

Toasting the technology innovators

Rio Tinto's new Processing Excellence Centre in Brisbane, Australia

Compliments have rained down for the first International Mining Technology Hall of Fame awards ceremony held in Salt Lake City in the Grand America Hotel in February.

Guests gathered from as far afield as Australia, Canada, Finland, the UK, and many more from within the USA. It was particularly pleasing to see two family groups at the event – the four daughters of Dr James J Scott (Split Set – the Underground Support inductee) and immediate family of Dr Terry Mudder (Environmental Management and Stewardship inductee).

There have been many very important innovations/technology developments that have massively changed the industry in terms of productivity and safety over the past 50 years. Before that too there were many decades of such breakthrough developments. Many of those remain unrecognised and we felt it was time to start redressing the situation. It will take many years to catch up and recognise the innovators of this great industry that is so crucial to the modern world.

This is the first truly International Hall of Fame in the industry – the first, 2013 inductions included Americans, Australians, South Africans, Finns, Swedes and Canadians. As yet there are no British, German, French or Polish inductees, for example, but there are many of them deserving of recognition. I urge you to nominate for this year, see the website for details (www.im-halloffame.com). Be aware that a well presented nomination – explaining who, the technology, what it achieved, etc. is important.

The International Technology Mining Hall of Fame will become better known each year and we will be able to revel in greater numbers of nominations each year. We would love to see all the people that we think worthy of recognition inducted over the coming years, but it is not up to us, it is up to the international panel of judges we have assembled around the world.

The inaugural International Mining Hall of Fame Dinner was held at the Grand America Hotel, Salt Lake City, Utah, USA. Preston Chiaro, Rio Tinto Group Executive, gave the welcoming address.

He noted that “innovation has been central throughout the history of Rio Tinto. As many of

you know, Rio Tinto got its start in 1873 when it acquired the Rio Tinto mines in Spain for the princely sum of £3.68 million (equivalent to about £60 million today). Rio Tinto has achieved great success over these past 140 years by being very good at what we do, and by continually adapting to the changing world around us.

“Rio Tinto began to introduce innovative mining techniques even in that first mining venture in Spain. And at about the same time here in Utah early work began on the Bingham

are always looking for ways to do things safer, better, and smarter.

“At Rio Tinto, like many of the companies represented here this evening, we focus on creating shareholder value and, most fundamentally, we create economic value by improving productivity – more outputs with fewer inputs. That simple truth dictates that we must do things differently tomorrow than we do today. Of course we also add value to society in other, non-financial ways by, for example, minimising adverse environmental effects or making our local communities stronger.

“But of course, innovation, and particularly step change innovation, also means taking on and managing risks, including both threats and opportunities. We are happy to take on calculated risks based on many years of industry experience, and we must always continue to adapt to the world around us. ‘Change or die’.

“We recognise that we cannot develop game-changing technology by ourselves, so we look to develop new business structures, new approaches to partnering, and new products in response to the changing needs of the world that we serve. We manage risk and increase the odds of successful development by working with leading centres of research expertise around the world.

“Our Mine of the Future™ program continues to reshape the industry, with efforts underway across the mining value chain. For example, VK1, a unique gravity gradiometer, will help us locate deep orebodies. Our program also includes new approaches to drill and blast, load and haul, crushing and conveying, mineral processing, and even maintenance practices. Finding ways to eliminate hazards and improve safety is at the core of all of this work, as is a desire to reduce our energy and carbon footprints.”

Touching on the relatively new Rio Tinto Operation Centre in Perth – an industry first, he noted “we have learned much from our early efforts and, with the help of partners like MIT and the US defence, aerospace and space



The SME Board of Directors has agreed to support the International Mining Technology Hall of Fame awards dinner on Monday, February 16, 2015 at the Brown Palace Hotel in Denver. The event will be an official part of SME week 2015, with both SME and CMA (Colorado Mining Association) supporting it.



Canyon copper deposit. At the dawn of the 20th century Daniel Jackling, the father of open pit mining, brought in huge, new-fangled steam shovels to make Bingham Canyon the first mine able to successfully exploit large, low grade, hard rock deposits of copper, gold, and silver.

“We embrace new technologies and ideas – either by creating something new, building on existing ideas, or creatively combining and applying ideas and approaches in new ways. We



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sectors we have improved immeasurably on the original concept by incorporating the philosophies of human systems engineering.”

In Western Australia, our fleet of autonomous mining trucks, operated by Rio Tinto, has already moved more than 130 Mt of dirt at the time of the event and driven over 2.3 million km.

Such “developments increase production and reduce our costs and our environmental footprint. They open up new resources, and extend the life of old ones. And they eliminate hazards that might harm people.

“But of course technology itself is nothing without the individuals and teams who are developing, testing and executing it. People and teams are at the centre of what we do in our Mine of the Future program in a number of senses. First, I’ve already mentioned our human factors work with MIT and NASA; to get the most out of new technology we must understand how people will most effectively and efficiently interact with it. I’ve also mentioned our partnership approach to innovation whereby we leverage the work of non-employee PhDs around the globe to help us develop new technology. Within the company we are creating new roles for both existing and new employees, along with training programs to help them come up to speed as rapidly as possible. There are exciting opportunities for people to be trained in new roles and gain new skills that will be at the forefront of mining in the future. And lastly, taking a progressive, modern approach to our technical challenges is helping us attract a new generation of talent to our industry.

“So I think it is very appropriate that this Hall of Fame dinner is also focused on the people who have made a real difference within the



Old friends: Terry Mudder and John Chadwick, founder of International Mining and this Hall of Fame

mining industry. We’ll all get a chance to meet a few of them in just a few minutes.”

ENVIRONMENTAL MANAGEMENT AND STEWARDSHIP

Dr Terry I. Mudder has more than 30 years’ experience in the investigation of the chemistry, analysis, fate, aquatic toxicity, and disposal of mining and cyanide wastes. During that time he emerged as the leading environmental scientist and engineer in the mining industry internationally related to cyanide issues and has been instrumental in expanding the fundamental information and data base regarding the environmental effects of cyanide and its many related compounds.

Mudder made a few observations about the inductees. “In spite of their varied backgrounds and contributions, there are similar threads amongst their characteristics. The first is innovation. These are the innovators who extend their extensive expertise and experience through vision to improve some aspect of the

mining industry in the areas of mining, metallurgy, safety or environment. Another characteristic is knowing how to take and accept risk in a controlled manner. But along with risk they are willing to accept that failure can and will occur but still press on. They can handle adversity and take criticism. Finally, it seems none of them were the proverbial ‘one trick pony’ as they say. Each one kept innovation as part of their constant mantra.

“I can guarantee you when developing the first microbial treatment process at

Homestake for tailings impoundment and mine waters I was under immense pressure at 28 years old and took continuous criticism. The continued viability of the operation depended on the environmental group’s success. As soon as it was a success I had plenty of people who said they were with me all along. Same with development of modern cyanide recovery and the passive biological process to treat heap leach drain down. I have worked to find ways to blend the environmental needs of an operation into the process or mining side to encourage management to come along. It has never been easy for this industry to accept vision and innovation. These processes go well beyond merely cyanide. Closure has also been a keen interest of mine as that is the period of the mine life along with decommissioning that true stewardship should arise along with maybe sustainability.”

EXPLORATION

Edmund Joseph Longyear founded the company EJ Longyear (which has now become Boart Longyear) in 1890 when he “inherited” an old abandoned diamond drill on the Iron Range in Minnesota.



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Now into its fourth year, the **IM Events In-Pit Crushing and Conveying Conference** continues to go from strength to strength. And in 2014 we have chosen South Africa as the venue – following the previous IPCC events in Brazil, Indonesia and Germany. South Africa was a popular choice among previous delegates for a number of reasons – the size of its domestic mining industry; the suitability of many of the operations for employing elements of IPCC; the relative lack of IPCC take-up so far relative to other parts of the world; and the massive potential in other major mining countries in the sub-Saharan region, from Botswana and Namibia to DRC and Zambia.

IPCC is moving rapidly to becoming a serious consideration in the feasibility stage of many projects – and increasingly large scale IPCC projects are coming to

fruition in Indonesia, China, Australia, Brazil, Kazakhstan and elsewhere. As ever, the program and audience will include a mix of real case studies, technology providers, mining groups, mining contractors, component suppliers, academics/mining engineers, consultants and others. While we are very keen to invite those within southern Africa with involvement or interest in IPCC, this as always is a global event so offers of presentations are welcome from all parts of the world. Those covering real projects and studies are particularly welcome. Following feedback from previous events, there will also be an element of training at this conference, helping interested parties understand the detail of IPCC as it relates to mine planning, financing, risk assessment, culture/mindset, and approach to maintenance planning.

Opportunities are open for both speaker slots and for sponsorship of the conference. Interested parties are advised to contact the **IPCC 2014 Conference Director Paul Moore** as soon as possible at paul@im-mining.com. Please also check for regular conference updates and details on how to register at <http://corporate.im-mining.com/imevents/>



Monika Portman collects Edmund Longyear's award from Paul Moore

His company basically invented contract diamond drilling and most of the drills and in-hole tools necessary to accomplish that expensive and necessary task.

"Edmund truly was a pioneer in mineral exploration and drilling," said Richard O'Brien, President and CEO of Boart Longyear. "He deserves the recognition that the International Mining Technology Hall of Fame bestows upon its inductees."

Monika Portman, Director of Product Management, Marketing, and Corporate Communications said "It is hard to imagine that E.J. Longyear could have predicted where his drive and innovation would eventually lead the company he founded in the late 19th century. Fast approaching our 125th anniversary, Boart Longyear continues to honour E.J. Longyear's legacy of innovations in drilling services, drilling equipment, performance tooling and safety.

"Drilling services innovations include our sonic drilling and water services. Boart Longyear has advanced sonic drilling equipment and methods to deliver precise drilling, efficient operations and minimal environmental impacts. Our water services employ a unique process that is capable

of drilling large-diameter holes in a single pass, offering better overall well efficiency and production which eliminates downtime and money spent over the life of the well. Boart Longyear offers a full range of drilling expertise. This includes exploration, production, mine dewatering, energy, and oil sands exploration.

"In drill rig innovations, the new LXTM11 is a powerful medium-sized exploration multipurpose drill capable of both diamond coring and reverse circulation drilling. The LX11 provides

increased levels of safety and operational flexibility with a low overall cost of ownership. This year we've also expanded our line of underground LMTM modular diamond drill rigs to include the new LM110. Ideal for deep holes, the LM110 is the most powerful Boart Longyear underground diamond coring drill rig to date.

"In coring performance tooling, Boart Longyear has produced many innovations over the years including the introduction of the QTM wireline system in 1958 and diamond-impregnated bits in the 1980s, both of which are among the most popular products in the industry today. Boart Longyear's patent applications over the years have approached close to 800 patents in various countries around the world.

"Recent innovations include the Quick DescentTM Roller LatchTM head assembly, which includes a MKIITM Spearhead. This head assembly contains a patented roller technology that eliminates the play and jamming associated with traditional 'swing out' latch mechanisms, preventing drag for increased tripping time. Our UltramatrixTM (UMXTM) product line includes diamond bits, diamond reamer shells and diamond casing shoes — all offering patent-

pending technology that makes diamond coring more efficient than ever before by drilling faster, lasting longer, and out-performing existing technology in a wide range of ground formations.

"Along with our world-class safety programs, Boart Longyear maintains industry certifications that ensure our employees have the necessary training and a clear picture of how their roles affect the environment, health, safety, quality and overall success of the company. And with stop work authority, we empower our employees to stop any work activity that does not comply with safety standards.

"From an equipment safety standpoint, Boart Longyear leads the way for hands-free drilling and removing the worker from harm's way with automation and remote controls. Boart Longyear develops components to distance drillers from the rigs, such as rod handlers, remote control stations and mechanical threading of rods.

"Boart Longyear is proud of our founding owner's legacy, and we're honoured to continue E.J. Longyear's rich legacy of technology and innovation in the drilling and mining industry for the next 125 years."

MINING SOFTWARE

You know you have made a difference in the world when your family name becomes a verb. This has happened in the mining planning world and the individual in question is **Jeff Whittle** – the man who has made a revolutionary impact on the mining industry in pioneering strategic mine planning. For well over three decades, His innovative thinking has made an impact on the vast majority of companies and professionals involved in the evaluation of mining deposits and the planning of mining operations.

Over a period of 16 years he developed a series of mining optimisation packages, including Whittle Four-X, Opti-Cut (inspired by Ken Lane's theories on cutoff grade optimisation) and the Milawa algorithm (a creative solution to the difficult non-linear mine scheduling problem). Whittle Programming was sold in January 2002 to Gemcom Software International, which is now known as GEOVIA following its acquisition by Dassault Systèmes. GEOVIA is the largest global provider of mining software.

Last year, Whittle Consulting, announced a significant upgrade to its in-house Prober software, after more than three years of development, prototyping and testing. The latest Prober C version enables modelling of multiple steps in the mining value chain, bringing technologies such as mine-to-mill, selective blasting, ore sorting, and complex comminution strategies into the strategic planning process.

"New technologies in ore characterisation and extraction processes enable substantial economic and energy saving opportunities.



Particular features of Boart Longyear's LM110: 1. Reversible Feed Cylinder – this reversibility increases up-hole drilling capacity; 2. Semi-automated Rod Handling (Optional) – makes handling of rods safer and easier; 3. High Torque Breakout – breaks most rod joints automatically; 4. Fail Safe Rod Clamp – hydraulic open and spring close rod clamp results in fail safe operation



Developments in these areas, led by our alliance partner JKTech, have clear operational benefits. We can now harness their strategic significance by re-optimising the pits/phases or underground mines, mining methods, life-of-mine schedules, cut-off grade and stockpiling strategies, processing policies, product strategies, logistics and capital scaling decisions to apply these technologies in an integrated fashion. This will compound economic performance and increase Returns on Capital Employed.” explains Whittle Consulting CEO, Gerald Whittle.

For the last decade, Whittle Consulting has helped mining companies substantially improve the cash flow profiles of their mining projects and operations through an integrated approach called ‘Enterprise Optimisation’.

Invariably the result is an increase in NPV of 5% to 35%, and sometimes substantially more. In many cases the net cash flow is doubled in the first 3 to 5 years, usually with little or no capital expenditure involved.

As the trends continue towards lower grade and problematic orebodies, escalating costs, scarce capital and diminishing margins – the

Not slowing down: Jeff Whittle (below) skydiving earlier this year



Enterprise Optimisation capability will help progressive mining companies lead the way in terms of competitiveness and sustainability.

Enterprise Optimisation, often nick-named the ‘Money Mining’ approach, is underpinned by Prober software developed by Jeff Whittle. His recent elevation to the International Mining Technology Hall of Fame is recognition of the impact his work has had upon the mining industry globally.

Jeff, now 83 years old, explains “We have been using the previous version Prober B for over a decade. It allows for three steps in the value chain: mining, processing and production,

although with some clever but convoluted modelling more could be accommodated.”

The new Prober C supports unlimited sequential or parallel procedures, making more detailed yet more intuitive modelling of complex mining and processing technologies possible. This is then simultaneously optimised to maximise the value of the business.”

Where to from here? In theory, economically successful operations will have the financial flexibility to deal with social, political and environmental considerations.

“We see the integration of

Enterprise Optimisation and Sustainable Operations (SUSOP®) being the ‘holy grail’ in strategic and operational planning. This both accelerates cash and sustainability outcomes fundamentally changing the economic and sustainability signature of assets.

“By linking hard technical options through economic optimisation to include the social, political and environmental consequences of the decisions, stakeholders can deepen their understanding of the economic trade-offs and their consequent impacts on the Sustainable Development Balance Sheet. We call this integration Green Line Mining.”

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When Jeff was recently asked why he keeps working his reply was simple, "because it's just such a fascinating problem".

UNDERGROUND DEVELOPMENT

Gustaf Andersson and **Erik Ryd** were two of the many great engineers we have seen from Atlas Copco over its history of more than 125 years. They are fathers, along with Gustaf Ryd (Erik's father), and there are many others, of modern rock drilling. Other fathers of rock drilling were to be found in companies like Tamrock (Sandvik), Ingersoll-Rand, Gardner Denver and Montabert. Andersson and Ryd are the 2013 inductees, but cannot be remembered in isolation. The earlier work of Ryd's father Gustaf was essential (as was John Munck's support) to the further development of the Ryd and Andersson innovations.

When young Swedish engineer Gustav Ryd returned from a study trip with a caulking hammer from England and a riveting hammer from America, little did he know he was about to embark on a journey that would make his company a global force in rock drilling technology. That was in the 1890s, and Ryd's work, and subsequently that of his son Erik, led to what became known as 'The Swedish Method', a compressed air powered hammer and pusher leg combination that is widely recognised as one of the most significant developments in the history of the mining industry.

Atlas Copco comments that "This groundbreaking invention quickly led to the development of compressed air driven drill rigs with rock drills mounted on several booms, followed by hydraulically driven versions that provided not only high speed, precision drilling but unprecedented operator comfort. By the mid-1970s, Atlas Copco's leadership in rock drilling technology was undisputed and productivity in the mines soared."

Today's rock drills are a far cry from those first, iconic inventions, but no less important. Extraordinarily powerful, they combine high productivity with remarkable energy efficiency. Mounted on the booms of today's advanced, computer-controlled drill rigs, they enable mining companies to achieve ever increasing productivity goals.

The work of Gustav Ryd and his colleagues provided the inspiration not only for effective drilling products but for a customer-focused mindset that has supported the mining industry for more than 100 years. However, today's product developers have now taken this legacy a step further, Atlas Copco says. "Great products are, by themselves, not enough, and the company must also strive to develop new ways of working that can lead to increased safety as well as higher productivity.

Bill Warfield of Atlas Copco USA collects the Underground Development award from John McGagh, Rio Tinto Head of Innovation

"The development of the Rig Control System (RCS) is a prime example. With all equipment sharing the same basic technical platform, it is now possible to manage an entire fleet of production drill rigs from a single control station, optimising production operations. Similarly, advancements in automation technology leading to driverless LHDs and dump trucks, have had a significant impact on safety, particularly in deep and hazardous mining areas.

"At the same time, Atlas Copco is also deeply involved in the drive for sustainability. Can today's mines be successful in bad times as well as good? Can their resources be used more efficiently with less waste and lower costs? Can safety be improved to the point where accidents and injuries become a thing of the past? Are mines prepared to abandon traditional practices and introduce new thinking that will encourage young, career-minded professionals to join the industry?

"All these issues and more spring from the legacy of Gustav Ryd and a handful of other outstanding Swedish engineers. As Atlas Copco celebrated its 140th year in business in 2013, coinciding with this induction into the International Mining Technology Hall of Fame, there can be little doubt that the company will continue to play a key role in shaping the mining industry of the future."

UNDERGROUND PRODUCTION

Don Maclean, who founded his namesake company MacLean Engineering in 1973, has been



in the mining equipment business since the early 1970s. He is a professional mining engineer who early in his career worked for Inco in Sudbury. Although not a mechanical engineer, Don brought ideas and concepts that could be turned into useful products. He spearheaded drawpoint obstruction clearance machines, known as Blockhole Jumbos, in the late 1970s that, although a very simple concept initially, became dependable and irreplaceable tools for underground bulk mining. It was his belief in the importance of ore flow conditioning at the drawpoint and his willingness to foster and adapt new technologies that enabled his company to go from being a regional manufacturer to one having an international impact on the underground mining equipment scene.

Don MacLean noted that "1966 was an eventful year at Inco in Sudbury. Not only was there a three-month strike which garnered the headlines, but two new pieces of equipment arrived quietly at Frood mine in April and Creighton in December. These were ScoopTrams designed and built by Wagner Equipment.

"As a young supervisor at Three Shaft, who



The family celebrate with Underground Production innovator Don MacLean



Congratulations to all inaugural nominees and inductees recognized by the International Mining Technology Hall of Fame.

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had seen no change in mining methods from his father's generation, but had seen a Joy Transloader working at Henderson mine in Chibougamau, the performance we quickly experienced on Creighton 18 level, foretold of a paradigm shift. We used the ST-4 Wagner Scoop in driving trackless headings to access drawpoints from the induced cave. The idea was to use these

LHD units to replace the 100 hp electric slushers in the scam drifts, which fed the network of raises, leading to the crushers below.

"Within six months the verdict was in, and a justification was made to not complete a Grangesberg Train installation, that was well along to completion. Instead it was proposed to use the new trackless system to feed the crushers.

"A 'hung up' boxhole, the only source of muck to demonstrate the superiority of the new technology for a sceptical board of directors, who



Paul Moore with Lou Boltik of Joy Global and the trophy for Surface Mine Load & Haul

were being asked for capital to replace a previously justified, and largely spent sum that would be of no value, stood in the road. That challenge was totally convincing with respect to the need for a technique to bring down 'hung up draw points' safely and cost effectively.

"The rest, as the saying goes, is history. New mining methods were developed, that along with the trackless equipment that enabled it, produced an overall increase in productivity allowing large tonnages of lower grade mineral inventory to be mined successfully.

"This recognition of the paradigm shift that was upon us, the belief in the need for unique pieces of support equipment to work alongside the scoops and jumbos, led to the founding of MacLean Engineering and Marketing, and the development of the team that would provide the 'solution to problems with mining in mind'.

I appreciate the nomination, and especially being chosen for induction to the International Mining Technology Hall of Fame. This award I accept on behalf of the people who worked with me in the past, and today, to make underground hard rock mining a safer and more productive industry. As

well, we at MacLean Engineering recognise and appreciate the strong support of the people in the mining industry who shared the risk of developing the many new innovations that have become successful tools of our trade."

SURFACE MINE LOAD AND HAUL

Alonzo Pawling and Henry Harnischfeger co-founded a company in 1884 which went on to bear the globally famous name of P&H Mining, now part of Joy Global.

"Joy Global is honored to receive the International Mining Technology Hall of Fame Award in the Surface Load and Haul Category," said Joy Global Corporate Communications Director Lou Boltik, following the induction of Alonzo Pawling and Henry Harnischfeger. "Now marketed under the brand of Joy Global Surface Mining, P&H Mining drilling equipment, shovels, wheel loaders and draglines are operable in more than 90% of today's global surface mines.

"Joy Global leadership is the result of a 130-year history of mining industry service, and an ongoing commitment to partner directly with customers by providing world-class products, people and processes," explained Boltik. Formed in 1884, the Pawling & Harnischfeger Machine and Pattern Shop rose from a small machine business to a major producer of earthmoving machines. In the early 20th century, P&H-trademarked equipment included the first gasoline-powered dragline; the first crawler-propelled power shovel; and on to the innovative 300-Series machines, which were the first convertible configuration units used as shovel, backhoe, clamshell, dragline, crane, auger, and backfill machines.

From this rich history comes a powerful presence. Today, Joy Global operates 132 locations in 18 countries, including recent mining equipment company acquisitions in China which allow the company to optimise its global supply chain while meeting the needs of strong emerging markets. "We recently introduced five new machines to the local China market. Each incorporates Joy Global technologies, allowing us to greatly differentiate these products from conventional local offerings," said Boltik. He also notes the expansion of Joy Global Business Systems (JBS) by implementing programs within all facilities with the goal of driving mining operation performance to safely increase production while lowering operating costs. "Safety is our number one priority at both our customers' mines and at our own facilities. It is our mission to lead by example in continually developing technologies that facilitate zero harm."

As to ongoing product development, Boltik points to several new innovative solutions on the horizon. "First, we are developing a new hybrid

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The future of mining

Rio Tinto is a global mining and metals group dedicated to the smartest discovery, extraction and processing of the Earth's natural resources.

The Mine of the Future™ programme is a holistic approach taken across Rio Tinto to find new ways to mine and extract minerals more efficiently while reducing environmental impacts and most importantly, further improving safety.

These advances are about achieving competitive advantage through step changes in mining. We aim to be global leaders in fully integrated, automated operations.

Through this approach Rio Tinto is changing the face of mining. To learn more about our Mine of the Future™ programme visit www.riotinto.com

RioTinto



Brett Cook, Timo Soikkeli and Brett Cook flew in from Finland to collect the award for Sandvik AutoMine. Riku Pulli had a prior commitment and could not attend



shovel/excavator for surface mining, which will give customers the reliability of an electric rope shovel, with the digging characteristics and mobility of a hydraulic excavator. Secondly, we are developing a unique loader product for underground hardrock mining that utilises both our proprietary switched-reluctance drive technology and our underground engineering expertise in continuous haulage.”

“Beyond product, Joy Global’s continuing commitment lies in its people and the processes amidst its direct service network which comprises field service experts; 24/7 support; product training; reliability-centered maintenance; rebuild services; parts forecasting; and its Smart Services platform, which directly connects its service fleet to technology centres worldwide.

“Since inductees Pawling and Harnischfeger pioneered our industry, Joy Global has continued to focus on service, safety, innovation and product leadership – via a team that is eager to tackle mining’s toughest challenges,” concluded Boltik.

UNDERGROUND LOAD AND HAUL

Finland and Sweden have led the world in the development of new mining technologies over the years. A team of four people – three from Sandvik Mining and one from Navitec – received the Finnish Engineering award in June 2013 for the development of the AutoMine automated loading technology. That Sandvik AutoMine team, inducted into the International Mining Technology Hall of Fame comprises **Riku Pulli**, Vice President, Mine Automation; engineer **Janne Kallio** from the Turku plant along with **Timo Soikkeli** and **Brett Cook**.

AutoMine is the automated loading and hauling system for underground hard rock mining which has transformed mining practices where it has been implemented. It can just as successfully be adapted to small scale operations as well as massive block caving applications. Moreover, the system incorporates functions and applications

that allow it to interface with other third party IT systems at the mine site.

AutoMine has now progressed to AutoMine-Lite, an advanced alternative for tele-remote and radio remote control (RRC) systems, based on the proven AutoMine® core technology. It is available for a vast range of Sandvik’s LHDs. A flexible and modular system it offers complete working safety. Among its specific advantages for any application are the ability to tram fast, the ability to relocate the system, its simplicity of use and the way it reduces LHD collision damage. AutoMine drilling systems are also now being deployed.

Looking forward, Sandvik Mining and Maptek are cooperating to develop integrated planning, execution solutions and robust automation systems for the industry. The two are working towards delivering automated mining equipment which can connect to and work directly from mine planning and measurement data in Maptek products.

“There are enormous benefits to be had by making Sandvik mining equipment more automated and more spatially aware,” said Rowan Melrose, Global Head of Automation at Sandvik Mining. “Improved accuracy and precision, improved safety and cost reductions are all directly related to the outcomes we are targeting.”

Melrose said the cooperation between Sandvik and Maptek will aim to remove the separation that exists between mine planning and design detail and production equipment and operators.

Peter Johnson, Maptek’s General Manager – Australia: “This work will be a huge leap forward for our customers, who will be able to send detailed design and modelling data flowing through their mine operations, and monitor in real time performance and conformance. This is the next step towards further unlocking the inherent value in resource and mine planning data. The biggest challenge remains in consistent delivery across the mining value chain, and this initiative between Maptek and Sandvik is aimed directly at that outcome.”

UNDERGROUND SUPPORT

Split Set stabilisers were originally developed by **Dr James J. (JJ) Scott** and were manufactured and distributed by Ingersoll-Rand for many years. They are now marketed by International Rollforms in New Jersey, USA. The system consists of a slotted high strength steel tube and a face plate. It is installed by pushing it into a slightly undersized hole and the radial spring force generated, by the compression of the tube, provides the frictional anchorage along the entire length of the hole.

Because the system is quick and simple to install, it gained massive acceptance by miners throughout the world. The device is particularly useful in mild rockburst environments, because it will slip rather than rupture and, when used with mesh, will retain the broken rock generated by a mild burst.

International Rollforms explains that “Split Set® rock bolts give a choice of tube and plate sizes. In the hole, the tube exerts radial pressure against the rock over its full contact length, and provides immediate plate load support.

“Detailed drawings specify materials, dimensions, and tolerances. Every Split Set is identified with model number, length, factory, rolling date, and heat lot of the steel.

“The tube is installed by driving it into a



JJ Scott's four daughters with the award for underground support



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slightly undersized hole using the same standard percussion drill which made the hole. As the tube slides into place, its full length slot narrows and the tube exerts radial pressure against the rock over its full contact length," explains Terry Karlsen of Split Set Products.

SAFETY

John T Ryan Sr contributed immeasurably to the development of coal mine safety during the first half of the 20th Century. In 1914, Ryan and George H Deike Sr formed the Mine Safety Appliances Company (MSA) in Pittsburgh, which began vigorously to develop methods of avoiding methane and dust explosions in mines. Their company would become the largest mine safety equipment supplier in the world.

Just after the event, MSA announced the new parent company name has changed from Mine Safety Appliances Co to MSA Safety Inc. Celebrating its centennial anniversary, MSA was founded in Pittsburgh in 1914 by John T. Ryan and George H. Deike to help protect the lives of miners. Among the company's first products was an electric cap lamp – developed by Thomas Edison – that reduced mine explosions and miner deaths by more than 75% over the following 25 years. Over the past 10 decades, MSA's business has evolved tremendously, growing from two employees to more than 5,000, who help protect workers, serving in a broad range of industries, in more than 140 countries.

The company's core product lines include self-contained breathing apparatus, fixed gas and flame detection systems, handheld gas detection instruments, industrial head protection products, and fall protection devices.

William M. Lambert, MSA President and CEO, explained "MSA has excellent growth potential around the world and this realignment positions the company to better realise that potential while maintaining the strong equity of the MSA brand and name that has been built over the past century."

COMMUNITION

Fittingly it was the Coalition for Eco-Efficient Comminution (CEEC) International that nominated **Professor Alban Lynch**. He was, from 1970-1989, the first Director of Australia's JKMRRC, and from 1988-1993 Head of the Department of Mining and Metallurgical Engineering at the University of Queensland, after which, until 2007 he was Visiting Professor at a group of notable institutions.

Left to right: Sandy Gray, Gekko and CEEC, John Chadwick, Gerald Whittle with his father's award, Professor Mike Nelson, Head of Mining at the University of Utah and a colleague of Alban Lynch for some years with the award he accepted on his behalf, and Elizabeth Lewis-Gray of Gekko and CEEC



Bob Delbridge, CMSR, Superintendent of Safety & Training, J.S. Redpath Corp (left) presents the Safety award to Matt Eichinger, representing John T Ryan Sr and George H Deike Sr, founders of MSA

Prof Lynch has published four books and over 150 technical publications in conference proceedings and refereed journals, and has been the recipient of many awards which prior to this International Mining Technology Hall of Fame induction included the 1978 President's Award from The Australasian Institute of Mining and Metallurgy (AusIMM); the 1985 Richards Award from the American Institute of Mining, Metallurgical and Petroleum Engineers; the 1989 AusIMM Distinguished Speaker Exchange Program; the 1991 AusIMM Sir Willis Connolly Medal; the 1993 Institute Medal from the AusIMM; and in 1999 an Officership in the Order of Australia, "for service to the mining industry, particularly in the area of research and education on the application of engineering technology in minerals processing."

Prof Lynch was unfortunately not able to attend his induction in the comminution category in Salt Lake City in February, but he wrote to John Chadwick with some comments. "I am honoured to be elected to join such a distinguished group of inventors and engineers. I would love to be able to attend the induction ceremony in Salt Lake City but my mobility is not good and I regret

to write that the trip would be beyond me.

"I have had time to think about the years of effort which went into making the inspired idea of the International Mining Technology Hall of Fame a reality. The accumulated stories over the years of the work of inductees will be a marvellous history of the development of Mining Technology and I wish to congratulate you on the result of your effort. I hope that you will have time to record your recollections of some of the great advances when you retire."

CONCENTRATION

Laureate **Professor Graeme Jameson** is Director of the University of Newcastle's (Australia) Centre for Multiphase Processes, a major centre for research and research training in the science and technology of fine particles and bubbles. He was nominated separately by two people, including Rio Tinto's John McGagh. He is a true pioneer in innovative flotation research, and the inventor of the Jameson Cell which bears his name. This was first introduced 25 years ago at Mt. Isa and is now installed in over 320 operations worldwide. Now in his 70s, he continues to publish innovative work on the fundamental nature of flotation, and in 2013 was awarded the Antoine M. Gaudin Memorial Award.

The University of Newcastle says Jameson's "contribution to the Australian economy and the environment as the inventor of what is considered by many to be the nation's biggest export earner in the last 25 years, has earned him gold status within the minerals industry. The Jameson Cell, a froth flotation device, has netted Australia more than A\$26 billion in exports."

Sadly, late in the preparations, Prof Jameson had to cancel his attendance for family reasons.

His research continues to push the boundaries and he is currently working on a Fluidised Bed Flotation Cell that has the potential to make massive reductions in the energy used in mineral concentration. This has the potential to recover





A LEGACY OF INNOVATION



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Thank you, Edmund Joseph Longyear, for your dedication and inspiration.



coarse particles as large as 600 μm , reducing grinding energy by as much as half. The new process is ideal for the recovery of copper, gold, silver, nickel, lead and zinc. "A device like this will maximise mineral recovery, as well as yield significant savings in both energy and money" says Jameson. "Another substantial benefit is that reducing the need to produce as much energy also minimises the amount of greenhouse gas emissions created during electricity production."

CSIRO has estimated that the energy used in grinding rock to retrieve valuable material is equal to 14% of Australia's electricity production. "In this day and age, the amount of valuable material recovered is very small, representing 1 to 2% of the feed material, so we are grinding 98% of the feed, only to throw it away," Jameson said.

"To recover particles of copper ore, for example, it is necessary to grind the whole of the feed to the plant, to a top size that is typically 150 μm - about the size of a human hair," he said. "Currently, because the coarse particles are knocked off the bubbles by the violent, turbulent action in the tank, there is a need to grind the particles to a super-fine state. My theory is that if we can extract these coarse particles, you won't have to grind so fine and you won't have to expend so much energy."

"Imagine a bed of sand. If you're well away from the water the sand will be pretty stable and if you stand on it, you don't sink. However, if you go a bit closer to the water you can make the sand fluidise just by moving your feet up and down," he said. "The sand stays more or less in the same place but the water in the sand is pumped up and down and momentarily it lifts particles away from their neighbours, so the sand becomes liquid-like and you can sink down into it."

"The fluidised bed flotation device uses the same principles by pushing air bubbles through the sediment and this creates a quiet environment for the larger particles to attach to the bubbles."

OUTSTANDING INNOVATOR (sponsored by Sandvik)

Last but by no means least **David George**, General Manager, Processing, Technology & Innovation (T&I) at Rio Tinto, has been involved in many mining technology projects. He was inducted for his contribution to the Kennecott-Outotec Flash Converting technology. This technology has revolutionised copper smelting; setting the standard for sulphur dioxide capture, improving safety by eliminating molten matte transfer, and reducing the labour required to produce copper. It is recognised by the US Environmental Protection Agency as the Best Available Current Technology (BACT) in copper smelting. The technology was developed by combining Outotec's well proven flash-smelting with the Kennecott Utah Copper (KUC) flash-

converting intellectual property, to which David was an instrumental contributor.

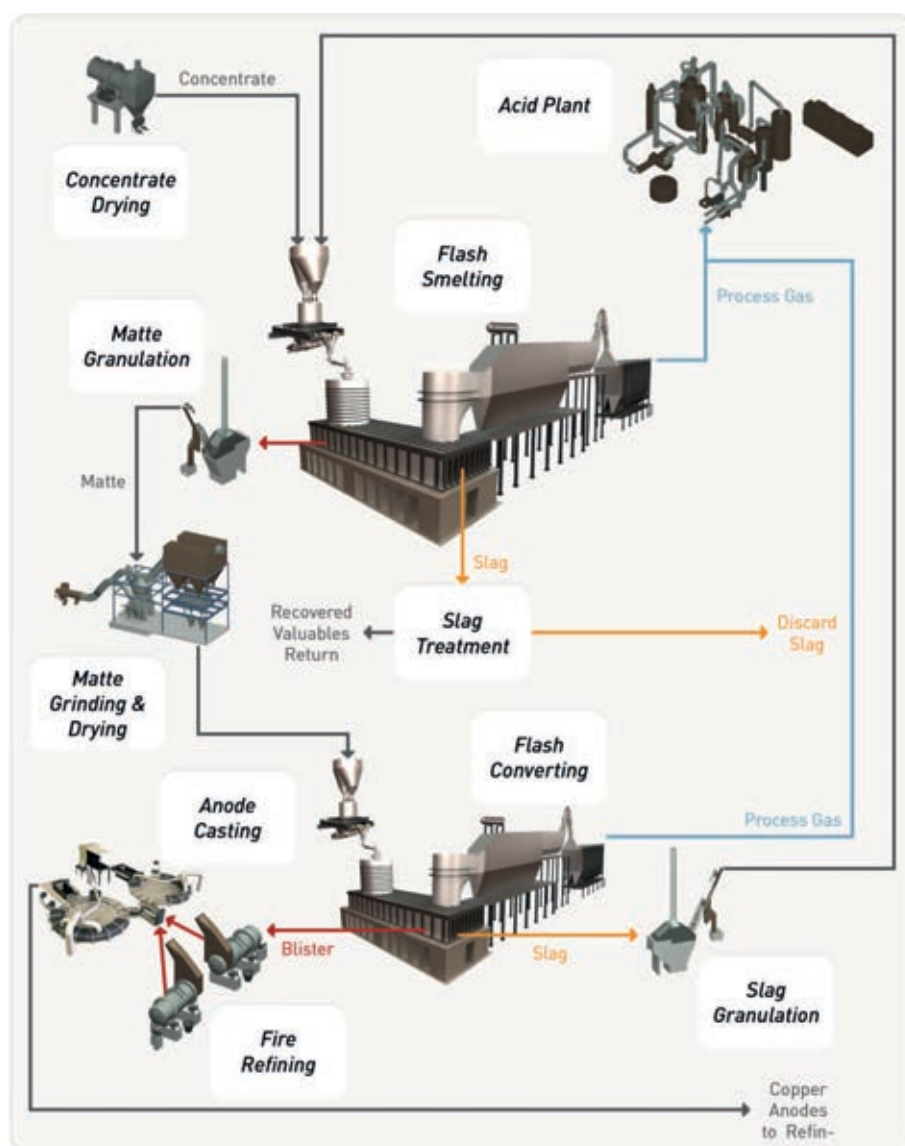
"I am both surprised and honoured to be selected as the Outstanding Innovator at the inaugural International Hall of Fame awards," he said. "The development of Flash Converting, which has now been in operation at Kennecott for nearly 20 years and is now being widely adopted in China, culminates 30 years of work."

"The easy part was coming up with the idea, after that it was difficult to develop the technology and convince the industry of the value of this approach. Fortunately when Rio Tinto acquired Kennecott in the late-1980's the technology was ready for commercialisation and the appetite for a new smelting process made it possible to construct the Kennecott smelter using the Flash Converting Process."



David George receives his award from Sandvik's Eric Gourley

"The opportunity to work closely with the Chinese copper smelting industry has been a very enlightening experience. Their ability to go from approval to operation in two years and achieve design capacity in mere months sets a high standard for the industry." "For me the most



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important benefit from the development has been the reduction in intrinsically dangerous tasks compared to conventional smelting.”

Inductees for 2014

Nominations are now open for the 2014 inductions that will be celebrated in Denver in February next year, at the Brown Palace Hotel. Send your nominations to us remembering that there is an international panel of judges that you have to convince. Tell us the innovation and the name of the person, or the names of the team that developed it. Tell us what that innovation achieved. Alternatively you could nominate someone in a mining company that facilitated the implementation of an innovation.

Facilitators already nominated include Northparkes Mines' Matthew Betts for Outstanding Innovator. He has led the development and implementation of several major innovations in mining at Northparkes including the automated underground mining and the Robotic Idler Change-out system (RIC).

Other nominations for Outstanding Innovator include Nick Hazen, President and CEO of Hazen Research, a company that was founded by his father and grandfather in 1961. The company has grown from a single-building laboratory to the largest private metallurgical and processing R&D facility in the USA and serves clients around the world. Atlas Copco's Sverker Hartwig is nominated as a driving force in advancing rapid underground development. Other nominations received already include:

EXPLORATION

- Robert (Bob) Loucks - Whole rock trace element ratios
- Douglas W. Oldenburg - Professor: Earth and Ocean Science, UBC
- Ray Roussy - President of Sonic Drilling and the Sonic Drill Corp
- Nikolai V. Sobolev - Study and development of Cr-Ca systematics in garnet concentrates, xenoliths and diamond inclusions.

UNDERGROUND DEVELOPMENT

- Udo Fischer and his Sandvik co-workers Torbjörn Hartzell and Jan Åkerman - Groundbreaking development of rock tools in the industry
- Jannie Smith - Developed a series of dependable technologies that have seen the rise of a range of Manitou flameproof mining utility vehicles (MUVs) and skid steer loaders.

UNDERGROUND LOAD & HAUL

- Dale Elphinstone – pioneering work on Cat machines leading to Caterpillar Underground Mining
- Joe Joy – The Joy Loader

- Jacques Melkonian – Started developments that led to Continental Industrie and Aramine.

UNDERGROUND PRODUCTION

- Donald Brisebois, Jean-Yves Therien, Andre Savard, John Stella and Ken K.J Onoda-Song – Thermal Rock Fragmentation
- Wilhelm Löbbbe - Invented and refined the coal plow.

UNDERGROUND SUPPORT

- Professor Charlie Li – The D-Bolt
- Tom Melbye, Mike Rispin, Odd Bjorn Kleven, Janne Lehto, Ismael Anabalon, Jouko Tenhunen and Rick Kraft – Normet sprayed concrete (wet shotcrete)
- John Patrick Wood – Founder of Hydramatic Engineering.

SURFACE PRODUCTION

- Juha Piipponen and team – Sandvik Ranger surface drill, its revolving superstructure was very revolutionary at the time it was launched
- Markus Reinikka and team - The new Sandvik Pantera percussive drill platform for both DTH (down-the-hole) and TH (top hammer) applications
- Karl-Axel Stjernström, Kurt Andersson and Jörgen Rodert - Development of Atlas Copco's Coprod system.

SURFACE LOAD & HAUL

- Peter Chittleborough, Rio Tinto - Supervisor of the Mine of the Future™, Autonomous Haulage Deployment Team
- Ralph Kress - The father of the modern off-highway truck
- Andrew Jessett - Advancing dragline operations closer to automation
- Dr Jonathan Peck - Co-founder and CEO of Aquila Mining System
- Dr Shahram Tafazoli - President and CEO of Motion Metrics International
- Dr James White, Mark Baker and Michael Arnold - Developed the first commercially accepted automated truck dispatching system for the mining industry, forming Modular Mining Systems

BULK HANDLING

- John S. Frater - FLSmidth Pump Technical Director with internationally renowned pump designs.

SAFETY

- Dr Daniel Bongers - SmartCap inventor (fatigue management)
- Elli Choi – The new DM Hybrid glove
- Dr Murray Johns – Optalert, real-time operator alertness monitoring system
- Jim Joy - Leading the technology transfer of

global education and project initiatives initiated in the Minerals Industry Safety and Health Centre (MISHC) at the University of Queensland

- Dr David Noon and team - GroundProbe SSR and WAM interferometric monitoring devices
- Andy O'Brien and Andy Cecala - Developing several new innovations including the dust booth and the helmet cam
- John Pierce-Jones - Founder and Chairman of Trolex Ltd.

MINING SOFTWARE

- Fred Banfield – Founder of Mintec
- Paul Higgins – Dingo Software CEO has moved the mining industry from a machine repair culture in the 1980s to a modern Asset Wellness™ approach
- Craig Koehrsen, Michael Murphy, Chuck Sahn, Carl Hendricks, Claude Aboujaoude, Jason Gough, Josh Bynon and Chuck Boen – Caterpillar's MineStar development team
- Graeme Tuder - Micromine Founder and Managing Director.

COMMUNITION

- Elizabeth Lewis-Gray – Founder of CEEC International Ltd
- Samuel Calvin McLanahan – An inventive genius who changed the direction of his family's company from that of a foundry to a leading manufacturer of mineral processing equipment
- Joe Pease – Chief Operating Officer (COO), Xstrata Technology, IsaMill
- Prof. TC Rao - Developed models for designing hydrocyclones in closed circuit with ball mills
- John Russell – Founder of RME, mill relining systems
- John Starkey – Inventor of the SAGDesign test.

CONCENTRATION

- Sandy Gray - Technical Director at Gekko Systems, maximising the recovery of minerals by gravity
- Ernst Joachim Holtz – Co-founder of Multotec and has played a huge role in the growth of the company
- Byron Knelson – Extensive gravity processing solutions (the Knelson Concentrator)
- Robert (Bob) Moorhead – FL Smidth, inventive cyclone designs
- Philip Thompson - FLSmidth Dawson Metallurgical Labs, a leader and innovator in concentrator-related flotation.

We need nominations for ENVIRONMENTAL MANAGEMENT AND STEWARDSHIP. Get your nominations in soon. They will all be distributed to the judges in September for decisions by the end of October. And don't forget this year's additional category – METALLURGY. **IM**