances Perry  (Frances.Perry@iom3.org)

EDITORIAL TEAM AND CONTRIBUTORS:

Christine Blackmore  Dr Rod Stace  contact via Frances Perry  (Frances.Perry@iom3.org)
I have been asked how a girl from Lancashire ended up as a renowned nickel hydrometallurgist, and co-founder of a junior mining company?

I don’t think there is a simple answer to that but it all began when I was in my 3rd year at Penwortham Girls’ High School. I had an inspirational chemistry teacher who initiated my passion for chemistry and told me I should follow in the footsteps of another of his pupils Sue Ions (now Dame Ions) and head to Imperial College (IC) to study metallurgy. This is exactly what I did and so began my studies there in 1987.

It was as a student at IC that I first became a member of the IOM3, after my first year I was awarded the medal for the outstanding first year student at the Royal School of Mines (RSM) and went on to become the Vice President of the RSM Union and thoroughly enjoyed my 3 years of study there.

Having spent the first 10 years or so of my working life as a metallurgist and later project engineer with engineering companies in the oil and gas side of natural resources in The Netherlands and France the chance arose to move back to my passion and work as a hydrometallurgist in the exciting new field of nickel laterite heap leaching.

Moving to Turkey and working alongside my husband Mike (an RSM mining engineer, who I met at IC) the next few years were spent proving up the heap leaching of nickel laterites at European Nickel’s Çaldağ project near Izmir in Western Turkey. In this time a large scale demonstration plant was built and following the technical success of the plant ENK raised funds and began plans for the construction of a full scale plant. Sadly various permits were never forthcoming for the project and ENK sold the project. For a while we moved on with ENK to look at the leaching of Philippine nickel laterites.

In 2010 having decided to leave ENK, my husband and I founded a new company to look to commercialise further the heap leaching of nickel laterites. Over the next few years we visited various possible projects in Indonesia, New Caledonia, The Philippines and Brazil to find the “best” project for us to acquire to be our flagship for the first stand-alone commercial nickel laterite heap leach.

Having managed to acquire the Piauí Nickel Project in Brazil from Vale we then founded a new company Brazilian Nickel (BRN) in 2013 and expanded our team to include a very experienced board and key management making sure we pulled all the world’s key nickel heap leach knowledge into BRN.

The project advanced with a revamp of a pilot plant built by Vale after a visit to Çaldağ! Full commercial size heaps were then operated and products produced to supply all the engineering data required for the next stages of the project.

The company is currently about to begin our bankable feasibility study for a commercial production plant that will produce approximately 1% of both the world’s nickel and cobalt. In parallel with this there will be a further expansion of the demo plant to enable a smaller production unit to rapidly start producing battery nickel and cobalt.

I thoroughly enjoy the challenge of being on the board of dynamic young company keen to commercialise a technology I am passionate will revolutionize the nickel industry. It will allow hereto uneconomic projects to get into production to help feed the ever growing need for nickel in the world. This is in both traditional markets like stainless steel and the extremely exciting new market for nickel in the cathodes for lithium ion batteries for the electric vehicle revolution and energy storage. Nickel also plays a significant role in the renewable energy space and hydrogen fuel cells, all exciting new areas of demand. In today’s world it is fantastic to be a part of the “greener” mining movement producing the raw materials to help counter climate change in the most environmentally friendly and sustainable way possible. My ultimate vision is for any BRN project to be carbon neutral. This could be possible in the future with carbon capture of our process CO₂ emissions, electrification of all transport fleets, along with offset planting and set aside of areas as carbon sinks within the project. I am currently leading BRN’s active pursuit of these opportunities as part of our ongoing studies.
WHAT’S IN THE NEWS: ROUND UP

The intention of this section is to highlight mining related news issues, whether that be supply of specific minerals or materials, mining sustainability and impacts on climate change, or mining related incidents from the last few months. Sometimes MTD will make a comment but invites others to join in the debate.

January 2020

Coronavirus

Coronavirus has caused havoc amongst many industries and since China is both the user and supplier of many of the minerals and materials used in manufacturing then the world’s industries have increasingly been affected by the virus since December and it’s effects are currently being felt across all of China.

A snap shot of views related to the Coronavirus indicates that Hyundai has stopped production in South Korea due to disruption of the supply chain. Foxconn, Nissan, PSA, Jaguar Land Rover, Airbus, have also had to stop specific production lines. Wuhan remains in lockdown with local plants run by Honda, General Motors, and Dongfeng Motor all affected. The media announced today (14th Feb 2020) that JCB in the UK are to place all their production staff on a reduced hours regime because of shortage of spare parts from their Asian supply chains.

Critical materials: Chinese feedstock and battery producers may ration critical materials to support the internal Chinese market at the expense of other customers. China’s nonferrous metal output will fall at least 10% y.o.y. in February as the country continues to try and contain the coronavirus, according to China’s Metal Association.

Update March 2020

China Coronavirus is having more of an impact on industry and related commodity prices. Trade volumes and prices have become very difficult to source since the countries lockdown. Lorry drivers are unable to cross regional boundaries and containers are stuck at locations. Jaguar Land-Rover, who had already suspended production of Electric Vehicles due to a lack of batteries, is now looking at a wider shutdown because of a lack of components produced by third party suppliers who often utilise smaller but critical components …… made in China. China is a huge manufacturer of LEDs causing a major issue for manufacturers who use LEDs.

MTD Comment:

*Should more effort be made in future to identify non-Chinese suppliers. Currently, the phrase putting all your eggs in not one basket comes to mind and the problem for electric vehicle and wind farm manufacturers is that virtually all permanent magnet production is based in China along with all the world’s lithium carbonate and hydroxide processing. Supplies were already dubious without the impact of the virus, see next article.*

Mercedes-Benz cuts EV production forecasts due to a battery supply bottleneck.

Supply bottlenecks are being reported. Reuters reported in late 2018, that Tesla expected a shortage of key minerals used in battery production due to long term supply challenges.

The Security of Supply of Mineral Resources multi-institute program calculated that just for the the UK fleet of 31.5m vehicles, and to meet targets of all new sales to be BEV in the UK by 2035, assuming use of NMC 811 batteries, would require 2x the world’s total annual cobalt production, 75% of lithium production and 50% of all copper production. (Petroleum economist)

February 2020

The Climate Group reports that the most significant barrier to corporate adoption of EVs is a lack of supply. The group has seen membership of its EV100 scheme more than double from 31 to 67 in the last year but is urging EV producers to deliver supply to meet the demand. (Future Net Zero). The leading driver for those committing to the scheme is a desire to lead on addressing the climate crisis. The number of company owned/leased vehicles has increased from 210,000 to 340,000. Contributing factors to supply challenges moving forward include scarcity of the resources required to make the batteries for the vehicles.

MTD comment:

*In a world chasing solutions to net zero emissions - mining looks like it is part of the solution not the problem.*

Trafigura is apparently in talks with the DRC to finance a new state-controlled company that will buy all of the country’s hand-mined cobalt. The company requires funding to buy cobalt from the artisanal miners, and Congo’s mining minister said last week that hand-dug cobalt accounts for a fifth of cobalt output in Congo, and the country supplies more than 60% of world cobalt production (Bloomberg).

MTD Comment:

*Let’s hope there are some sustainability and health and safety improvements attached to the deal. If not then any blockchain transparency efforts could be compromised and artisanal mining artificially cleaned up!*

Robin Dean—MTD Board Member
**CONFRONTING MODERN SLAVERY IN DRC**

The Foreign and Commonwealth Office, British Embassy Kinshasa and Pact UK invited IOM3 MTD Chairman and Associate Director of Wardell Armstrong **Christine Blackmore** to a select workshop to discuss “Confronting Modern Slavery in Democratic Republic of Congo (DRC) - United Kingdom Mineral Supply Chains”. Christine has recently been working in DRC with a significant cobalt producer. Cobalt is a key metal required in the manufacture of Lithium Ion Batteries (LIBs) needed to power Electric Vehicles (EVs) as part of the UKs “clean energy revolution”.

The workshop was focussed on the artisanal and small-scale mining (ASM) in DRC. Growth in the use of EVs and other new technologies will require a tremendous amount of battery metals. Although the amount of cobalt used in LIBs has been progressively reduced, it still remains a key metal in the manufacturing of LIBs. Currently approximately 60% of cobalt originates from mines in DRC, of this 20-40% is produced by ASM providing a key livelihood to 60,000-80,000 people, of which there is an estimated 5,000 to 40,000 children involved in some way or another.

There was a lively debate on what is meant by slavery and indeed what age a child or minor is. In the UK it is not until the age of 18 that young people are regarded as being unequivocally adult, whereas in the DRC it is not unusual for a 17 year old male to be married with 2 children to support. Working in ASM is often the only way to provide for the family and alternative employment prospects often not available. In many cases ASM is a “family” concern and represents the norm with many generations, including young children, involved. Should this be regarded as “slavery”?

The workshop was attended by a cross section of invited guests, from battery manufacturers, mining companies, academia, institutes and UK Government. WAI was one of the few consultants represented. A main objective of the workshop was to highlight issues associated with ASM. ASMs are not regulated, have a lack of safety measures and recompense is low. ASM is often a dangerous environment to work in, especially for women and children. By working with ASMs there is potential to implement improved safety and legitimise the operation. This could help bring more ethically produced cobalt into the supply chain for cobalt. The workshop highlighted cases where such improvements have already been implemented.

Often ASM activities are close to large, formal mines operating to international standards. Whilst the large mine might not be able to employ all ASM miners and their extended families they can assist the local community as part of their Corporate Social Responsibility (CSR), one model being adopted by mining companies, is to provide Personal Protective Equipment (PPE) and clearing the overburden therefore the ore body will be easier for the ASM to access. Licenses to mine are be issued to ASMs so there is increased legitimacy.

ASM miners generally do not have access to the latest technology and therefore it is inevitable that any concentrate they produce is inferior in terms of Co grade compared to that produced by organised, formal mines. Cobalt ores produced by ASM typically has a Co concentration of only 4% whereas modern mines can produce concentrates with a much higher grade. However, the material produced by ASM can be blended with ROM ore from a large mine to supplement mine production. The ASM mining can be legitimised, H&S improved and fairer revenues earned – creating a so called “Half and Half” mine. Then structured, transparent payments from the mine rather than often very poor payments from a “broker” can improve the finances of ASM workers and even lift them out of poverty or slavery altogether.

The poverty successfully highlighted how modern slavery is currently contributing to the cobalt mineral supply chain and how promoting and raising the awareness of practical solutions to modern slavery can improve the lives of ASM workers and families and assist the UKs clean energy agenda without adding to the poverty and misery of others – a true win-win situation.

Christine Blackmore —Chair MTD
The conference was hosted by the Canadian Institute of Mining, Metallurgy and Petroleum supported by the Institute of Materials, Minerals and Mining via the Mining Technology Division.

A total of 296 registered delegates, representing 15 different countries, assembled in the Marriott Downtown Hotel, at CF Toronto Eaton Centre, for the three-day conference. Its theme was ‘Deeper, Faster, Safer’. The Conference hard copy volume contained 44 high quality, peer reviewed, technical papers which were presented covering topics grouped into six categories: Keynote addresses, Safety, Case studies, Design, Innovation, and General.

The first Keynote Address was given by Bill Shaver, a very experienced shaft sinking contractor, whose topic was “Shaft sinking in the next five decades/2070”. It was an excellent review of past and current practice in shaft sinking. He went on to predict what he saw would happen in the next five decades with the emphasis on going deeper, faster and safer. His final comment in his paper was “You will build deep shafts twice as fast for 30% less in real terms”. Time will tell.

The second Keynote Address was given by Dick McIvor, another very experienced engineer on mine hoisting, his topic being “Mine hoist plant design fundamentals”. His address was an excellent review of the fundamentals involved in the design of mine hoist plant. He emphasised the need to make the correct decisions at the design stage to avoid higher maintenance costs, increased downtime and increased safety risk.

Three papers grouped under the Safety heading involved a South African Case Study on the remote rehabilitation of underground excavations, the benefits of the International Standard ISO 19426 for the design of Mine Structures and the development of a standardized approach to shaft inspections to improve shaft safety.

There was a comprehensive set of 16 Case Study papers presented. Three of the Case Studies described the use of the Shaft Boring Roadheader (SBR) for mechanised shaft sinking. Will this be the way forward in the future for deeper, faster and safer shaft sinking? Another set of 14 papers on Design were presented. The subject of Shaft Lining Design itself warranted a separate Focus Stream of 8 presentations. One of the 8 papers presented was by the Author on “Design and construction of deep shaft concrete linings in the UK”.

Under the heading Innovation there were 5 presentations covering Shaft inspection using camera, Stability monitoring of closed shafts, Wireless for mine shafts, Measurement for shaft alignment, and Ground condition monitoring during shaft sinking.

Finally, under the General heading there were 4 presentations covering Shaft sinking in China, Economics and long-term planning for shaft projects in Mexico, Deep shaft sinking mechanisation developments and Assessment of ageing shaft linings for potash and salt mines.

The Author’s second presentation at the Conference was “Deep shaft sinking mechanisation developments”. In Summary, although the basic theme of the Conference was Deeper, Faster, Safer, and many presentations were appropriate, the topic range was more widespread. One observation was that the Conference was predominantly mining related with very little input on civil engineering shafts. The Author believes that the Conference was very well received and a huge success.

On the second evening of the Conference there was social and networking event. It was a special evening of cocktails and a local dinner to be savoured in the much-acclaimed 1871 Berkeley Church, a unique Toronto event centre where 240 delegates attended. The Shaft Bottom Boys provided the musical entertainment.

Following the Conference, a Field Trip to the Onaping Depth Project at Craig Mine, near Sudbury, Ontario, was available for delegates and 37 attended. This is an internal shaft project (winze) that has just commenced sinking.

In the Final Session of the Conference, a proposal was made by the Chinese delegation to host the 5th International Conference on Shaft Design and Construction (SDC2021) in Beijing, China, in 2021.

Alun Auld—MTD Board Member
Alun’s full report with more images can be found at https://www.iom3.org/mining-technology-division
A delegate’s thoughts

I recently attended this excellent two-day conference in London with an open mind. I spent nearly 40 years in the coal mining industry in the mechanical sector starting out as an apprentice fitter to working as a professional mechanical engineer. During my time in mining I was very aware of electric vehicles, such as battery locomotives (along with diesel ones), shuttle cars and cutting machines. I was, therefore, not sure what the conference would do for me.

Around 60 delegates attended with an 80/20 gender split, with people from different countries including as far away as the USA. The venue, IOM3 headquarters in London, proved a really good location.

The first day consisted of eleven presentations, bringing together different companies, ranging from those that mine the minerals required to make our batteries to the ones that use the batteries in their equipment. The papers discussed the current state of mineral supply and where in the world they occur and are mined. This in itself seems to present problems as the major part of the materials used in modern technology is mined in countries with very poorly developed human rights policies and produced by extremely low paid labour working with poor mining practices.

In the presentations it was suggested that much more investment is needed due to the need to develop the electric cars that every Green government says we need. To underline this, there was a very good presentation from the CEO of Cornish Lithium, who have got the backing of the local council and Government but, as I mentioned above, more investment is needed. Governments seem to know what is needed but it is not clear whether the investment is going to be forthcoming. One thing for sure is that the problem is real and needs addressing now and not just something to talk about and plan in the years to come. It seems the clock is already ticking.

A major concern is whether the general public know or care where the materials needed to make products have to come from, and understand that this is a problem that cannot be addressed by recycling alone.

The first day of the conference concluded with a dinner on a boat cruise along the River Thames (I do wish it had been summer and light). The food and company were excellent with plenty of time for networking and reflecting on the day’s events along with the social aspect.

Day two with presentations which reflected more on the safety aspect of using electric vehicles with speakers from various Health and Safety organisations including the Keynote speech from Mr Paul Bradley, Head of Operations, Health and Safety Executive Energy Division

The presentations highlighted the many different safety aspects associated with the use of electric vehicles with different training, education and competency needs.

The conference heard of the future being developed today with the use of space technology being used to assist in locating the materials needed to manufacture the batteries and the need to reuse and recycle the materials used from out of life Lithium-Ion batteries.

Overall, the two-day conference was very interesting and educational with much learnt. Personally, I enjoyed day one more, maybe because it brought back memories of my time in mining but I have taken away the message that more development should be happening now with more investment in sustainable mining, as well as making more effort to reach a wider audience on the issues. The conference was preaching to the converted but its messages were important for everyone!

Steve Straw—MTD Board Member
Those of us of a certain age and generation can remember the reason for British mining engineers (and others involved in the extractive industries) being a “sought-after” commodity. We had a number of mining universities and schools, hundreds of mines (mostly coal admittedly, but let’s not forget the “golden age” of tin, and china clay in the south western counties, and salt and gypsum, and the gold mine in Wales supplying the Royal Household), equipment and technology suppliers, as well as hundreds of graduates who were employed all over the world, proudly flying the flag for British expertise! Our Mining Institutes were active and revered by mining practitioners across the globe.

As the world has changed somewhat, and our mining industry has declined, those nations that looked upon our mining expertise with awe are now at the forefront of developing and promoting mining expertise across the globe.

In a series of articles, we will address this change of “dynamic”, and see how we can contribute to the global mining initiative, and which organisations are driving the development of a truly global mining capability.

In the beginning there was the North of England Institute of Mining and Mechanical Engineers (NEIMME), commonly known as “The Mining Institute” founded in 1852 in Newcastle upon Tyne, and was granted a Royal Charter by Queen Victoria in 1876. The Midlands Institute of Mining Engineers was founded in 1857. Then came the Institute of Mining Engineers, founded on the first of July 1889, incorporated by Royal Charter on the ninth of February 1915. The Institute was an organisation dedicated to the professions of mining engineering, mechanical engineering, mining electrical engineering and related professions. It is the world’s oldest professional mining organisation and were dedicated to training engineers to meet the needs of a rapidly expanding coal mining industry in the UK and abroad. These Institutes have changed over the years, and now the UK professional organisation representing mining professions is the IOM3.

A member society of the American Institute of Mining, Metallurgical and Petroleum Engineers (AIME), the Society for Mining, Metallurgy & Exploration Inc. (SME)’s roots date back to 1871 when a small group of coal mining engineers founded AIME.

In the late Nineteenth Century, mining was conducted in many “new” countries around the world. This led to the development of a number of professional organisations being developed in these countries. The Australian Institute of Mining and Metallurgy (AusIMM) was founded in 1893 and operates under a Royal Charter.

The South African Institute of Mining and Metallurgy (SAIMM) started in 1894, a few years after the invention of the cyanide process had saved the gold mining industry in South Africa.

In March 1898, the Canadian Mining Institute (CIM) was founded in Montreal at the second annual meeting of the Federated Canadian Mining Institute. The Institute was incorporated by an Act of Parliament to include all former provincial groups except The Mining Society of Nova Scotia, which remained a separate body until 1918.

Further to these, generally English speaking Institutes, let us not overlook some of the other great mining nations.

Saint Petersburg Mining University is Russia’s oldest technical university, and one of the oldest technical colleges in Europe. It was founded in 1773 by Empress Catherine the Great, who developed an idea for training engineers for the mining and metals industries. Other European countries also have a long history of mining, these include Poland and Germany. In 1878 an organisation of Polish mining and metallurgical students established a reading room, and in 1892 a secret representation of Polish miners and metallurgists was formed in Krakow establishing the Association of Mining Engineers and Technicians (SITG).

A number of European Societies and Associations elated to mining can be found on the IOM3 website (https://www.iom3.org/european-materials-minerals-mining-organisations).

The Institute of Mining Engineers of Peru (IIMP) was founded in 1943 by a group of mining engineers, to establish itself as one of the most important organizations in the Peruvian mining sector, basing its success and prestige in the technical contribution delivered over seven decades of mining in the country.

The next article will address the development of international professional alliances and organisations, and “standardisation” of certain processes around the world.

Andy Birtles—MTD Board Member
The Mining Institute of Scotland

The Mining Institute of Scotland (the ‘Institute’) was founded in 1878 and is an affiliated local society of the Institute of Materials, Minerals and Mining (IOM3). The mission of the Institute is to support the art, science and sustainability of mining, minerals and ground engineering that meet the needs of society. This is achieved through bringing together professionals with a mutual interest in natural resources and their extraction, materials engineering and materials technologies. As such the Institute is one of the key organisations in Scotland for the dissemination of ideas and information about mining and affiliated activities to end-users and policy makers in government, industry and academia, as well as to the public. In addition, today, the Institute is a private limited company registered in Scotland.

The need for resources and materials is increasing rapidly and to meet that challenge necessitates unprecedented cooperation between scientists, engineers and industrialists. The Institute facilitates those interactions by offering members a congenial setting to integrate today’s expertise in science and technology with the vast body of knowledge obtained from more than two centuries of mining natural resources.

Technical Meetings are held from September to May and industrial visits during the summer. The primary bases for these meetings are in Edinburgh and Aberdeen where a video link is available between the venues. Other venues used include the University of St Andrews, the University of Edinburgh, the Robert Gordon University, the University of Stirling and the Garvock House Hotel, Dunfermline. Presently, only the University of St Andrews can video link with the primary bases in Edinburgh and Aberdeen.

Members of the Institute are afforded a number of exciting opportunities. As an affiliated local society of the IOM3, the Institute is an ideal networking platform, particularly for Scottish-based students and professionals at the start of their careers. Further, through the IOM3, the Institute can help facilitate interactions with professionals from relevant technical and academic communities. For more senior members, the Institute organises bi-annual social events. Moreover, members have ready access to IOM3 benefits.

The Institute also assists in further education, training and practice through its annual programme of technical meetings and events, student seminars, as well as organising bespoke visits to work sites and places of scientific or engineering interest. Annually, we sponsor a local heat of the Young Persons’ Lecture Competition, an open competition for undergraduate, postgraduate and early career researchers to showcase their work. Presentations are given at a host institution and the winner progresses to a National Final in London and, potentially, to the World Lecture Competition held at an international venue.

Student Seminars are held annually at the University of St Andrews, the Robert Gordon University and the University of Glasgow. Student membership is encouraged also at the University of Edinburgh, Heriot-Watt University and Fife College (which has its own Student Chapter). The Institute encourages and pays student membership fees for those students undertaking a relevant undergraduate degree, HND (SCQF Level 8) or HNC (SCQF Level 7) who join the IOM3.

Officers of the Institute are currently:

President - R A Laird CEng CEnv FIMMM
Secretary - D Seath CEng FIMMM
Treasurer - I Purdie CEng MIMMM.

These officers are supported by a Council of around 20 members, both male and female, drawn from the various grades of IOM3 membership. There is a Younger Members Representative on the Council.

We invite you to select us as your Preferred Local Society and contribute to our mission. All Institute events are open to visitors and for more details visit our website at: www.iom3.org/mining-institute-scotland for further information on the Institute and a full list of Council members.

David Seath—MTD Board Member
Colleyweston Slate Mine has been in the news in recent months providing unique slate to reroof prodigious buildings in Cambridge and New York. Claude N Smith Ltd., a roofing and mining company based in the village of Colleyweston, close to Stamford in Northamptonshire, previously undertook reroofing projects using reclaimed slates but increased demand and the development of a new, modern method for splitting the stone led to the redevelopment of underground mine workings which opened in 2016.

Although referred to as Colleyweston slate, the rock is a sedimentary Jurassic limestone which like slate has well defined bedding planes that allow the rock to cleave into thin ‘slates’. The rock is regarded as a heritage building stone and has been quarried and mined around Colleyweston for centuries. Historic England accounts for several thousand properties that have a Colleyweston slate roof. Unlike true slate the Colleyweston slate, once mined or quarried was left outside for varying periods and kept damp so frost action would split the stone into layers that could then be further split to produce slates of various size and thickness. Underground mining of the rock ceased in the 1960s largely because of difficulties in relying on the traditional method to split the stone, the frosty mornings weren’t as numerous as they used to be – perhaps an early warning of climate change even back then.

Research in conjunction with Historic England and Sheffield Hallam University developed an artificial method to mimic the freeze-thaw cycle where the stone is put into specialised freezers whose temperature was kept in the range of -5 or -10°C and thaw temperatures a little over 0°C to replicate typical January and February conditions. This new method for speeding up the natural splitting process provided the impetus to redevelop the underground mine as the time required to produce the slates was vastly reduced.

Originally mining took place around 60 feet below ground using a technique known locally as ‘foxing’ where a miner would lie on his side and tap away at the overhead rock with a foxing pick. Eventually the overhead rock would fall and the roof would be supported with waste stone. Claude N Smith Ltd working with Darren Bland at CQA International Ltd excavated over 100 m of rock to form an access tunnel to new mine workings. In the mining areas a 2 m high access passage was developed for a robotic mining machine with minimum width to reduce support requirement, masonry columns to support the roof and RSJ beams installed as required. The Mines Regulations 2014 apply to the mine and it is looked after by Neil Battison HM Principal Inspector of Electrical Engineering in Mines and a member of the MTD. In 2020 Colleyweston slate will be used to reroof Clare College and Christ College in Cambridge, a true mining success story that has ensured a historic resource will be available for many years to come.

Darron Dixon-Hardy—MTD Board Member

Colleyweston slates and slating on the Bodley Court building of Kings College, Cambridge

Old Westbury Gardens, Long Island, New York

Colleyweston Robotic Mining Machine